

European Partnership under Horizon Europe

Connected, Cooperative and Automated Mobility (CCAM)

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1 General information

1.1 Draft title of the European Partnership

European Partnership on Connected, Cooperative and Automated Mobility (CCAM)

1.2 Lead entity (main contact)

ERTRAC

Email: info@ertrac.org

1.3 Commission services (main contact)

DG MOVE, DG RTD

Email: EU-CCAM-PARTNERSHIP@ec.europa.eu

1.4 Summary (max 500 characters)

The proposed Partnership aims to harmonise European R&I efforts to accelerate the implementation of innovative CCAM technologies and services. It aims to exploit the full systemic benefits of new mobility solutions enabled by CCAM: increased safety, reduced environmental impacts, and inclusiveness. By bringing together the actors of the complex cross-sectoral value chain, the Partnership will work on a shared, coherent and long-term R&I agenda. The Vision of the Partnership is: “European leadership in safe and sustainable road transport through automation”.

2 Context, objectives, expected impacts

2.1 Context and problem definition

Mobility is crossing a new – digital – frontier in terms of connectivity, allowing vehicles to “communicate” to each other, to the road infrastructure and to other road users. This will enable a coordination and cooperation, managing traffic and mobility at an entirely new level (e.g. warning messages not limited by line-of-sight or congestion management using real-time information). At the same time, automated vehicles have a 360° vision of the surrounding environment.

Current road vehicles already provide advanced assistance systems and intervene when a dangerous situation is detected. Future systems will have significant reduced reaction times and be able to control the vehicle for extended periods – and, at some point in the future, will no longer rely on human back-up.

*Combining **connectivity, cooperative systems and automation** will enable automated and fully orchestrated manoeuvres, bringing us closer to **Vision Zero**.*

Cooperative, Connected and Automated Mobility (CCAM) is expected to reshape the way we travel and move, not only in Europe, but around the world. With CCAM, the vehicles are well integrated into the mobility and transport system, its infrastructure, all operations and new services. In theory, fully automated driving could double existing average road infrastructure capacity¹ by smoothing traffic flow, while enabling off-peak usage of infrastructure for freight transportation (e.g. night-time deliveries). Smart traffic management will further increase efficiency and reduce congestion.

CCAM enabled shared mobility services will enable seamless integration with public transport and Mobility-as-a-Service (MaaS) platforms. It will provide accessible mobility to people who cannot drive (e.g. incapacitated or disabled people, and those without a driving license), or who no longer want to drive.

*The goal is to create more **user-centred, all-inclusive mobility**, while increasing **safety, reducing congestion** and contributing to **decarbonisation**.*

Automated public transport services will deliver profound changes, not only in how people travel, but also in the way of life. The usage of shared CCAM is expected to bring a tide of benefits, including: flexible, customizable, more widespread and accessible services, reduced noise and air pollution, and better use of urban space, while providing a safer, more comfortable and integrated travel experience.

As concerns freight and logistics, the shortage of truck drivers, in particular for the long haul, and the demand for better working conditions requires higher levels of automation that could support further transport productivity². According to the European Transport Workers Federation and the International Road Union, a driver shortage of 21% exists across the freight

¹ New Technology and Automation in Freight Transport and Handling Systems. Daniela Paddeu, Thomas Calvert, Ben Clark, Graham Parkhurst, University of the West of England, Bristol. UK Government Office for Science. February 2019

² Tavasszy, L.A. (2016). The value case for truck platooning, working paper, Delft University of Technology. Doi 10.13140/RG.2.2.13325.54247.

transport sector³. Moreover, CCAM coupled with innovative fleet management may enable larger quantities of freight to be transported compared with current operating practice, and guarantee the same transit time even at lower speeds (i.e. saving energy).⁴ Additionally, platooning and higher-levels of automation can increase the resilience of supply chains by enabling goods to move with less, or even without, human intervention, autonomously broadening access to citizens and destinations in critical areas or under exceptional circumstances such as pandemics⁵.

CCAM is expected to bring operational efficiency to logistics hubs, integrating road transport with other logistics operations; for example, if truck arrivals at a terminal are known beforehand, yard planning can be made more efficient by avoiding congestion in the hub area. Moreover, autonomous systems could facilitate last mile operations between logistics centres and port terminals⁶, hence reducing barriers for intermodal transport.

CCAM will also enable the provision of new mobility services for passengers and goods, fostering benefits for users and for the mobility system as a whole.

CCAM will have a remarkable economic impact. McKinsey found in their “RACE 2050”⁷ report, that the economic value contribution is one of the core requirements to create a profitable future mobility industry and maintain relevance as a global export industry. According to the McKinsey Auto 2030 model, European automotive revenues based on consumer spending will almost double from EUR 850 billion in 2016 to EUR 1,400 billion by 2030. By using its strengths in vehicle and system innovations to promote socio-economic benefits and sustainable development, **Europe has the unique opportunity to consolidate its leading role in cooperative, connected and automated mobility against rising competition in global value chains and markets.** The European Patent Office (EPO) stated in a recent report⁸ that the number of related European patent applications is growing 20 times faster (see Figure 1) than other technologies. In fact, a new EPO study shows that Europe accounted for 37.2% of all patent applications related to self-driving vehicle technologies at the EPO between 2011 and 2017 - ahead of China (3%), Japan (13%) and the United States (33.7%).

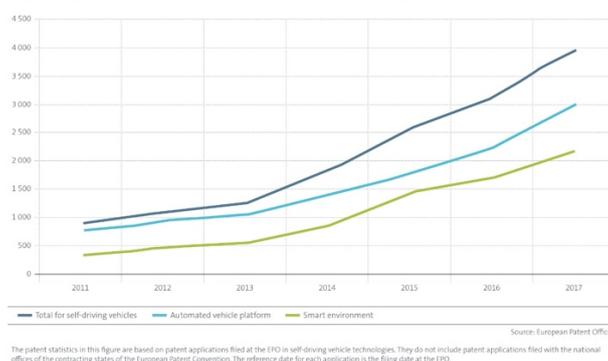


Figure 1: Patent applications at the EPO in self-driving vehicle technologies and their sectors 2011-2017

³ <https://www.iru.org/resources/newsroom/iru-and-ef-urge-eu-address-unprecedented-driver-shortage-road-transport-industry>

⁴ in line with the Physical Internet concept: Ballot, E. et al. (2014) *The Physical Internet: The Network of Logistics Networks*. Paris, France: La documentation Française.

⁵ <https://www.forbes.com/sites/bernardmarr/2020/03/18/how-robots-and-drones-are-helping-to-fight-coronavirus/>

⁶ <https://www.volvotrucks.com/en-en/news/volvo-trucks-magazine/2019/jun/Veras-First-Assignment.html>

⁷ McKinsey, RACE 2050: Accessed at: <https://www.mckinsey.com>

⁸ <https://www.epo.org/news-issues/news/2018/20181106.html>

The development of CCAM shall provide benefits to all citizens. With full integration of CCAM in the transport system, the principal **expected positive impacts** for society will be:

- **Safety**⁹: Reducing the number of road fatalities and accidents caused by human error;
- **Environment**¹⁰: Reducing transport emissions and congestion by optimising capacity, smoothening traffic flow and avoiding unnecessary trips;
- **Inclusiveness**: Ensuring inclusive mobility and goods access for all; and
- **Competitiveness**: Strengthen competitiveness of European industries by technological leadership, ensuring long-term growth and jobs¹¹.

Risks and problem drivers hindering innovation

Reaching the above-mentioned objectives, however, requires overcoming a multitude of challenges defined as problem drivers (PD) that need to be addressed and solved at several levels: societal, human, technical, regulatory, economic and operational.

Insufficient demand as Society is not yet prepared to accept the transition to CCAM enabled mobility. Potential implications and impacts of integration of CCAM solutions into the mobility system are not well understood. (PD1)

Society does not yet demand that a transition to CCAM enabled mobility be adopted since the potential implications and impacts (such as effects on safety or the environment) of the integration of CCAM solutions into the mobility system are not well understood.

There is a lack of awareness and acceptance by citizens and policy makers. To change public opinion, evidence of safe CCAM system functioning is required. The main challenge for future safety validation processes is that many different driving situations and scenarios must be tested and validated depending on the operational domain. Currently available procedures¹² do not provide an efficient and cost-effective solution. Expanding these domains with a high level of automation will drastically increase the need for testing and validation. Cost considerations and the time needed for testing are of great relevance, and the knowledge and data gathered from pilot tests across Europe can provide a significant contribution to the validation of safe CCAM functioning.

The existing infrastructure requires further investment to support future CCAM solutions. Services need to be well integrated with urban planning and urban economics, with appropriate governance models in order to ensure collaboration between stakeholders. Business models for automated and shared vehicles need to be researched, as well as interoperability and integration with public transport.

⁹ Vision Zero: by 2050, move close to zero fatalities and serious injuries in road transport. In line with this goal, the EU aims at halving road casualties by 2030. (see <https://ec.europa.eu/transport/sites/transport/files/3rd-mobility-pack/3rd-mobility-pack-factsheets-safety.pdf>).

¹⁰ 'Automated and connected multimodal mobility will play an increasing role, together with smart traffic management systems enabled by digitalisation. The EU transport system and infrastructure will be made fit to support new sustainable mobility services that can reduce congestion and pollution' European Green Deal, [COM\(2019\) 640 final](#)

¹¹ [GEAR 2030 final report](#)

¹² In the ISO-26262 standard for functional safety an Automotive Safety Integrity Level (ASIL) is defined. Currently, hazardous events are identified in the assessment and an ASIL is assigned under consideration and reactions of a (human) driver.

In less dense areas, the main challenge will be to provide shared, on-demand and personalised transportation available to all. Automated taxi/pods/shuttles/buses, and shared vehicles in general, will be new options made available to help fulfil this mission.

CCAM solutions are not yet sufficiently mature for market take-up, and current investment levels in CCAM R&I are inadequate to maintain and extend EU industrial leadership. (PD2)

The technological capabilities due to the increased complexity for advanced CCAM solutions are not yet sufficiently mature for market take-up. This depends on two major complexity drivers: traffic and vehicle speed. It is far easier to handle traffic situations without vulnerable road users and with vehicles driving in the same direction – hence initial applications limit the operational domain¹³ (e.g. on motorways with physical separation of oncoming traffic with limited access via merging in- and out-lanes and no low-speed vehicles, bicycles or pedestrians). The next step is to tackle complex traffic, but with very low speeds, in order to limit accident risks¹⁴. The limitation in use cases result in higher costs and limited benefit to society and lower private side investments.

Current R&I efforts are fragmented and lack a coherent, longer-term vision and strategy for targeting systemic solutions. (PD3)

Public R&I funding and private investments in CCAM technologies are fragmented and insufficient to maintain and extend EU industrial leadership. To overcome this, it is essential that Research and Innovation efforts are taken beyond the current state with its lack of cohesion. The R&I efforts must be aligned and jointly support the full value chain, while matching a longer term vision in which societal benefits of CCAM enabled mobility represent a core value. Only when this is achieved can R&I investments, as well as other investments in relation to the deployment of CCAM technologies, enable the European mobility and communications industries to maintain and extend their international leadership. Europe's knowledge base regarding these technologies, their validation, impact assessment and user validation can simultaneously promote international competitiveness.

Demonstration and scale-up is limited, since a well organised, extensive and complex cross-sectorial value chain is still required to build complete CCAM solutions. (PD4)

To build complete CCAM solutions, a well organised extensive cross-sectorial value chain is required, which today is only partially in place¹¹. Effective, profitable and transparent cooperation among local and regional authorities and the private sector is mandatory, to provide end-users with inclusive, equitable and accessible services for all, and to develop interoperable systems and operating conditions.

¹³ The Operational Design Domains (ODD), introduced by SAE, defines the boundaries of the system functionality at a certain level of automation, e.g. a particular road environment. Each driving mode, i.e. system feature or use case, of an automated driving system is reflecting a particular ODD. With the concept of automation levels and ODD, relevant cases can be distinguished as follows:

Level 3 automation means to take the driver out of the perception and response task while keeping him or her as a fallback solution for the dynamic driving task. Level 4 in contrast means there is no driver needed due to the system fallback, but the ODD is limited, while for level 5 the ODD would be unlimited. For all levels up to 4 the ODD is - by definition - limited.

¹⁴ The crash intensity/severity scales with the energy stored in the vehicle as a quadratic function of speed.

There are high costs, risks, barriers and long lead times before R&I investments in CCAM can lead to innovative new products and/or services being widely deployed. Automated mobility, particularly in road transport, is characterised by complex interactions within the overall mobility system. The interdependency of different parts of this system requires that a specific innovation (e.g. new vehicle automation or communication system) needs to be accompanied by timely innovation and roll-out in other segments, such as infrastructure, logistics or business models, for it to have a beneficial impact on the overall system. It also requires cross-sectors synergies with enablers (e.g. electronic components and systems, processing technologies, data driven engineering, Internet-of-Things, Artificial Intelligence) and innovative business models (e.g. 'mobility as a service', Logistics as a Service/Physical Internet, 5G services) to really pay off. Moreover, the advent of automated vehicles opens important new challenges in relation to security and privacy topics.

Building on achievements in Horizon 2020

Many Research and Innovation (R&I) actions and tests are already ongoing in Europe at the level of industry, local, national and the EU. Many of these are supported by the European Commission through research funding programmes or deployment projects including cross-border demonstration and testing¹⁵.

In total from 2014 to 2020, around EUR 350 million from the EU's framework programme for research and innovation Horizon 2020 was allocated to support R&I on automated road transport. The majority of these projects¹⁶ were funded under the H2020 Mobility for Growth and ICT calls, tackling different aspects of CCAM, advancing technologies and solutions towards market introduction and deployment in the following areas:

- **In-vehicle technologies:**
 - DENSE: Eliminating the inability of current systems to sense their surroundings under severe weather (snow, heavy rain or fog).
 - AUTODRIVE: Providing fail-aware, fail-safe, and fail-operational integrated electronic components, Electrical/Electronic (E/E) architectures as well as (deeply) embedded software systems for highly and fully automated driving.
 - PRYSTINE: Realizing fail-operational urban surround perception based on robust radar and LiDAR sensor fusion and control functions.
- **Integrating the vehicle in the transport system:**
 - INFRAMIX: Adapting the road infrastructure for future automated transport systems.
 - COEXIST: Integrating connected and automated vehicles on road networks.
 - ICT4CART: Designing, implementing and testing in real-life conditions an innovative ICT infrastructure that will support higher levels of automated driving.
 - TRANSAID: Allow a smooth integration of automated vehicles in traffic systems.
 - 5G-CARMEN: drive the research, implementation, and demonstration of refined 5G solutions for the Cooperative, Connected, and Automated Mobility.
 - 5GCroCo: demonstrate 5G technologies in cross-border corridors and aims at defining new business models.
 - 5GMobix: examines the implications of 5G and its role in the future of autonomous driving

¹⁵ EC JRC "Research and Innovation in connected and automated transport in Europe", December 2019: <https://trimis.ec.europa.eu/content/research-and-innovation-connected-and-automated-transport-europe>
¹⁶ <https://ec.europa.eu/inea/en/horizon-2020/h2020-transport/projects-by-field/480>

- **Human Factors:**
 - ADASANDME: Developing cooperative intelligent transport systems that compensate human errors, facilitate driving behaviour, avoid collisions and increase safety on road.
 - INTERACT: Improving the communication and cooperation strategy between automated vehicles and other traffic participants.
 - VI-DAS: Developing ADAS and navigation aids in societally acceptable and personalised manner, based on a reliable combination of the overall traffic scene understanding and essential consideration of the driver's physical, mental, demographic and behavioural state.
- **Demonstration activities towards larger scales:**
 - AVENUE: The project deploys, validates and integrates autonomous vehicles (mini-busses) in public transportation services.
 - SHOW: deploying new services and business models of shared cooperative connected Level 4 automated and electric vehicles integrated with public transport and accessible to all, in 20 European cities.
 - L3PILOT: Operating 100 vehicles with 1000 drivers in the public transport system in order to test automated drive systems in conformity with Level 3 and Level 4 under real conditions and in a wide range of applications.
 - ENSEMBLE: Implementing and demonstrating multi-brand truck platooning on European roads.
- **Validation of CCAM systems:**
 - 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.
- **Social aspects and user acceptance:**
 - BRAVE: Increasing society's confidence in automated vehicles.
 - 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.
- **Coordination activities:**
 - ARCADE¹⁷: Building consensus across stakeholders from all sectors for a sound and harmonized deployment of Connected, Cooperative and Automated Driving (CAD) in Europe and beyond.
 - COSMOS: Supporting the Lighthouse Mobility.E¹⁸ of the ECSEL Joint Undertaking in creating new links between innovations in electronic components and systems and the requirements of automotive applications, particularly for CCAM.

The three demonstration activities provide the state of the art in Horizon 2020 with some SAE **Level 3 technologies** being demonstrated and tested in **limited operational domains**. The results will be used for further advancement of connectivity and automation technologies for road transport and bringing solutions to the market.

- For passenger cars, the **L3PILOT** project tests the viability of automated driving as a safe and efficient means of transportation on public roads. It will focus on large-scale piloting of SAE Level 3 functions, with additional assessment of some Level 4

¹⁷ <https://knowledge-base.connectedautomateddriving.eu/thematic-areas/>

¹⁸ <https://www.mobilitye.eu/>

functions. The functionality of the systems will be exposed to variable conditions with 1,000 drivers and 100 cars across ten European countries, including cross-border routes. The technologies being tested cover a wide range of driving situations, including parking, overtaking on highways and driving through urban intersections.

- For shared mobility services the **AVENUE** project aims to validate the advantages that autonomous vehicles will offer to public transportation, linked with new innovative passenger service and guaranteeing road and passenger safety with demonstrators implemented for 4 years in Copenhagen, Geneva, Luxembourg and Lyon.
- For freight transport, the **ENSEMBLE** project will implement and demonstrate multi-brand truck platooning on European roads improving fuel economy, CO2 emissions, traffic safety and efficiency.

Not all the challenges and problem drivers for CCAM have been addressed in these Horizon 2020 projects. Further collaborative research is needed to enable CCAM.

As they are highly interdependent, many of the required steps for CCAM have to be planned consistently across private and public sectors, and in cooperation with the European Commission and the Member States.

If not planned comprehensively, and matched with the proper framework conditions, e.g. in the regulatory domain, the innovation process may slow down or may not trigger the expected benefits. Resources and investments could be wasted and Europe may miss the opportunity to benefit from CCAM for its society and economy.

2.2 Common vision, objectives and expected impacts

Vision

The vision for the next 10 years is to make Europe a world leader in the development and deployment of connected and automated mobility and logistics services and systems. A step-change in Europe's mobility system is required to reduce the number of road accidents significantly and bring down the number of road fatalities towards zero, increase traffic efficiency and enhance traffic planning, foster cooperation between different transport modes, reduce harmful emissions from transport and decrease travel time and congestion as well as increase accessibility for all also in lower population density areas.

Matching citizens demand and end-user expectations for mobility and transport while contributing to the Societal Development Goals¹⁹.

Within this period, CCAM shall foster and support new mobility concepts, shifting design and development from a driver-centred to mobility-user oriented approach, providing viable alternatives for private vehicle ownership while increasing inclusiveness of mobility. CCAM solutions will be integrated in the whole transport system, accompanied by the right support measures of the public sector (e.g. incentives, legal frameworks) to fully exploit the potential benefits of CCAM and minimise potential adverse effects, such as increasingly congested traffic or new risks in mixed traffic environments.

Automated vehicles will increasingly allow the transfer of the control tasks from the driver to the vehicle system, and the driver may finally be obsolete, even in particularly challenging and

¹⁹ <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

complex traffic environments. This implies a step change in the safety concept of road transport and poses big challenges in terms of robustness and reliability.

The vehicles and other road users, including vulnerable ones such as pedestrians and cyclists, will benefit from increased connectivity with vehicles and the infrastructure. This connectivity will allow them to better coordinate their manoeuvres, making use of active infrastructure support and enabling smart traffic and fleet management for improved throughput and increased safety. Shared, automated mobility and freight services will become widely available, providing seamless door-to-door mobility for people and goods including fully autonomous last mile deliveries²⁰, leading to healthier, safer, more accessible, greener, cost-effective, demand-responsive and more sustainable transport everywhere.

In short, the CCAM Partnership Vision is to ensure

European leadership in safe and sustainable road transport through automation

To move towards this vision, the operational domains and use cases of these vehicles need to be extended to the point where they become **economically viable** and **societal benefits** are realised. As the associated challenges in this expansion grow exponentially, an unlimited operational domain seems unrealistic with the 2020 state of the art technologies²¹. A long **transition phase** is expected, with **conventional** and **CCAM** vehicles with specific traffic management needs ensuring **good co-existence** and specifically protecting vulnerable road users.

This common vision is supported by very relevant **policy actions and communications**. In December 2019, the new European Commission announced a comprehensive and ambitious strategy package for Europe to become the world's first climate-neutral continent by 2050, the **European Green Deal**²². For the mobility sector, this includes leveraging the digitalisation of transport with smart and automated mobility systems.

In the Communication "On the road to automated mobility: An EU strategy for mobility of the future"²³ the European Commission lays down its vision, objectives and actions for an accelerated deployment of CCAM with the ambition of making Europe a world leader in this domain. The communication highlights use cases of CCAM that will be particularly relevant from the public policy perspective in the next decade. Intended actions in the areas of technology development, regulation, certification and impact assessment are outlined as well as the establishment of a partnership for CCAM as detailed in this proposal.

²⁰ <https://www.valeo.com/en/ces-2020-in-a-world-first-valeo-is-unveiling-its-autonomous-electric-delivery-droid-developed-in-partnership-with-meituan-dianping-chinas-leading-e-commerce-platform-for-services/>

²¹ As SAE Level 5 is a theoretical description of ultimate automation, it merely gives a direction and not a realistic outcome: The general goal of the CCAM Partnership is to enlarge the operational design domains (ODD) of automated driving systems, and thus related use cases, particularly of level 4 solutions to the point where they become economically viable and ready for (pre-) deployment. This should not be seen as a limitation for enabling CCAM services with real societal impact. On the contrary, the most efficient and cost-effective solutions are likely those that are optimised for a specific ODD, and provided this is sufficiently large, it can be integrated into the overall transport system to provide door-to-door solutions. A key challenge remains to ensure safety; to design and prove that a complex CCAM system of Level 3 or higher, without the human driver as major fallback role for the dynamic driving task, is functionally and operational safe. A larger ODD will have an exponential effect on dealing with this challenge.

²² [COM\(2019\) 640 final](#)

²³ [COM\(2018\)283](#)

The final report of the high-level group on the competitiveness and sustainable growth of the automotive industry in the European Union (GEAR 2030)²⁴ emphasise among others the medium and long-term recommendations for automated and connected vehicles.

The **Declaration of Amsterdam**²⁵ highlighted the willingness of EU Member States to cooperate and agree on joint goals and actions to facilitate the introduction of connected and automated driving on European roads. Its objective is to prevent that a patchwork of regulations arises within the EU, which would be an obstacle for both the industry and the road users. It means that EU Member States must work on compatibility e.g. of safety requirements, liability issues, communication systems and services, in order to facilitate future market deployment, and therefore promote European competitiveness in this field.

Objectives and expected impacts

Advancing CCAM solution and preparing them for deployment (Deployment Readiness) is understood as a key element to further address societal challenges for clean, safe, efficient and smart transport. The Deployment Readiness is combining the **validated safe system functioning**, a good **understanding of the expected impact** and potential **risks** and the readiness of users and **society accepting and adopting CCAM** solutions.

The CCAM partnership shall contribute to achieving the following positive impacts for society:

- **Safety**⁹: Reducing the number of road fatalities and accidents caused by human error;
- **Environment**¹⁰: Reducing transport emissions and congestion by optimising capacity, smoothening traffic flow and avoiding unnecessary trips;
- **Inclusiveness**: Ensuring inclusive mobility and goods access for all; and
- **Competitiveness**¹¹: Strengthen competitiveness of European industries by technological leadership, ensuring long-term growth and jobs

The deployment of CCAM solutions will lead to a paradigm shift, and consequently, if fully integrated and well managed, the expected impacts will be achieved.

This transition will have a huge impact on all road-, traffic- and driving- situations. In addition, progressing digitalization, extreme growth in (big) data availability and increasing connectivity for users are shaping **new business models** in transport, modifying the future mobility needs and perceptions in society.

The intervention logic for the Partnership foresees specific objectives (SO) and operational objectives (OO) to advance the Deployment Readiness for CCAM solutions, as shown in the table below. With **progressing deployment**, the specific objectives of the partnership will **trigger positive trends** and contribute to the general objectives (GO) that will yield the expected impacts.

Expected Impact	General objectives (GO)	Specific objectives (SO)- expected outcomes by 2030
Improving safety and security of the transport system drastically	<ul style="list-style-type: none"> • (GO1) Reduced number of fatalities and injuries in road transport 	<ul style="list-style-type: none"> • (SO1) Secure and trustworthy interaction between road users, vehicles, infrastructure and services (link to PD4)

²⁴ https://ec.europa.eu/growth/content/high-level-group-gear-2030-report-on-automotive-competitiveness-and-sustainability_en

²⁵ [Declaration of Amsterdam, “Cooperation in the field of connected and automated driving”, 14-15 April 2016](#)

	<ul style="list-style-type: none"> • (GO2) Safe and efficient co-existence between automated and non-automated “conventional” traffic for a long transition period of mixed traffic 	<ul style="list-style-type: none"> • (SO2) Agreed safety standards for highly automated driving systems to operate and function on public roads²⁶ (link to PD4) • (SO3) Validated functional safety for CCAM use cases (link to PD1)
Meeting societal needs for mobility while reducing environmental impacts and strengthening our economy	<ul style="list-style-type: none"> • (GO3) High public acceptance and adoption of CCAM with clear understanding of its benefits and limits • (GO4) Increased efficiency of transport flows (people and goods) leading to better use of infrastructure capacity and preservation of public space • (GO5) Reduced transport emissions and congestion 	<ul style="list-style-type: none"> • (SO4) Demonstrate inclusive, user-oriented and well-integrated mobility concepts enabled by CCAM with a reduced carbon footprint and reliable predicted travel times (link to PD1 and PD4) • (SO5) Demonstrate new freight and logistics concepts and services enabled by CCAM with a reduced CO2 emission per tonne-km, further reducing congestions (link to PD3) • (SO6) Societal impacts (e.g. safety, efficiency, environment) and wider economic impacts are sufficiently assessed and accepted (link to PD4)
Maintain and extend industrial leadership for new jobs and economic growth all over Europe	<ul style="list-style-type: none"> • (GO6) Making Europe a world leader in the deployment of connected and automated mobility for people and goods • (GO7) More focused and long-term investments in R&I, development and pre-deployment of CCAM. 	<ul style="list-style-type: none"> • (SO7) Long-term coordination framework for R&I and large-scale testing activities, involving all relevant public and private stakeholders from European, national and regional levels (link to PD1 and PD2) • (SO8) Improved synergies between public and private investment plans to advance vehicle and infrastructure technologies (link to PD2) • (SO9) Common evaluation framework for R&I results to foster exchange and reuse of results from CCAM projects in Europe (link to PD2 and PD3)
Strengthen leadership in all technological and societal aspects of CCAM through targeted knowledge and capacity building	<ul style="list-style-type: none"> • (GO8) Support the creation, dissemination and capitalisation of knowledge to accelerate the development and improvement of CCAM enabled solutions 	<ul style="list-style-type: none"> • (SO10) Inclusion of new and emerging knowledge fields addressing user needs and wide industrial application CCAM solutions (link to PD1, PD3 and PD4) • (SO11) Expand and disseminate the knowledge base on CCAM solutions, stakeholders, R&I programmes and projects, and testing activities.

Yet, this transformation is not happening, due to the hinderance by the identified Problem Drivers:

- (PD1) **Insufficient demand** as Society is not yet prepared to accept the transition to CCAM enabled mobility. Potential implications and impacts of integration of CCAM solutions into the mobility system are not well understood.
- (PD1) CCAM solutions are **not yet sufficiently mature for market take-up**, and current investment levels in CCAM R&I are inadequate to maintain and extend EU industrial leadership.

²⁶ Under all environmental and road conditions.

- (PD3) Current **R&I efforts are fragmented** and lack a coherent, longer-term vision and strategy.
- (PD4) **Demonstration and scale-up is limited**, since as a well organised, large and complex, cross-sectorial value chain is still required to build complete CCAM solutions.

A set of operational objectives (and the related performance indicators) shall ensure the progress towards Deployment Readiness by achieving the specific objectives (SO) and addressing the PDs. This triggers a transformational process enabling the Partnership members representing the value chain in CCAM and the wider stakeholder community to benefit from this process by fostering knowledge and capacity building all over Europe.

Operational objectives	Performance indicators
Establish a detailed Strategic Research and Innovation Agenda (SRIA) for CCAM with clear milestones for Specific Objectives.	<ul style="list-style-type: none"> • Delivery of SRIA document addressing the specific objectives of the partnership; • Level of milestone achievement from SRIA during programme • Annual review of the R&I priorities and updating SRIA following latest developments and project results • Industrial and public/MS commitment/involvement to the SRIA development/updating processes
Implement the R&I actions identified in the SRIA and undertake actions ensuring uptake and impact of the project results (e.g. dissemination, exploitation and facilitation actions, subsequent investments)	<ul style="list-style-type: none"> • Number and ambition of demonstrators, including large scale, with diverse use cases • Number and quality of patents & peer-reviewed publications. • Number of dissemination events and facilitation actions.
Create and continuously strengthen the synergies along the value chain, enabling and supporting the knowledge exchange and dialogue on results, needs and implementation potential	<ul style="list-style-type: none"> • Projects with cross-industry, cross-value chain involvement • Inclusion of new partners to the Partnership and projects with SMEs and start-ups
Demonstrate benefits of CCAM solutions for road safety, efficiency, environment and wider societal needs.	<ul style="list-style-type: none"> • Maintain and expand common integrated and central evidence base of CCAM R&I including results from demonstration activities and wider initiatives. • Number of R&I projects assessing the potential socio-economic impacts of CCAM.
Ensure open and transparent processes for consulting all constituent entities and relevant stakeholders on the identification of Partnership's priorities and the design of its activities. This includes appropriate governance structures, open membership policies and assistance to members.	<ul style="list-style-type: none"> • Number and diversity of actors engaged in the partnership and in the projects, including number of SMEs as well as attendance in dissemination and awareness raising activities.

Operational objectives	Performance indicators
Ensure coordination and synergy with the other relevant European Partnerships and the relevant parts of Horizon Europe (including missions), as well as, where relevant, other Union programmes, Union bodies and national, international, and intergovernmental activities.	<ul style="list-style-type: none"> • Common calls, topics or demonstration projects with other relevant European Partnerships and the relevant parts of Horizon Europe. • Identification and consideration of relevant standardisation actions. • Feeding input/ triggering regulatory discussions at national and international level.

Measures to end the partnership (exit strategy)

The partnership serves as a ‘mean to an end’ to achieve its objectives. The SRIA for CCAM will describe a clear and comprehensive roadmap to deliver in the expected time frame. With reaching its objectives and Deployment Readiness at the end or earlier will allow the CCAM stakeholders to move to the next investment phase (industrialization, competitive development and infrastructure deployment). Other exit strategies are foreseen:

- In cases of very slow progress towards set objectives (specific and operational objectives) which would make a successful programme delivery very unlikely.
- Radical technological progress in an area relevant for the CCAM partnership that would make further moving forward to achieving its targets obsolete.

In these cases, the constituent stakeholders can propose through the governing board the premature ending of the partnership.

Process to set up a Strategic Research and Innovation Agenda (SRIA)

The SRIA of the CCAM Partnership will indicate what in terms of research and innovation needs to be done in order to achieve the objectives outlined in this proposal. It will detail further the content, set priorities and provide a timeframe for the R&I activities. This process will be open and transparent, involving public and private stakeholders from the entire value chain of CCAM. It builds on previous strategic R&I recommendations setting, in particular the work done by the Working Group 1 of the CCAM Platform. Further multi-stakeholder R&I roadmaps, such as

- the Strategic Transport Research and Innovation Agenda (STRIA) Roadmap on Connected and Automated Transport,
- the ERTRAC CAD roadmap of the Working Group Connectivity and Automated Driving, the Transportation Working Group of EPoSS, and
- the results of the EU-funded Coordination and Support Actions CARTRE, ARCADE and SCOUT

will be used as CCAM SRIA input. The SRIA of the CCAM Partnership will therefore build on many years of stakeholder consultation and cooperation.

The Working Group 1 of the CCAM Platform is instrumental in the initial SRIA drafting.

A first open stakeholders workshop was organised mid-February to inform stakeholders about the Partnership preparation process: about 140 people participated. Interests of participants to contribute to the Partnership were collected. In mid-March, a public draft of the CCAM Partnership Proposal was provided for open consultation. The received feedback and confirmed

interest from more than 80 contributors is ample evidence of the co-creation process that will be continued during the coming months drafting the SRIA until June 2020. The content development of the SRIA will be done jointly with the stakeholder community.

The SRIA will describe R&I actions as well as complementing action for each of the 7 CCAM clusters (as described in chapter 3.1) and present these in a timeline of the Partnership. There is a clear logical sequence of actions due to maturity of technologies (TRL) and successful delivery of preceding enabling actions. This allows for a stepwise approach towards Deployment Readiness.

The structure for the SRIA document will include the following chapters:

- Developing the SRIA: a consultative approach
- Policy & scientific context
- Challenges on the way to deploy CCAM systems and services
- Vision/objectives/scope of the European partnership
- 7 clusters of R&I areas
 - Scope and objective of the R&I area
 - Challenges & expected outcomes by 2030
 - Overview of planned R&I actions
- SRIA Implementation – principles
 - Joint investments, cooperation between stakeholders, living labs, coordination of tests
 - Cooperation with other European partnerships & other instruments
- Multi-annual agenda & planning process

Ensuring consistency and coherence of the SRIA requires the input from a broad range of stakeholders, both private and public actors, forming the CCAM value chain. The successful stakeholder interaction (i.e. WG1 workshop and the public consultation) result in a broad range of contributors to the Partnership development with about 130 companies, actors and associations by the end of March (as described in chapter 2.4). The broad stakeholder involvement, with a large variety of public and private actors is ensured through direct involvement and supported by European associations, serving as multiplier for the community. For the public sector, the different levels will be represented, including national authorities as well as representatives of cities and regions.

Following the success of the first stakeholder consultation, another web-based stakeholder consultation is foreseen at end May/beginning June. A public draft of the CCAM SRIA document will be published and feedback gathered. In addition, interested stakeholders are invited to join the development process and even increase the stakeholder community.

The SRIA will be finalised by the end of June, to be submitted to the European Commission services as input for Horizon Europe strategic planning. It will be the basis for discussing and defining the annual research priorities of the CCAM Partnership.

2.3 Necessity for a European Partnership

Despite the aforementioned expected impacts and benefits of CCAM, there is yet a fairly limited demand in society to implement these solutions. The order of magnitude of the benefits, but also further risks and implications are not known or well understood. A Partnership is needed to strengthen awareness, assess impacts and understand user and societal effects across many different Member States.

Europe needs more large-scale testing, demonstrations and pilot projects involving all relevant stakeholders to accelerate implementation and remove barriers²⁷.

These activities, due to the technical maturity and multi stakeholder involvement are highly cost intensive and require sufficient resources. The large cross-sectoral value chain and interaction between public and private stakeholders is another barrier for deployment of CCAM solutions. Commitment towards coordinated European actions are needed to develop this ecosystem with vehicle manufacturers, local and regional authorities, road operators, service providers, telecom industry etc. Coordination at EU level is needed in order to develop harmonised and interoperable solutions.

In the past, the big innovations in vehicle technology like seat belts or airbags were introduced by industry as another component to the existing vehicle. After five to ten years of experience with the new technologies, technical standardisation (e.g. ISO standards) gave a thorough basis for developing regulations. Making CCAM solutions ready for deployment requires all three processes advancing at the same time. Today, vehicle technology is starting to lead to standards, but regulation needs to be in place at the same time, with all the uncertainties and permanent adaptations necessary to keep up speed. To solve this situation, the most flexible and closest possible cooperation between actors involved in research, standardisation and regulation (national and international) is key.

It is evident that digitalisation and particularly technologies such as 5G networks, AI, IoT and electronic components and systems will form the most significant key enablers in CCAM. The observed *extreme returns to scale* in digital markets make CCAM a highly competitive topic. Keeping a leading edge in innovation is mandatory to sustain a long-term economic benefit in this domain. This will be essential for staying ahead of e.g. the USA and China as Europe's main competitors and likewise most important external markets for CCAM.

For these reasons, Europe needs a CCAM Partnership with clear objectives and effective coordination across research areas.

The development of a long-term strategy, in close cooperation with all actors. The European dimension enhances interoperability and ensures a critical mass of demand to allow industrialisation of innovation as well as bringing benefits to society.

This ambition is underlined by several relevant political communications at a Member State and European level (see chapter 2.2). In the Communication “*On the road to automated mobility: An EU strategy for mobility of the future*” the European Commission has laid down its vision for Connected, Cooperative and Automated Mobility (CCAM). In the *European Green Deal*, the Commission aspires to catalyse the shift to ‘sustainable and smart mobility,’ with a particular focus on transport and mobility. The *Climate Pact*, described as “bringing together regions, local communities, civil society, industry and schools” seems close to the ecosystem thinking that CCAM strongly advocates: a multi-actor collaboration that would lead

²⁷ https://ec.europa.eu/growth/sectors/automotive/policy-strategy_en

to a joint commitment towards decarbonisation. This is also highlighted in the *Green Deal*. In addition to involving citizen initiatives and community-driven innovation, a stronger relation should be created with cities and regions with their role, and responsibility, to engage with their community and move towards a new more collaborative research and innovation practice.

Member States, local and regional authorities have a key role in the Partnership beyond the question of adapting road infrastructure. They ensure the alignment with transport policies and regulatory actions. Due to increased demands on the industry's constantly evolving business environment, it is crucial to improve the agility and flexibility of actions while allowing for more longer-term strategic planning.

To make efficient use of resources, there is a need to align public and private R&I investments engaging all relevant stakeholders to ensure capacity is built consistently in Europe. Consensus building and sharing is needed across stakeholders' groups to leverage the full potential of CCAM. Different perspectives beyond technology development need to be addressed to match use cases developed by industries with the needs of public authorities (including local and regional ones) delivering value to the user of the mobility and logistics system.

Involvement of Member States

The involvement of Member States is highly relevant to the success of the co-programmed CCAM Partnership:

- They provide the policy framework for CCAM on national level and in coherence with the European Commission aiming at harmonization.
- In line with national automation and connectivity strategies they own, fund and manage research programmes at Member State level, to some extent also transnational pooled funding (regional and/or sectoral cooperation). The programme goals point well beyond the CCAM scope and include also e.g. the competitiveness of the domestic industry, supporting SMEs. While the European Commission is regularly informing the Member States on the drafting process of the regular and Partnership work programmes and collecting their inputs at the meeting of the Programme Committee for Transport, the CCAM Partnership aims to complement this by an additional advisory body bringing together Member State representatives and CCAM stakeholders for a direct exchange of ideas and assessments.
- They are responsible for managing and operating the mobility infrastructure whereby different settings are used (e.g. private concessionaires in parts of the road network, varying degrees of integration between high level and lower levels of the road network, split or integrated responsibility at the urban-interurban interface). The bundle of roles is typically allocated to National Road Authorities (NRAs) whereby operating the roads is an integrated or adjacent part of the overall tasks. The context of the CCAM Partnership spans across all of NRAs' core business processes such as:
 - Operations and Services (operational infrastructure – traffic management incl. incidents and events, road maintenance incl. winter, crisis management, traffic information);
 - Planning and Building (new roads, road works planning, physical infrastructure);
 - ICT (ITS systems, digital infrastructure, enforcement, tolling).
- They give guidance on societal needs and expectations and support the definition, set-up and implementation of large scale demonstration projects.

2.4 Partner composition and target group

The Partnership needs stakeholder engagement from across the entire value chain of CCAM. To meet the overall objectives of the Partnership, active involvement is needed from different sectors, backgrounds and fields of expertise. This means that the European Partnership is open to all those stakeholders representing industry, public authorities, research and users that are needed to address the Problem Drivers and advance all elements of CCAM (user, vehicle, its interaction with the surrounding environment, physical, digital and the bridge between the two, which is the operational infrastructure²⁸, interfaces between the individual transport modes) and all technical and non-technical enablers (see chapter 3.1). The types of actors to be included as members of the Partnership are shown in Figure 2 and comprise single private companies and public organisations, complemented by European stakeholder associations representing overarching goals and expertise.

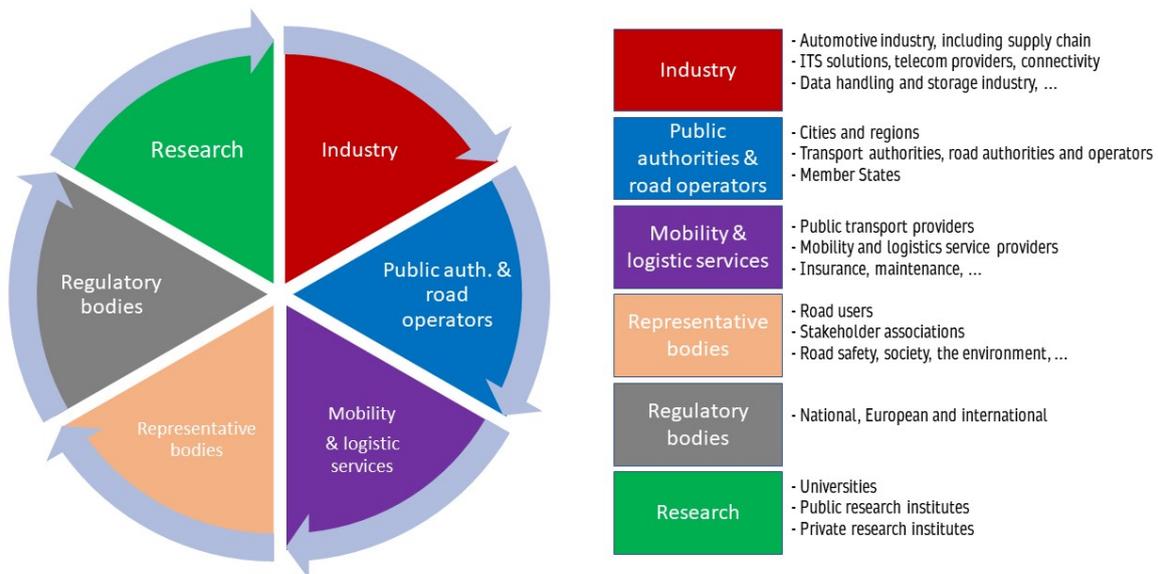


Figure 2: Sectors and types of stakeholders contributing to the Partnership

All stakeholder categories have a significant part to play in achieving the objectives of the Partnership and implementing the planned R&I actions.

Private industry and research bodies will play a key role in the advancement of the technology, and together with authorities will facilitate demonstration activities in cities and regions, drive consistency and interoperability of common solutions whilst ensuring societal needs are met and suitable regulations are established. Mobility and logistics service providers will need to play a cross cutting role, with activities ranging from challenge definition based on their activity chain needs, via use case development to piloting. Research bodies will strengthen the evidence base for CCAM. Stakeholder associations, together with representative bodies, will ensure that key requirements and focus areas are addressed. Regional clusters are useful in order to reach smaller companies and SMEs, that do not have the capacity to represent themselves in European institutions, but can receive information and support to join R&I activities at the European level through clusters. Representative bodies can furthermore play a critical role in bringing in the users' perspective and in creating user awareness and user acceptance, which will be critical for the overall deployment of CCAM solutions. In due time, during the evolution of the Partnership and of the technology field, new types of actors may

²⁸ Physical road infrastructure means the road, road signs, road markings, communication infrastructure and so on that form part of the physical world where vehicles operate. Digital road infrastructure includes static and dynamic digital representations of the physical world with which CCAM vehicles interact. Operational road infrastructure means traffic-management functions which facilitate the traffic flow by providing information or guidance. For example: speed sign (physical), speed – digital message via I2V (digital), speed limit (operational).

arise as being relevant to the Partnership, which will remain open to new CCAM value chain partners to join.

Together, these partners bring value to the end user, whether this is the individual citizen using the mobility system, companies providing mobility services or parties in the logistics chain. Due to the wide variety of use cases and potential applications, there is no single value chain for the full sector. Figure 3 gives a major value chain as example. For the actors adding value in the CCAM R&I value chain, their main type of activity within the framework of the Partnership is indicated.

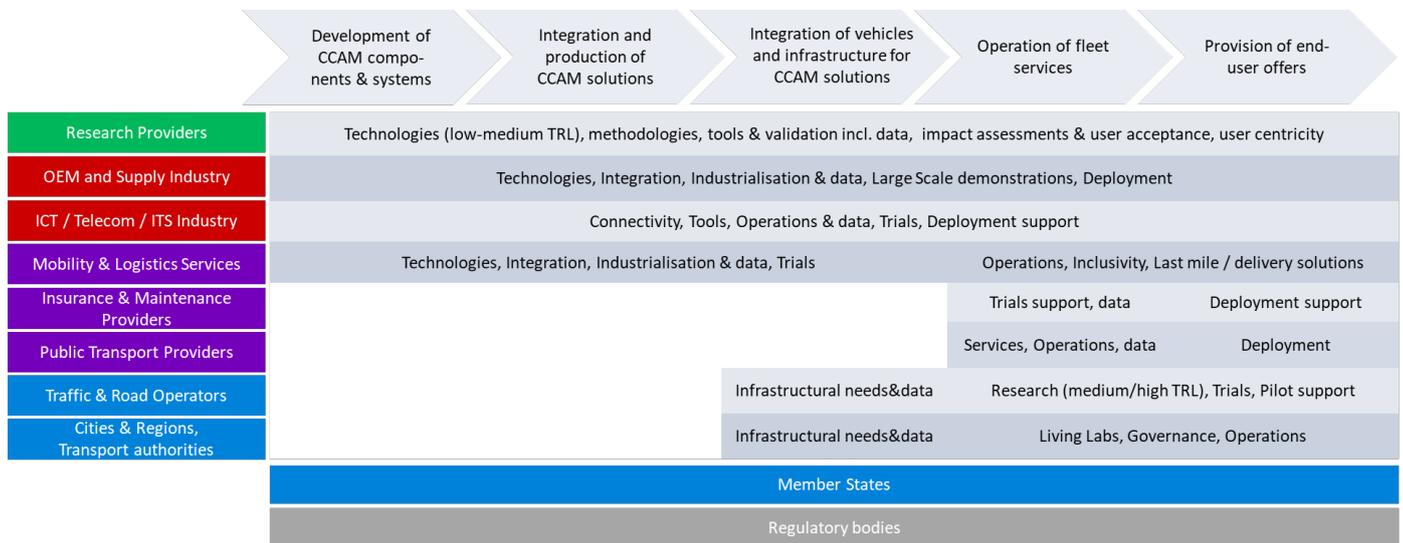


Figure 3: Schematic simplification of the CCAM value chain

Although the added value in the chain is depicted from top to bottom, the interactions between stakeholders are bidirectional. The CCAM value chain above is a schematic representation of a very complex and diverse ecosystem.

At a European level, the previously described stakeholders are supported by their respective European association, gathering them into representation bodies. These associations organise an important bi-directional flow of information between single entities and the EU level. As such, they are crucial in the information exchange, ensuring effective and sector-wide communication on the Partnership activities. Moreover, associations work to reach the different regions of Europe, including EU-13 countries. Efforts to ensure this wide geographical coverage will be described in chapter 3.3 and 3.4 about the governance and the openness of the Partnership.

The following European sector associations are supporting the development of the CCAM Partnership by contributing to the drafting of this Proposal: EUCAR (automotive OEMs), CLEPA (automotive supply industry), CEDR (national road authorities), ERTICO (ITS Europe), POLIS (cities and regions), EARPA (road mobility research providers), ECTRI (transport research institutes), UITP (public transport stakeholders), FIA (mobility users), IRU (commercial road freight and passenger transport operators), ALICE (logistics), EPoSS (smart systems), GSMA (mobile network operators), 5GAA (5G automotive alliance), ETNO (Telecommunications Network Operators). The intention is to involve more organisations in the course of the proposal drafting, so this list must be understood as not exhaustive.

Moreover, these associations have involved several of their members in the preparation process: hence, even though the European associations play a very important role in coordinating and building an aggregated input from stakeholders, this Partnership Proposal is anchored in individual companies and organisations. As such, this proposal has already received the direct input from research organisations, industrial players, city representatives and national bodies representing EU Member States. Moreover, the public consultation

undertaken during the drafting of this Proposal has allowed to build a substantial list of stakeholders expressing willingness to contribute to the Partnership.

An initial set of over 130 actors have expressed interest and support, and have indicated in which R&I areas they offer expertise and want to contribute to. The list below provides a short overview of these stakeholders: this list must be understood as illustrative and non-exhaustive, and fully open to be extended to any actor expressing commitment to participate. Since more than hundred stakeholders have been gathered in a short timeframe of a few weeks, in February/March 2020, it is expected that several hundreds more stakeholders will express interest in the next months during the next preparation steps of the Partnership, especially when drafting the SRIA. The current list clearly demonstrates the wide CCAM community support for the Partnership, with broad variety of private and public actors supporting the initiative and ready to contribute to it.

CCAM stakeholders supporting the Partnership	
Research providers	AVL, AIT, CEA, Cerema, DLR, Eurecat, Everis, FEV, fka, Fraunhofer, ICCS, ICOOR, IDIADA, IFPEN, Lero, Ricardo, RISE, SAFER, SINTEF, TNO, VTI, VTT
Universities	Aachen, Budapest, Chalmers, DTU, Eindhoven, Florence, Galway, Istanbul, Leeds, Leuven, Milano, Modena, Mondragon, Paris, Warsaw, Zilina
Automotive	Akka, BMW Group, Bosch, Continental, DAF Trucks, Faurecia, FCA, Irizar, JLR, Renault, Valeo, Volkswagen, Volvo Group
ITS	Bestmile, Dinniq, HERE, TomTom, PTV, Swarco, Ubiwhere, TTS Italia
Telecom/IT	ELMOS, Ericsson, EVERIS, Huawei, NXP, Vicomtech
Infrastructure	Asfinag, Sanef, Vinci
Freight & Logistics Services and Users	ALICE, Colruyt Group, Gebruder Weiss, IDIT, Procter & Gamble
Member States	Austria, Belgium, Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden, UK
Regions, cities and public transport operators	Flanders, Gothenburg, Helmond, Paris/Ile-de-France, Madrid, Stuttgart, Vienna
Representative bodies:	ALICE, AMICE, ANEC, CEDR, CLEPA, CONEBI, EARPA, ECTRI, EPoSS, ERF, ERTICO, ETNO, ETRMA, EUCAR, Eurocities, EuroRap, FEMA, FIA, GSMA, IRU, POLIS, UITP, 5GAA
Cluster and test centres	AIPSS, Aurora Snowbox, Austriatech, CARA, Catapult, Drive Sweden, Moveo, PTCarrereta, Tempere, Vedecom, Zalazone

The Partnership proposal is built on already existing collaboration networks using a multi-stakeholders approach:

- The CCAM Single Platform, as already mentioned, is a key initial source of content for this Proposal, especially WG 1. The Platform gathers private and public actors involved in CCAM in order to provide advice to the European institutions on research and development, innovation, pre-deployment and regulatory issues.
- The stakeholders network currently managed by the European support action ARCADE provides a large basis of experts from companies, research institutes and public authorities, working on research challenges and developing in detail R&I topic descriptions. The network

has contributed to the Strategic Transport Research and Innovation Agenda (STRIA) on Connected and Automated Road Transport from the European Commission, as well as to the ERTRAC roadmap on Connected Automated Driving. The project manages the knowledge base on <https://knowledge-base.connectedautomateddriving.eu/>, gathering up-to-date information on CCAM-related R&I projects and pilot activities in Europe and beyond, regulations and policies, standards, and evaluation and data sharing methodologies. The project gathers knowledge structured in thematic areas corresponding to key challenges areas for the development and deployment of Connected Automated Driving. The knowledge base gathers online resources such as trainings and webinars, as well as outcomes from related meetings and conferences. ARCADE is also working on a strategy safeguarding a long-term sustainable development of the knowledge base beyond the lifetime of the project. ARCADE is supporting the European Commission in organising the European contribution to the Trilateral EU-US-Japan Working Group on Automation in Road Transport and for the organisation of the EU CAD Conference and EU CAD Symposium, taking place once per two years.

- The European Technology Platform for road transport ERTRAC, and in particular its Working Group on “Connectivity and Automated Driving” is also gathering experts from the industry, research community and public authorities, and has issued a Roadmap on “Connected Automated Driving” providing a view on how automation of road vehicles can be progressively developed, and which are the research and development challenges that need to be addressed. This Roadmap is updated every two years in order to provide an updated view of the sector on current challenges and the development paths expected for CAD systems. Other Working Groups of ERTRAC have also provided research recommendations linked to connectivity and automation, since they hold a key potential to bring substantial benefits within their fields: Road Safety, Urban Mobility, and Long Distance Freight Transport.

- The European Technology Platform for logistics ALICE is also working with the topics of connectivity and automation, as they are enablers for a more efficient freight transport system and towards the vision of a Physical Internet. CCAM is an enabler for increased multi-modality and towards the creation of a truly integrated transport system for sustainable and efficient logistics²⁹. Different application and use cases are proposed to be explored and socio-economic impact and benefits are well assessed: autonomous end to end (intermodal) transport chains, last mile rail to warehouse autonomous transport, port and terminal autonomous transport operations, infrastructure usage off-peak and or at night, reduced transport speed, urban freight transport automation and last mile autonomous delivery.

- The European Technology Platform EPoSS defines R&D and innovation needs as well as policy requirements related to Smart Systems Integration and integrated Micro- and Nanosystems. The role of these technologies for enabling CCAM has been described in much detail in the EPoSS roadmap “Smart Systems for Automated Driving”. Being a founding member of the Joint Undertaking “Electronic Components and Systems for European Leadership” (ECSEL) and its successor in Horizon Europe, EPoSS can help to identify opportunities for alignment of the partnerships along the value chain.

The collaboration networks mentioned above address different stakeholder groups from various sectors often resulting in fragmented approaches in identifying needs and requirements for CCAM. While bilateral exchanges or common initiatives between the networks often take place, the CCAM Platform has brought all these organisations and initiatives together. One example is the EU-wide *Knowledge base on CCAM*, developed and maintained by the ARCADE project. The CCAM Platform extended the network of stakeholders contributing to the gathered knowledge and lessons learned significantly.

²⁹ *A truly Integrated Transport System for Sustainable and Efficient Logistics*. ACARE, ALICE, ERTRAC, ERRAC and WATERBORNE. (2017) <http://www.etp-logistics.eu/?p=1298>

The European CCAM Partnership will further leverage these existing collaboration networks and stakeholder organisations by combining and coordinating efforts, involving Member States and the entire value chain of CCAM, complemented by user groups, research and academia. Consistency and coherence will be guaranteed through the joint definition of the SRIA.

International dimension

The CCAM partnership shall explore opportunities for complementing its activities in collaboration with partners and stakeholders at international level.

International cooperation and dissemination is essential to ensure that Europe effectively contributes to worldwide harmonisation efforts and to raise awareness about European technologies as well as current development, testing and deployment activities in the region. Essential ongoing initiatives for international collaboration and exchanges on CCAM activities are the Trilateral EU-US-Japan Working Group on Automation in Road Transport and the regular concertation sessions and workshops organised in the frame of international conferences taking place annually in the three region and supported from the European side by the ARCADE project (EUCAD conferences, Automated Vehicle Symposium and SIP-adus conferences and workshops). The partnership will further support the development and maintenance of strategic partnerships and close cooperation with other regions of the world to exchange knowledge, expertise, lessons learned and best practice, as well as to work towards a global framework and international standards for connectivity and automation technologies.

The exchange of information with the U.S. and Japan shall be continued in the context of the Trilateral Working Group on Automated Road Transport where the activities of the Partnership and the SRIA will be regularly presented and twining and collaboration opportunities identified. New relations, networks and collaborations shall be established with other relevant regions on the world as well, e.g. the Republic of Korea and Australia which have joined the Trilateral Working Group as observers recently, and China and Singapore: Korea is a major auto making country, thus establishing collaborations on CCAM may provide insight into technical requirements for the automotive supply industry in Europe. Australia, despite not being a vehicle manufacturing country, has become an important living lab for CCAM in recent years where experiences with the adoption of regulation can be gathered. Singapore is very innovative in introducing CCAM in the city state's transport system and may provide best practice examples for urban transport planning in Europe in this regard, while the Chinese government has established ambitious goals for the network and AI-support of CCAM that deserve close monitoring, as these may not match prospects from a European perspective, thus Chinese attempts for worldwide standards in this domain needed to be anticipated and responded to.

The European sector associations of the partnership are connected to the international CCAM stakeholder community as their activities extend beyond Europe. Most have members in the main or emerging international markets for CCAM under the form of local organisations, supplier, driver or users associations, ITS industry, service providers or city authorities. Through these local representations and members, the partnership will have the means to monitor developments and identify main local stakeholders and cooperation areas. The collaboration will be enabled by the identification of twining opportunities and recommendations for cooperation with specific institution and topics of common interest in the SRIA and the resulting projects proposal calls. It will be in the continuity of activities with the Trilateral ART Working Group and on the extension of international cooperation currently being carried out by ERTICO and CLEPA in the ARCADE project. A close exchange will also be required between the partnership and the CSAs working on the Strategic European agenda for R&I and large-scale testing and on the EU-wide Knowledge base.

3 Planned Implementation

3.1 Activities

R&I actions needed in the Partnership

The success of the CCAM Partnership will be measured with the proven Deployment Readiness for CCAM solutions and achieving the specific objectives (see chapter 2.2). For this a broad range of cross-border activities from research and innovation actions (RIA and IA) to large-scale demonstrations, coordination and support actions (CSA) and living labs will be necessary to advance technologies, coordinate and involve end-users and citizens. RIAs shall advance technologies from lower Technology Readiness Levels (TRLs) to be demonstrated in operational environments. The SRIA will focus on enabling the large-scale demonstrations to assess the performance and demonstrate the safe system functioning. They provide evidence for the **Deployment Readiness**. The demonstrations include CCAM solutions for passenger and freight, in all environments, including mixed traffic with unprotected road users. The interaction with the transport system, the associated services and innovative business cases are examples of aspects in high-TRL actions, still precompetitive, within the partnership.

*The necessity for the **cross-border** elements is the strong need for harmonisation and interoperability of technologies and methodologies.*

The development of assessment and validation methods shall provide tools to share knowledge and compare results across Member States. Actions will develop technical specifications for interoperability, making sure that investments at local, regional, national and EU level, both of public and private nature, are complementing each other towards a fully integrated European mobility system.

Complementing actions supporting the Deployment Readiness

These bundle activities within the Partnership is strongly linked to **transnational alignment** actions and **knowledge sharing**. The involvement of member states representatives in the advisory board will provide a good impetus for this purpose. The R&I development process in CCAM is complemented by a set of necessary actions towards standardisation and regulatory measures. This close link between research and demonstration, providing evidence towards regulatory bodies, as well as preparing needed standards will play a key role in the CCAM Partnership implementation. The SRIA will also include a number of actions to support the strategic planning, coordination and cooperation between EU and national R&I projects and programmes (following-up the ongoing work of ARCADE and the CCAM Platform, e.g. well maintained and searchable knowledge base, data sharing framework, common scenario databases)

*For most types of R&I actions addressed, **cross-sector collaboration** is very important from early stages of research on CCAM elements (**infrastructure, services and vehicles**) onwards to enable seamless deployment.*

Prospective deployment partners, such as vehicle manufacturers, national or regional road authorities, road operators and mobility service providers, are key actors already in the early research phases, together with cross-sector research and innovation partners, such as research and technology organisations (RTOs) and universities, in order to develop CCAM and achieve Deployment Readiness.

The **industrial and private** actors are **committed** to further advance technologies and solutions within the **competitive development phase** from own investments. At this stage, i.e. market development, infrastructure actors prepare coherent and harmonised deployment actions (roll out). In this phase, different planning cycles for investments represent a significant challenge (e.g. sufficient lead time for planning and deployment budgets). The early coordination and commitment of the actors in the Partnership provides certainty for aligned actions and better synchronisation investments in order to deliver value for all members of the Partnership and society.

Deploying and/or adapting physical, digital and operational infrastructure in support of CCAM is costly and the return on investment is to a significant extent contributing to societal goals (safety, traffic efficiency, decarbonisation) and policy objectives of the EU. Hence, deploying CCAM needs support from infrastructure deployment focused co-funding programmes like Connecting Europe Facility (CEF 2).

Portfolio of activities of the CCAM Partnership

The R&I activities will be the value creating core of the Partnership activity portfolio, feeding into Deployment Readiness activities, leading to Large scale demonstrations for a new mobility system, but also for freight and conventional passenger mobility. Additionally, the portfolio will also deliver clear and objective-oriented coordination as well as systematic evaluation on social aspects and user acceptance. Moreover, the Partnership will support necessary activities outside the Partnership for a successful Deployment Readiness strategy, which are

- Harmonisation and certification, which are key enablers for wide deployment and implementation of CCAM enabled mobility solutions
- Technical standardisation to support European industrial leadership and highest possible efficiency of solutions.

Implementing the Partnership with CCAM Clusters

For a better understanding of the envisioned portfolio of activities and its interactions, the Partnership is structured in seven CCAM Clusters (Figure 4):

- Cluster 1: Large-scale demonstration
- Cluster 2: In-vehicle technologies
- Cluster 3: Validation
- Cluster 4: Integrating the vehicle in the transport system
- Cluster 5: Key enabling technologies
- Cluster 6: Social aspects and user acceptance
- Cluster 7: Coordination

Each CCAM cluster provides the elements for the SRIA roadmap with a brief description of the scope, the link and interface to other European Partnership activities as relevant for CCAM, and the actions towards standardisation, regulatory bodies or policy alignment.

For a deeper understanding, the correlation between the clusters, the clusters creating bonds between the total of clusters together, are summarised here. **Key enabling technologies** like Artificial intelligence, Big data and cybersecurity will support the whole mobility system consisting of in-vehicle technologies, integrating the vehicles in the transport system, as well as the validation of all aspects of the entire system.

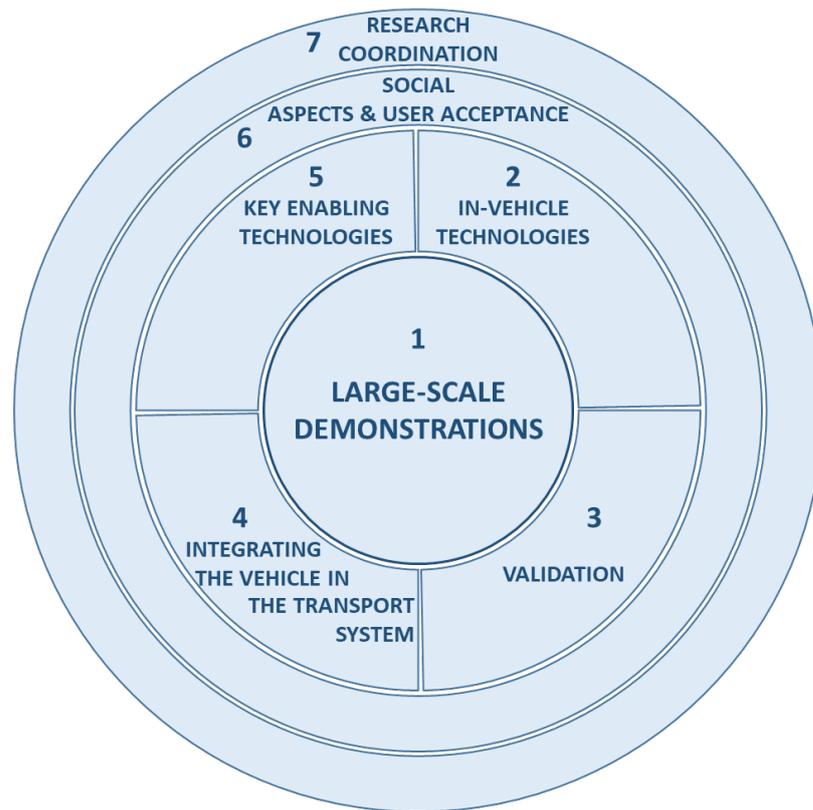


Figure 4: The seven CCAM clusters

In-vehicle technologies research will deliver the most efficient and effective future solutions for the entire mobility system of Europe and also enable the **large-scale demonstrations**.

The biggest technical research and innovation challenge is the **validation** of all aspects of the entire transport system, from computer vision and human factors up to remote operation and traffic management.

Integrating the vehicle into the transport system includes the biggest change for all stakeholders and is so the most innovative and also sociologically most relevant part of the portfolio. It will change not only the traffic, but also the behaviour of all people in Europe as well as how our cities will look in the future.

All stakeholders of the CCAM value chain, including end users, are required in order to achieve the objectives.

This Partnership for research and innovation addresses all development paths of CCAM for the next decade that are relevant from a public policy perspective, a road operator, a road user / consumer perspective and from an industry perspective. It will focus on CCAM solutions and services that can bring gains in terms of safety, efficiency and sustainability of the overall transport system.

The aim is to support the development and pre-deployment of innovative (shared) mobility and logistics services using fully connected and highly automated vehicles (SAE level 4) for passengers and freight. The SRIA will follow an iterative approach (see chapter 2.4) with the objective to continuously expand the operational design domain of CCAM. The seven CCAM Clusters will be used to structure the initial content of the SRIA and the updating during the partnership life-cycle.

Differences in terms of type and maturity of CCAM systems and services in the different geographical areas are to be expected. However, our overall goal and long-term ambition level for CCAM is the same for passengers and freight and in all application areas. The selection of

use cases in the SRIA process is impact driven. The ones most relevant to achieve the objectives identified in section **Erreur ! Source du renvoi introuvable.** and with great potential for deployment in the short to medium term (Deployment Readiness, industrialisation) should be favoured. At the same time, the Partnership remains open for other possible new mobility services / use cases being developed in the coming years.

3.1.1 CCAM Cluster 1: Large-scale demonstration

This CCAM Cluster will organise large scale demonstration actions for **pilots** and field operational trials (**FOT**)s. The large scale CCAM pilots are required to prepare for FOT actions and pre-deployment demonstration activities. They comprise different operational domains, and various (adverse) environmental and road conditions to validate the safe system functioning. Pilots are conducted with CCAM vehicles e.g. in mixed traffic with different type of vehicles and various automation levels.

The large scale FOTs for mobility of passengers and goods are necessary to gather information on user interaction and acceptance. They will provide sufficient data to assess impacts on quantifiable transport objectives such as increased transport efficiency, improved road infrastructure utilization, reduced energy consumption and increased road safety. They provide further insights on requirements for smart, shared, automated mobility solutions and foster the development of new technologies and business models.

Living-labs will support user-interaction and analysis of public acceptance with CCAM in real operation. They offer stakeholders with the opportunity to innovate, propose, test, and improve high value mobility and logistics services for the benefit of the end-users and society. Specific interest lies on shared automated mobility solutions that are fully integrated with public transport and soft modes, and logistics solutions, including proven and tested stimulation methods (like incentives, regulations and taxation schemes

The network of large-scale pilots will boost knowledge acquisition through harmonised data/scenario exchange. Improvements of operation efficiency in urban, sub-urban environment and smaller villages and for human-machine interaction will be assessed.

Public and private stakeholder collaboration will be fostered to achieve common objectives and assess societal impact.

Develop and demonstrate shared and integrated automated mobility solutions (IA)

- Provide appropriate living-labs to analyse public acceptance of CCAM in real-world conditions while offering stakeholders with the opportunity to innovate, propose, test, and improve innovative mobility and logistics services.
- Conduct large-scale demonstrations to increase the scalability of demonstrations of advanced shared automated mobility and logistics solutions, including automated door-to-door goods delivery solutions, to pre-deployment in more complex ODDs in urban, peri-urban and rural environments.
- Demonstrate efficient ways to integrate shared mobility solutions using CCAM vehicles into the transport system.
- Facilitate the uptake of new business and operational models which positive societal impacts by demonstrating inclusive shared automated mobility solutions that complement mass transit, in particular for users with special needs (such as disabled, elderly) and for Mobility White Spots, where other public transport is not economically viable.

Large-scale demonstration of highly automated passenger vehicles (IA)

- Conduct large-scale pilots and field operational trials (FOT) which ensure safety, providing valuable insights into the capacity of automated driving systems (ADS) and their current limitations.
- Perform large-scale pilots with prototype vehicles in order to provide data for verifying and validating ADS ensuring safety and reliability before market introduction.
- Conduct demonstrations with small series production passenger vehicles (i.e. FOTs) to raise user awareness, help assess the impact on society and accelerate implementation. For these FOTs, “Living Labs” provide the infrastructure (including connectivity), mixed dynamic traffic environments and user communities. The coordination of Living Labs for ADS is important to foster harmonization and interoperability and support cross-border functionality all over Europe.

Large-scale demonstration pilots of automated commercial / freight vehicles (IA)

- Deliver evidence for quantifiable freight transport objectives via large-scale demonstration pilots and pre-deployment such as increased freight transport efficiency, improved road infrastructure utilization, reduced energy consumption, increased safety, and improved working environment.
- Involve early the different freight logistics stakeholders such as; road haulage operators, shippers, port, terminal, road infrastructure authorities, forwarders, truck OEMs, trailer and load-carrier manufacturers will identify opportunities and obstacles.
- Develop, test and evaluate new operational and business-models through logistics operational pilots in a “European logistics living lab” for integration into a global logistics context and to strengthen European competitiveness to pave the way for innovative concepts and new products and services. and to strengthen European competitiveness to pave the way for innovative concepts and new products and services.

Specific Objectives

- (SO4) Demonstrate inclusive, user-oriented and well-integrated mobility concepts enabled by CCAM with a reduced carbon footprint
- (SO5) Demonstrate new freight and logistics concepts and services enabled by CCAM with a reduced CO2 emission per tonne-km

Link to Standardisation, Regulation, Policy

- Applying the European framework for testing
- Providing input to common test data

3.1.2 CCAM Cluster 2: In-Vehicle Technologies

This Cluster focuses on CCAM R&I actions with respect to technologies on board the vehicle which enable to perceive the environment, take decisions, interact with the users and other traffic participants and to provide protection in case of emergency.

Robust and accurate environment perception is essential for highly automated vehicles. To guarantee safe operation of CAVs, since systems are not currently ready for complex driving conditions and demanding ODDs, on-board decision making should concentrate on the combination of system, human and environment status within the framework of digital traffic rules; furthermore, on-board decision making must be performed in real time and in a safe and unambiguous way.

To enable CCAM, active safety functions need to enable automated vehicles to navigate safely in both expected and un-expected scenarios. Advanced passive safety systems are also required

in order to protect passengers in new, unconventional seating positions. New challenges arise with higher levels of automation concerning Human Machine Interactions, such as handing over the driving task between automated and manual driving, and the interaction with other road users.

Environment Perception (RIA)

- Increase performance, accuracy and reliability of perception systems based on enhanced sensing, localization and cognition also using machine learning
- Develop more powerful embedded in-vehicle systems
- Improve integration with infrastructure-based perception systems to complete data fusion where internal systems are out of range
- Reduce false detections for improved driver comfort and enhance trust from other vehicles and road users of CCAM, expanding the ODD (rainfall, fog, snow, complex urban environments).
- Develop self-assessment methods for environment perception systems
- Define performance standards

Passive & active safety (RIA)

- Develop advanced safety systems to protect passengers in new, unconventional seating positions and body postures, taking into account the situations and conditions for the use of such systems (e.g. public shared automated vehicles)
- Develop consistent methods and assessment tools to fully understand the safety impact of automated vehicles in mixed traffic and derive safety requirements.
- Define requirements and potential needs for the adaptation of traffic rules
- Improve reliability levels of in-vehicle systems and components as an element of accident avoidance

On-board decision making (RIA)

- Develop on-board safe, unambiguous, real-time decision-making for CCAM using complex in-vehicle systems-of-systems with advanced sensors, extensive computational power, reliable, dynamic high-definition digital maps.
- Implement harsh and complex conditions where advanced capabilities such as pattern recognition, big-data analysis and self-learning require high performance computing on-and off-board.
- Define and harmonise, at the EU-level, Operational Domains to ensure real-time decision-making for safe and secure CCAM for all types of traffic situations and roads.
- Develop tamper-proof electronic controls architecture of connected and automated vehicles

Human-Machine interaction and interface design (Requirements, RIA)

- Perform research and international standardization activities on design strategies for in-vehicle input, in-vehicle interface with driver, output devices and actuators as well as on how to interact with surrounding road users (VRU, people in adjacent vehicles, police, etc).
- Develop different design strategies depending on road type, ODD, vehicle type etc.
- Ensure inclusiveness for a wider range of user groups (e.g. children, elderly, disabled) especially when designing for mobility services.
- Perform continued research and proof of concepts (PoC) on driver state assessment methods and technologies.
- Develop solutions to address situations where human drivers are unfit to resume control.
- Develop training and information campaigns for users and general public which complement intuitive vehicle designs.

- Address the optimisation of the on-board experience of vehicle occupants with respect to new automated modes of transport

Specific Objectives

- (SO2) Agreed safety standards for highly automated driving systems to operate and function on public roads
- (SO1) Secure and trustworthy interaction between road users, vehicles, infrastructure and services

Link to Standardisation, Regulation, Policy

- Recommendations for performance standards for environment perception for CCAM
- Recommendations for harmonized validation methods for passive and active safety
- Inputs to UNECE WGs on vehicle safety
- Inputs to EuroNCAP
- Recommendations for harmonized validation methods for on board decision making systems
- Recommendations for industry standard for CAD control architectures
- Inputs to international standardisation activities on HMI design guidelines

3.1.3 CCAM Cluster 3: Validation

The success of CCAM depends mainly on the acceptance and adoption in society. The decisive factor will be, assuring the effective safety of CCAM. Therefore, the validation of the vehicles' automated driving functions and their operation in the intended ODD are forming an important cluster in the portfolio of activities of the CCAM Partnership. Higher levels of automated driving require scenario-based validation methodologies following hybrid approaches with physical and virtual testing. This is necessary to reduce the high number of test kilometres needed for safety validation specifically with more complex ODDs.

A challenge will be identifying and considering all relevant critical scenarios with their probability of occurrence. Validation in this context should not only take technical systems into account, but also human factors. This applies to human-technology interaction as well as to the understanding of human driving performance as a reference for the CCAM systems performance in reducing the number of fatalities and accidents.

The CCAM Partners will actively use the results of R&I actions in this cluster to support European and international working groups developing relevant standards and type approval /compliance testing frameworks, e.g. at UNECE in coherence with regard to national policies. Moreover, coherence and synergies in relation to relevant national policies and programmes will be supported by the involvement of Members States in the CCAM Partnership and the CCAM Advisory Board. This effective multi-directional dissemination channel will inform policy making and regulatory bodies, e.g. by supporting the development of a common understanding of the required safety level of CCAM.

Validation of CCAM systems (RIA)

- Ensure the safety of higher levels of automation, particularly in mixed traffic situations which require scenario-based validation and verification of the vehicle and its operation in the intended ODD. Moreover, functional safety, reliability and security need to be evaluated. Within this context virtual, physical and hybrid approaches are needed allowing a cost-effective, reproducible and interchangeable validation of individual components and software as well as of the vehicle automation functions, including the underlying safety concept.

- Develop common methodologies and tools to define the validation and verification requirements as well as the orchestration of the required tests including the derivation of representative scenarios and tests. This includes the development of a standardised, virtual simulation environment, dedicated hardware and physical infrastructure for testing.
- Address the validation of self-learning systems, as their properties are principally dynamic and will change with time and with increasing experience on the road.
- Elaborate recommendations for a common framework for harmonisation, standardisation and homologation.

Validation of human factors and human-machine interaction (RIA)

- Develop a reference model of human driving performance as a basis of a common understanding of the required safety and reliability level of CCAM
- Develop HMI testing procedures, methods and tools for higher levels of automation which include both strict experimental set-ups as well as more naturalistic ones
- Derive design guidelines for novel HMI concepts that fulfil upcoming requirements with respect to safe human interaction and intuitive usability
- Elaborate recommendations for a European Statement of Principles (ESoP) on automated vehicles, including HMI and their communication with vulnerable road users

Specific Objectives

- (SO1) Secure and trustworthy interaction between road users, vehicles, infrastructure and services
- (SO2) Agreed safety standards for highly automated driving systems to operate and function on public roads
- (SO3) Validated functional safety for CCAM use cases

Link to Standardisation, Regulation, Policy

- Deliver recommendations for European and global harmonisation and standardisation of validation methods for a type approval and compliance testing framework of automated vehicles (input to relevant and competent bodies at EC and UN-ECE).
- Deliver HMI design guidelines and recommendations for an update version of the European 'Statement of Principles' (SoP) on internal and external HMI of automated vehicles;
- Deliver the evidence basis of a common understanding of the required safety, reliability and security of CCAM to policy makers

3.1.4 CCAM Cluster 4: Integrating the vehicle in the transport system

This CCAM cluster focuses on realising a future effective and efficient Mobility System where Connected Automated Vehicles are an integrated part of, interacting with their environment, humans and other – old and new – transport means. The system integration points at the necessity to interact with infrastructures, comprising road and telecommunication infrastructure as well as automotive backend infrastructure. Both elements of physical and digital infrastructure are important, in particular building a common understanding of what is required, how it can be achieved and which roads should be prioritised.

Interoperability is key for providing seamless mobility, most notably at locations where handovers between infrastructure operators (e.g. urban – interurban road network, cross-border, Mobile Network Operators) are needed and between transport operators and service providers. Besides the connectivity aspect, cross-sector harmonised message sets based on standards are needed for communicating C-ITS information and also triggering actions of and between vehicles (e.g. cooperative manoeuvres, negotiation of intentions). Furthermore,

Connected and Automated Vehicles may not necessarily be driven as an individual object in a swarm (traffic flow) but to an increasing extent becoming part of a managed fleet operated in the mobility system. Although differing in operational aspects, from an overall perspective, the task of fleet management and orchestration is independent from which actor takes this role (e.g. service provided by fleet management, individualised or semi-collective recommendations from traffic management) and whether a fleet is shared or mixed in modes. A specific element with regard to safe operation of Connected Automated Vehicles is remote operation and surveillance which forms also a part of this cluster.

Physical and digital infrastructure (PDI, RIA)

- Enable the transition in the most efficient and cost-effective manner for physical infrastructure (markings, road signs, layout, road condition, etc.) and digital infrastructure (digitised spatial network and regulations, etc.).
- Define a cost-effective transition for the operational challenges (traffic management of the mobility network, fleet orchestrator, etc.)
- Conduct research on business and financing models, infrastructure classification schemes, policy options and ways to increase competencies and resources for road authorities (and/or operators) to ensure the physical, digital and operational infrastructure remains fit for purpose.
- Achieve a common understanding of the role of PDI for CCAM and specifications of required infrastructure.

Connectivity / cooperative systems (RIA)

- Secure effective connectivity for the needs of CCAM.
- Ensure robustness and redundancy, availability of communication channels (network coverage) and a minimum quality of service (QoS) especially for higher levels of automation. For safety critical applications of CCAM, the performance and resilience of connectivity is essential.
- Create trust among the different entities exchanging information.
- Assess the performance from an end-to-end perspective in real-world driving conditions and in hybrid communication environments, safeguard fail-safe operation, appropriate degradation, privacy protection and end-to-end security.
- Ensure interoperability of systems and services provided by the different actors (vehicles, infrastructure, road users, road/fleet operators, public authorities, etc.), develop standardised C-ITS messages and message sets (e.g. for manoeuvres) and test EU-wide interoperability and compatibility.

Fleet and (mixed) Traffic Management

- Integrate (shared) automated vehicle systems in existing traffic, with conventional vehicles and on existing roads.
- Integrate (shared) automated services in fleet and traffic management systems. This requires reaching agreements on targets and roles within the mobility system among multiple stakeholders, as well as research on a multitude of aspects, e.g. simulation and big data analysis, impacts on operations and users, total system effects, infrastructure savings and needs, etc.
- Develop the concept of fleet orchestration for the monitoring and management of shared fleets, and its integration with the other relevant systems and services like shared vehicles, smart infrastructure, Public Transport or Goods delivery back-end systems.
- Test new options and governance models to operate shared automated mobility systems as part of real-life fleet and traffic management systems. Guidance for authorities (e.g. local, regional, national, port, EU-wide) to prepare and plan for CCAM services.

Specific Objectives

- (SO1) Secure and trustworthy interaction between road users, vehicles, infrastructure and services
- (SO2) Agreed safety standards for highly automated driving systems to operate and function on public roads
- (SO8) Improved synergies between public and private investment plans to advance vehicle and infrastructure technologies

Link to Standardisation, Regulation, Policy

- Secure and trustworthy interaction of vehicles, infrastructure and third-party services in cross-border dimension through infrastructure support level (ISAD) specification with clarified roles and responsibilities business and operating models in PDI.
- Harmonisation for cross-border communication supporting CCAM (e.g. in ITS Directive Working Programme Activity 3.4.).
- Input to T-PEG and DATEX II standardisation.
- Input to the revision of the ITS Directive 2010/40/EU, and the two Commission Delegated Regulations stemming from it: a) Delegated Regulation 886/2013 of 15 May 2013 with regard to data and procedures for the provision, where possible, of road safety-related minimum universal traffic information free of charge to users and Delegated Regulation on Safety Related Traffic Information and b) Delegated Regulation 2015/962 of 18 December 2014 with regard to the provision of EU-wide real-time traffic information services.

3.1.5 CCAM Cluster 5: Key Enabling Technologies

The successful development and implementation of CCAM enabled mobility solutions relies on the maturity of a number of key enabling technologies. Though these key enabling technologies (KET) can be applicable (partially) in other application areas, too, specific approaches and development paths are needed to allow for addressing specific CCAM related challenges. This includes the strict requirements for e.g. the security and trustworthiness of the interactions between road users, vehicles, infrastructure and services (relates to SO1).

KETs are technologies that will allow European mobility industry to retain competitiveness and capitalise on new markets. They are, by nature, cross sectoral. The focus of this KET cluster is R&I on enabling technologies which are ‘key’ for large scale deployment of CCAM.

Having these technology fields in a dedicated cluster, which is linked to other Partnerships, allows for a fast uptake of new and emerging knowledge fields, while at the same time allowing for an early identification of user needs and new challenges which should be addressed with the help of Key Enabling Technologies (relates to SO10). An important pillar of CCAM Cluster 5 on KETs is on the data availability, data storage and data sharing. Another pillar is on Artificial Intelligence for CCAM technologies, linked to user acceptance and self-learning algorithms. Furthermore, security architectures, harmonisation and a link to legislation in relation to data policy and ethics are needed.

Cyber-security

- Assess the robustness and resilience of vehicles function related to different types of attacks (over the air, in physical proximity, different magnitudes of attacks...); system analysis for cybersecure functions
- Address the detection and prevention of malicious activities; automated consistency and plausibility checks as part of the inherent security concept along the entire lifetime and value chain, from production to operation to maintenance or repair.

- Ensure secure electronics components and interfaces, operating systems of devices, firmware, communication, application software. The security value chain has to be considered at each level of the value chain – from vehicle parts up to the transport infrastructure including the related services (e.g. maintenance, mobility...) and ensuring the protection of users' privacy and integrity.
- Tailor vehicle specific cypher algorithms (solutions based on zero trust policy) to protect in-vehicle communication and quantum resistance to protect CCAM vehicles against brute force attacks from quantum computers
- Ensure safety of the CCAM system in case of failure in subsystems or components, enhanced via advanced redundancy measures. Redundancy spans from the typical additional components and functions to unlocking the potential for multi-purpose use of (sensor) data and calculations or data transmission.

Artificial Intelligence (AI)

- Develop explainable concepts, techniques and models of Artificial Intelligence (AI) for CCAM. Huge amounts of in-vehicle and infrastructure-based sensor data together with other data sources will be used to 'train' AI algorithms. This development process is accelerated and supported through harmonization, availability, quality assurance, interoperability and exploitation of relevant data.
- Industrialisation, requirement-based development, continuous improvement of trained modules for application in safety critical domains and the verification and certification of AI for automated driving functions.
- Develop AI for situational awareness: estimate and predict the system state, human state and traffic state, the three parts that together determine the safety of a situation. This should then be taken a step further, from situational awareness towards cooperative, reactive, adaptive and predictive perception, decision making and actions.

Data storage and sharing

- Develop a harmonised approach for data sharing based on open and interoperable programming interfaces (APIs) and access control by defined user rights.
- Focus on the data value chains, data storage and formats, standards and related infrastructure.
- Provide a complete and secure system architecture that complies with privacy, data security and cybersecurity requirements while allowing access to in-vehicle real-time data and resources, on-board and remotely, as needed.
- Foster cross-industry interoperability, choice by and portability of services for the user, price affordability, and competitiveness

Link to Standardisation, Regulation, Policy

- (Functional) Safety Standards, harmonisation and standardisation of cyber safe interfaces, as well as an EU cybersecurity label to be developed with other European initiatives and Partnerships
- AI for automotive applications, in line with the European AI framework building on European fundamental rights and values, as composed in the Partnership on AI, big data and robotics
- Data exchange framework, data ownership, GDPR

3.1.6 CCAM Cluster 6: Social aspects and user acceptance

The objective of this cluster is to interface connected and automated mobility systems to society with users having a central role. A decisive factor related to CCAM's successful uptake consists on how society and users will accept it. Therefore, technological development in the field of CCAM should consistently take into account the needs of users and how CCAM can solve what conventional vehicles cannot currently. At the same time, the implementation of advanced driver assistance systems towards higher levels of automation will require trust and acceptance from users and society at large. Particular attention should be paid towards the interaction of users with the system but also issues related to privacy and liability. A clear overview of the technological novelties inside the vehicle will ultimately increase user acceptance.

The socio-economic and environmental impact of CCAM will need to be further analysed to assess the impact on accessibility, driver and mobility behaviour and emissions, among others. CCAM has the potential to promote a socially inclusive approach by integrating into society those users that are most vulnerable (e.g. people with reduced mobility, elderly) or facilitating them to access goods. Areas that need further investigation include the impact of CCAM on road-safety, traffic efficiency, health and pollution, affordability for users.

Moreover, European businesses need to be supported, in particular small and medium-sized enterprises, to better understand and face challenges, including business challenges, related to automated mobility, and promote exchange of best practices. As the job may change, drivers will need to be retrained and professional drivers should be encouraged to enter the transport industry, and as such address the ongoing driver shortage.

Societal needs analysis (RIA)

- Analyse user requirements, expectations and concerns related to the use of connected, cooperative and automated driving technologies and systems in their broadest sense.
- Perform ethics evaluation as the understanding of CCAM will evolve.
- Perform positive risk analyses to identify, assess and manage the potentially beneficial outcomes of CCAM for users and society.

Societal needs analysis (CSA)

- Assess the impact of the implementation of CCAM by organising targeted debates, workshops and knowledge sharing sessions amongst different stakeholders, users and society at large.
- Conduct targeted campaigns aimed at increasing user awareness, obtaining trust in CCAM, the results of which will be analysed.
- Perform demonstrations with real users to receive valuable day-to-day feedback and insights.

Socio-economic and environmental impact analysis (RIA)

- Assess the short, medium- and long-term impacts, benefits and costs of CCAM (in all areas)
- Conduct comprehensive cost / benefit analyses and projections of the overall investment requirements, vehicle equipment costs, operating costs, infrastructure costs and environmental costs
- Identify and develop specific use cases with a positive socio-economic impact, defining the policy framework and specific use cases and roll-out plans.

- Define policy and planning measures that can mitigate any potential negative CCAM outcome.

Workforce development (RIA)

- Assess the impacts of higher degrees of automation and digitalisation in road transport on existing and future workforce (including job location, working environment, working times, needs for new skills, education and driver training).
- Analyse requirements and training needs for new workforce by focusing on relevant legislation
- Define policies for labour market incentives and ways to adapt workforce development and value chains to new and fast changing framework conditions and technological evolutions of CCAM.
- Identification of necessary incentives for investment in human capital, financial mechanisms for retraining, supporting labour market dynamism and flexibility, adaptation of workplace and workflow by industry and SMEs.
- Develop tools and methods to help road and transport authorities and operators plan for and transition towards an increasingly automated transport system.

3.1.7 CCAM Cluster 7: Research coordination

The objective of this cluster is to develop harmonised approaches and European frameworks for the assessment of impacts of CCAM technologies and systems, testing on public roads and sharing of transport, traffic and test data. The cluster will also build and maintain the EU-wide Knowledgebase that will publish and disseminate R&I and piloting activities as well as methodologies, common scenarios enabling the exchange of knowledge, experiences and lessons learned. The different activities of the cluster will support the coordination and cooperation of R&I and testing activities across Europe, facilitating the collaboration between stakeholders from all sectors and create the fundamentals to move from testing and piloting towards the harmonised deployment and operations of the CCAM.

A common evaluation framework for large-scale demonstration pilots will allow comparability of results, complementing evaluations and meta-analysis over multiple evaluation studies. Similarly, a European framework for testing on public roads will help streamlining the different national and local processes for obtaining testing permissions, resulting in unified testing approaches for a better data analysis, verification and validation of systems. Harmonised approaches for data sharing complying with privacy, data security and cybersecurity requirements will foster cross-industry interoperability and portability of services for the user, price affordability and competitiveness. The effectiveness of large scale testing in Europe can be largely increased by a more systematic exchange of experience, test results, and test data.

EU-wide knowledge base, including common scenario database (CSA)

- Consolidate and maintain the existing web-based Knowledge Base centralising information about stakeholders, R&I programmes and projects and testing activities in the field of CCAM in Europe and worldwide.
- Create a common baseline for CCAM Knowledge in Europe and define the governance structure for the Knowledge base with a strong focus on facilitating the contribution stakeholders from all sectors and in particular exchanges with Member States.
- Extend the Knowledge Base by providing more information about national, international CCAM activities, standards, testing methodologies, common scenario database, lessons learned.

Common evaluation framework (CSA)

- Develop a common evaluation framework for large-scale demonstration pilots in Europe. Identify tools for assessment and align views on missing and needed methodologies.
- Prepare scaling up, creating an ODD database including all events and detailed characterization with a link to statistics on incidents, etc...
- Perform classification of the networks: what is the network on which automated vehicles can actually drive? Describe the physical layouts of the cities
- Define system levels parameters to adequately assess system level and societal target effects of various deployment options.
- Provide life-cycle assessment KPIs for commercial product, process and service

Common evaluation framework (IA)

- Create the tools and methodologies to assess future scenarios for deployment

Test Data exchange framework (CSA)

- Establish a data exchange framework to improve cooperation and make better use of the results of all testing activities in Europe.
- Ensure provision of high quality and well-documented datasets, co-operate on a technical reference platform with other data sharing initiatives, encourage data re-use, establish win-win situations, and keep the balance between privacy / IPR and availability.

Test Data exchange framework (IA)

- Identification of the required data, of their specifications, formats, etc. in order to define the framework for the data labelling and formats

European framework for testing on public roads (CSA)

- Propose and promote a legislation harmonizing conditions for obtaining permission for testing on public roads across European member states.
- Elaborate harmonised data needs and specifications for specific use cases and scenarios, define data sharing principles and create a unified European shared, publicly available database on incidents and other events related to safety of automated vehicles
- Define minimal conditions for entities interested in testing on public roads to meet before receiving permission for tests. Develop flexible functional scheme for “safe testing”, based on vehicle capabilities in conjunction with infrastructure support, context and traffic situation as well as driver/operator maturity, including “safe systems” approach.
- Develop and define a common edge (use) case approach
- Analyse and elaborate user experience/behavioural aspects in relation and addition to test/validate technical components and systems.

European framework for testing on public roads (IA)

- Define and develop tools for assessment of testing on public roads in order to have clearly defined measures for evaluation of how entities stick to the framework, develop common test and validation methodologies in RDI projects/initiatives, including the foundation of common quality assessment metrics.

Strategic European agenda for R&I and large-scale testing (CSA)

- Develop and continuously update a clear long-term European agenda for research & innovation and large-scale testing activities, making sure that investments at European, national and local levels, both of public and private nature, are complementing each other towards systemic and interoperable solutions for a fully integrated European mobility system

- Ensure European contribution in the Trilateral ART Working group and foster the exchange of knowledge with the international CCAM community for the identification of strategic alignment and cooperation areas.
- Support the organisation of CCAM expert networking events and workshops for the alignment on R&I and testing challenges and priorities.

Links with other European Partnerships

The CCAM Partnership is at the focal point between societal and mobility system transformation and shaping Europe’s digital future. This is well recognised when analysing the links, synergetic effects and interaction of the CCAM Partnership with other European Partnerships. At this stage, close interactions are foreseen with five proposed Partnerships, as well as with the succeeding initiative for the cPPP ECSO on cyber-security:

- Towards zero emission road transport - 2ZERO
- Driving Urban Transitions -DUT
- Key digital technologies - KDT
- Smart networks and services - SNS
- AI, data and robotics - AI

The mobility system and societal Partnership are well linked (i.e. 2ZERO, DUT) together with digital enablers (i.e. SNS, KDT, and AI) through the CCAM Partnership. This section describes the foreseen interfaces and synergies. Furthermore, the potential fields of joint actions are described, based on the proposed activities in the clusters as introduced in **Erreur ! Source du renvoi introuvable.** Apart from the collaboration possibilities described below, an important joint activity can be in standardisation, harmonisation and inputs for certification.

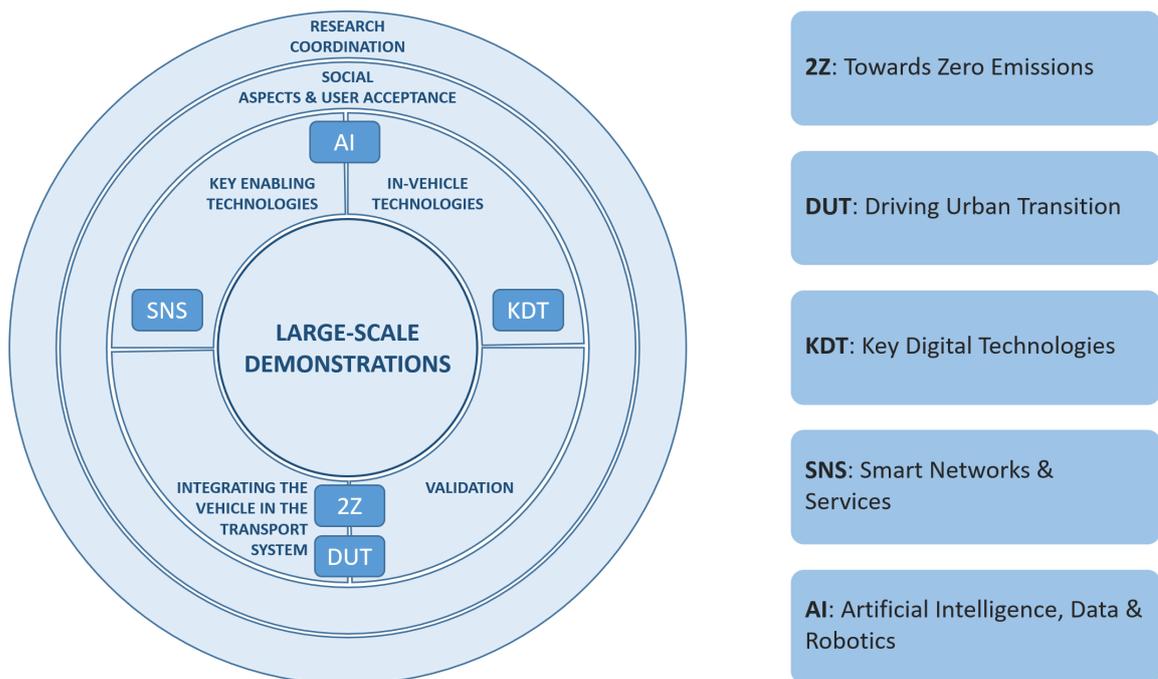


Figure 5: R&I Clusters in the CCAM Partnership with closest collaboration with 5 other proposed Partnerships

Cooperation between the CCAM and DUT Partnerships

Interface: DUT - Driving Urban Transitions - is a candidate Co-funded Partnership in Horizon Europe: it addresses urban transitions with a cross-sectoral and integrated approach and includes the transformation of the urban mobility system as one pillar of sustainable urban development. The interfacing towards the CCAM Partnership is shown in Figure 6.

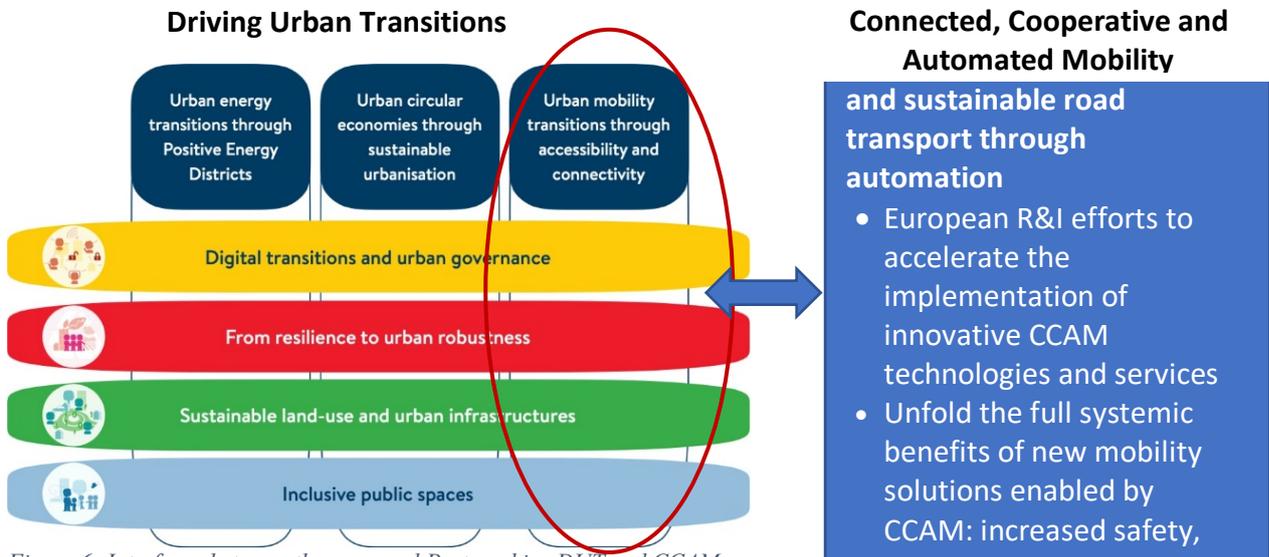


Figure 6: Interfaces between the proposed Partnerships DUT and CCAM

Synergies:

Connecting the two initiatives CCAM and DUT allows to build a European approach for the implementation of CCAM, ensuring that its technologies, infrastructures, services and systems are developed with a sound understanding of their implications on the wider urban context. Urban-related results and issues developed and identified in the CCAM Partnership could be considered and taken up within the DUT Partnership, to investigate the wider consequences and potentials of CCAM solutions for urban planning and management. On the other hand, the DUT programme could also support CCAM in mobilising a wider set of actors in the participating countries, contributing to experimentation in cities and urban areas with different local conditions, covering some aspects related to governance, the role of CCAM in integrated mobility systems, behavioural issues and needs, as well as relationships to other sectors and systems (e.g. energy).

As one preparatory action of the DUT Partnership, JPI Urban Europe is currently implementing the ERA-NET Cofund Urban Accessibility and Connectivity, which is covering some aspects related to the implementation of innovative and integrated mobility system with regard to scenarios, policies, behavioural issues, governance, planning etc. Depending on the portfolio of projects finally granted (expected end of 2020), relevant projects could be connected to the CCAM community and activities.

Potential fields for cooperation:

CCAM R&I action areas:	Cooperation potentials with activities in DUT:
Physical and digital infrastructure	Sustainable land use and urban infrastructures is one key priority of DUT. CCAM related infrastructure demands, solutions and their impacts on other urban infrastructures can be considered in the DUT programme.

Fleet and (mixed) Traffic Management	As already started in the ERA-NET Cofund Urban Accessibility and Connectivity, decision support systems for policy makers and comparison of scenarios and policies are addressed to support uptake of new approaches in urban planning and development. Continuing such activities in DUT, fleet and traffic management concepts developed in CCAM could be picked up in DUT to investigate relationships with other mobility modes and the consequences and potentials for multi-modal systems.
Develop and demonstrate shared and integrated automated mobility solutions	DUT strongly fosters urban living labs (ULLs) to support co-creation in local environments. This would support not only testing of solutions in the urban context but co-designing and validating implementation concepts with all relevant stakeholders. In particular, aspects of governance and management, urban planning issues, user behaviour and societal needs could be addressed in such ULLs, complementing demonstration activities of CCAM.
Large-scale demonstration of highly automated passenger vehicles	Support to such large scale demonstrations in urban environments could be given, connected to ULLs
Large-scale demonstration pilots of Automated commercial / freight vehicles	Support to such large scale demonstrations on urban logistics or last-mile delivery could be given, connected to ULLs
Societal needs analysis	Addressing societal needs and support societal actors to contribute to the development of new approaches is one of the guiding principles of DUT. With such formats, DUT can contribute to covering particular aspects of CCAM-related issues and offering co-design formats, e.g. ULLs.
Socio-economic and environmental impact analysis	DUT follows an integrated approach, across sectors and disciplines. According to the DUT concept, the three key areas of urban transformation will be addressed in an integrated way. This opens opportunities to assess CCAM solutions and approaches in a wider context, not only with an impact analysis but investigating barriers or benefits for other sectors and different stakeholder groups.
EU-wide knowledge base, including common scenario database	Complementing the CCAM approach on establishing a web-based knowledge platform, DUT is planning to facilitate capacity building, learning and dissemination through various activities, combining physical and virtual formats for experience exchange, stakeholder dialogues, webinars, etc.

Formats for cooperation:

- Contribution of R&I results created by CCAM projects, in form of new technologies, infrastructure requirements and services to the DUT priorities and activities. Such results could be taken up in DUT calls, dissemination and exploitation activities to validate and test their potential from an integrated urban development perspective, by considering aspects of systems integration, urban governance, public sector innovation, behavioural aspects, etc.
- Identifying local stakeholder needs and raising research and innovation demands from the DUT perspective towards the CCAM Partnership, for incorporation in the CCAM SRIA.

- Connecting projects and facilitating joint discussions with all stakeholder groups to ensure alignment and foster dissemination and take-up of new solutions, technologies and services across Europe.
- Supporting dissemination of results towards Member States, regions, cities and municipalities, also in terms of national framework conditions, capacity building or replication.

Cooperation between the CCAM and KDT Partnerships

Interfaces and Synergies:

KDT – Key Digital Technologies – is a Partnership succeeding the ECSEL Joint Undertaking of Horizon 2020 in the next framework programme. Its focus is on Electronic Components and Systems as enabling technologies for multiple application fields including mobility. Therein, enabling affordable, automated and connected road mobility is a high-priority R&D&I area. Moreover, KDT shall support the validation and certification for safety, security and comfort of (artificial) intelligence embedded in vehicles. The aim is to develop digital innovation that help to increase the safety of (automated) road vehicles and reduce the number of road fatalities and accidents caused by human errors to zero until 2050 as well as ensuring that no additional road fatalities are introduced by automated transport while bringing validation costs down to 50% of development costs from current 70–80%.

The focus topics of KDT is mostly on providing the components, building blocks and systems. Their customized integration, verification and optimization for a certain traffic scene of CAD would be a matter of projects in CCAM, while requirements and standards to be met by the electronic components and systems within KDT shall be derived from the results of CCAM projects.

Potential fields for cooperation:

CCAM R&I action areas:	Cooperation potentials with activities in KDT:
Environment Perception	An accurate detection of positions, directions and types of road users is essential for environment perception to properly represent automated vehicles and other road users in dynamic maps, and thus to avoid conflicts and accidents – the essential feature of CAD. A part of the underlying technologies are high-priority R&I topics to be addressed in the envisaged KDT Partnership, e.g. reliable and precise sensor systems for environment detection and localization as well as machine learning and AI-based cognition methods. Which particular sensors need to be combined in a suite, whether they have to be embedded into in the vehicle or the infrastructure, and how their data can be fused and interpreted in view of known patterns for a certain traffic scene is to be explored in CCAM, though. Also performance requirements of a sensor suite in terms of resolution, contrast and speed should be defined for relevant ODDs within CCAM, and submitted to KDT for a check of feasibility and potential implementation.
On-Board Decision Making	The control system for automated driving functions is based on sensors, communication devices, actuators, controllers and algorithms or AI that are assembled in a sophisticated HW/SW architecture. While the general concepts of such architectures, be them service, function or domain oriented are a matter of KDT, their adaption to the requirements of e.g. a certain automation level or ODD, needs to be studied and developed within CCAM. Also the testing and validation of such control systems (methods, tools, platforms), and particularly their self-learning parts, in view of relevant traffic scenarios, whether in real world or virtually, is a matter of CCAM. This is not only highly relevant for the certification of complete

	vehicle systems, but also for setting standards to be met by components and architectures to be provided by KDT.
Cyber-Security	Cybersecurity goes beyond vehicles' data in the digital infrastructure and the communication between vehicle and networks. It is also an issue related to the electronic architecture of the in-vehicle system(s). While the hard- and software-based methods of shielding, tamper proofing and encryption are a matter of KDT, their adaption to a comprehensive concept is done in CCAM.
Passive and Active Safety	Active safety and assistance systems supporting CAD with sensors, actuators and controls are to be developed within KDT. Reliability levels of the components required for accident avoidance should be assessed in CCAM and reflected back to KDT.
Human-Machine Interaction	Systems for actuation and signalling that are essential for the HMI of automated vehicles are developed in KDT and integrated as well as assessed in CCAM.
Validation of CCAM systems	Validation requirements defined in CCAM result in specific demands for electronic components and systems developed in KDT, especially for fail-operational and fail-aware solutions. While testing and homologation are a focus in CCAM, tools and methodologies for virtual and physical testing and common or compatible standardisation frameworks are subjects for both KDT and CCAM.

Formats for cooperation:

- A mechanism for connecting the emerging ecosystems of novel mobility solutions such as CAD and their enabling technologies by matching push and pull links has been established in the Lighthouse Mobility.E of the ECSEL Joint Undertaking recently. It shall be applied for a better coordination of the alignment for KDT and CCAM as well. To accelerate the deployment of CAD, all stakeholders of the ecosystem and along the (automotive) value chain must cooperate and work towards a joint vision for safer, greener and more inclusive mobility. Regular exchange and alignment both using online tools/platforms and at meetings/workshops should be ensured.
- Societal needs and socio-economic impacts are covered primarily by CCAM, but also carry central implications for the component and system development pursued in KDT. The identification of technical and non-technical challenges as well as the interdependencies between them is key for overcoming them and thus for the advancement of CAD. User needs identified in CCAM should be translated into requirements for developments in KDT.
- KDT and CCAM together provide - related to the areas they address - full coverage of the automotive value chain, with varying levels of overlap at the interfaces. Success and speed of CAD deployment thus hinges on the alignment of contiguous research priorities across both initiatives. The use of similar or matchable taxonomies can facilitate exchange and alignment which should take place on a regular basis, e.g. through regular meeting and the exchange of position papers.
- Communication of aligned research priorities for mobility and results to policy makers shall be co-ordinated
- Inter-project exchange and collaboration should be encouraged to share best practices. Results of KTD projects can be tested and validated in CCAM demonstration projects. Joint dissemination activities can increase awareness and acceptance for CAD and associated benefits and foster communication between all stakeholders.

Cooperation between the CCAM and 2ZERO Partnerships

Interface:

2Zero - Towards zero emission road transport - is a candidate Co-Programmed Partnership in Horizon Europe. It is the follow-up of the EGVI - European Green Vehicles Initiative - Public-Private Partnership implemented in Horizon 2020. Figure 7 shows the interfaces between 2Zero and proposed Partnerships like CCAM.

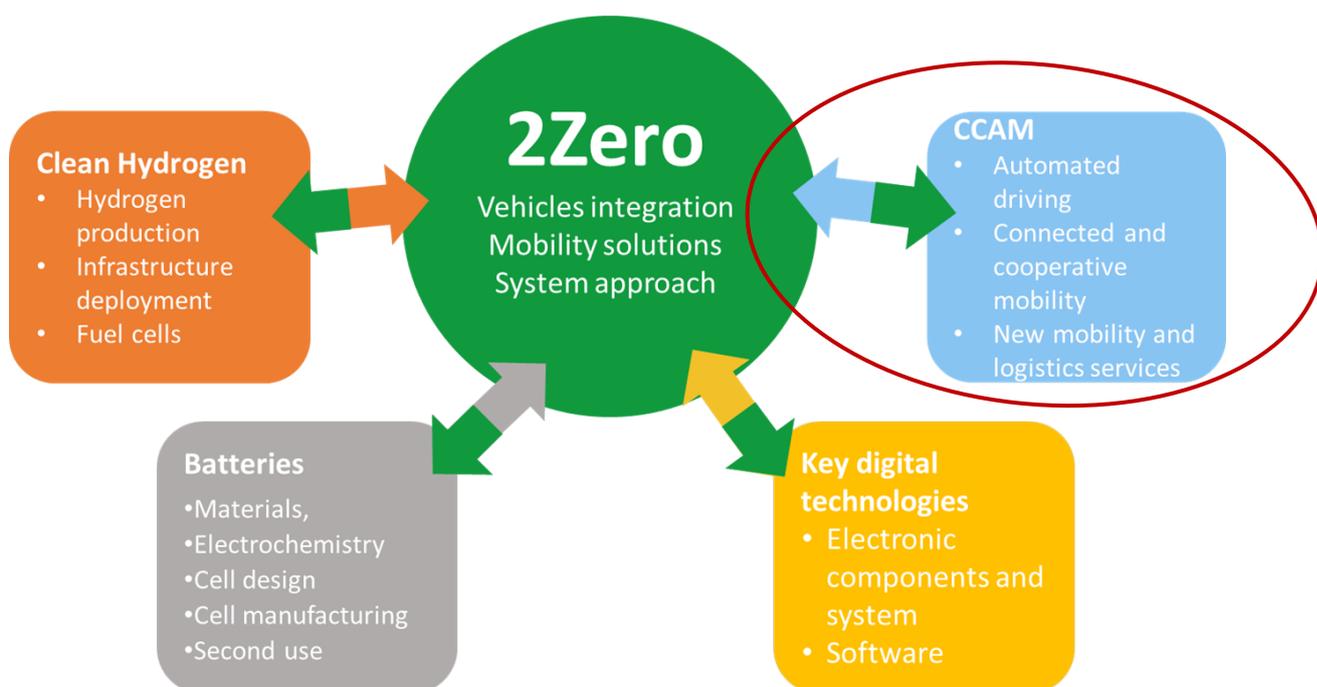


Figure 7: The 2Zero interfaces with other proposed Partnerships, including CCAM

Synergies:

The 2Zero proposal is taking a system approach extending the EGVI scope wider, from a vehicle perspective towards system aspects that can bring a decisive contribution to the decarbonization of road transport. Its core objective is the acceleration of the introduction of zero emission vehicles. It will address a portfolio of powertrain technologies adapted to the different road vehicle categories with the objective to improve air quality and pave the way to a climate-neutral road transport system, contributing to the European Green Deal.

By adopting a system approach, the 2Zero Partnership does not only look at powertrains and vehicle technologies but looks at the mobility of people and goods, aiming at a European leadership in innovation of products and services. The decarbonisation of road transport is closely linked and is enabled by digitalization, which offers opportunities to further improve the efficiency, both at vehicle level and at mobility system level. Zero emission powertrains and digitalisation come hand in hand to enable improved logistics operations and the development of new public and shared mobility services. Therefore, the 2Zero and the CCAM Partnerships should work together to develop solutions that maximize the environmental impacts and the potential decarbonisation benefits. Potential risks need to be jointly assessed and mitigated, looking at the impacts of CCAM on road transport energy consumption and related emissions.

Potential fields for cooperation:

Within the 2Zero proposal, the following topics make an explicit reference to CCAM:

2Zero R&I topics:	Cooperation potentials with activities in CCAM:
Innovative concepts and services for zero emission mobility of people and goods	In cooperation with the CCAM Partnership, the 2Zero Partnership will investigate the effectiveness of the non-technological measures that are taken to reduce emissions: impact of new ownership models on traffic network, user behaviour and related emission, etc.
LCA approaches and circular economy for sustainable and innovative road mobility solutions	Assessment of actual and future road mobility scenarios including CCAM: in the future, road transport will be more and more “cooperative, connected and automated”. The development of the relevant technologies will be supported by the CCAM Partnership. CCAM solutions will have wider effects on CO2 emissions. The LCA in the 2Zero Partnership will need to be considered, as well as the overall energy needs and emissions of road transport.
Vehicles technologies and propulsion solutions: energy efficient multi-technology options for carbon-neutral, zero emission road mobility	Digital technologies relevant for energy efficiency will be covered in collaboration with the CCAM Partnership: assessment of electric power consumption of CCAM vehicles, control strategies related to emission reduction, energy and thermal management, tyre wear, thermal braking, etc.

CCAM R&I action areas:	Cooperation potentials with 2Zero:
Develop and demonstrate shared and integrated automated mobility solutions	For the demonstration of new mobility services for passengers and goods transport in particular within urban areas, the CCAM Partnership could favour the use of zero emission vehicles, adding a positive environmental benefit to the new solutions being tested and assessed. While within 2Zero, the innovative mobility concepts considered for decarbonisation should exploit the new vehicle designs and usages patterns that are enabled by CCAM.
Socio-economic and environmental impact analysis	The environmental impacts of CCAM solutions need to be included in their overall impact assessment. But these potential effects of CCAM need themselves to be integrated within the decarbonisation and climate-neutrality objective pursued by the 2Zero Partnership, where they add on with all other efficiency improvement opportunities.
Fleet and (mixed) Traffic Management	The objectives driving the management of fleet and traffic systems shall include environmental aspects such as emissions reduction. They will need to be balanced with other aspects such as impacts on operations and users, and infrastructures needs. Concepts of fleet orchestration shall include an assessment of environmental effects, which will be one aspect within the governance models. Guidance for authorities to prepare and plan for new CCAM services shall go together with authorities’ plans for sustainability and climate-neutrality.

Formats for cooperation:

- Exchange of R&I results obtained within CCAM and 2Zero, both for new technologies and new services, with the understanding that digitalisation and decarbonisation are the two major trends impacting the future of road transport. The SRIA of the two Partnerships will therefore need to be coherent and take into account the evolutions done in the two fields, as they ultimately come together into vehicles and services experienced by the users.
- Joint events and workshops can be organised to promote this exchange or to address specific common topics. Connecting projects and facilitating joint discussions of common stakeholder groups can ensure alignment and foster dissemination and take-up of new solutions across Europe (i.e. supporting jointly the promotion of activities and dissemination of results towards the Member States, cities and regions).
- Potentially set joint calls for specific topics of common interest.

Cooperation between the CCAM and SNS Partnerships

Interface and synergies

The SNS - Smart Networks and Services - Partnership proposal is a follow-up of the 5G PPP activities. One of its key objectives is to enable the full digitization of vertical industries. CCAM was identified as one of the main vertical domains (besides other domains like healthcare and wellness, media and entertainment, smart manufacturing, energy, smart cities, etc.). The 5G Infrastructure Association (5G IA), currently the lead contact partner for the SNS Partnership, has already ongoing collaboration on the CCAM field with stakeholder associations such as ERTICO, GSMA and 5GAA which are also involved in the CCAM Partnership proposal. This link facilitates the interaction and synergetic effects between the Partnerships.

The SNS proposal will further investigate innovative solutions to provide network and device enhancements necessary to support the development and deployment of CCAM enabled mobility solutions. These solutions will use as enablers the technological innovations developed in the SNS Partnership.

Potential fields for cooperation:

CCAM R&I action areas with biggest cooperation potential with SNS:	Cooperation potentials with SNS activities :
Physical and digital infrastructure	Digitised spatial network and regulations Ensuring that the physical, digital and operational infrastructure remains fit for purpose Specifications, requirements and enabling technologies for the digital infrastructure to enable safe and secure operation of CCAM systems
Connectivity/Cooperative Systems	Secure effective connectivity for the needs of CCAM build further on SNS results to allow for early adoption of new connectivity innovations Jointly define robustness and redundancy, availability of communication channels and a minimum quality of service
Fleet and (mixed) Traffic Management	Define clear targets and roles for stakeholders engaging in the mobility system and fleet and traffic management

Further CCAM R&I action areas for potential exchanges and collaboration:

- Remote operation and surveillance
- Develop and demonstrate shared and integrated automated mobility solutions
- Large-scale demonstration of highly automated passenger vehicles
- Large-scale demonstration pilots of Automated commercial / freight vehicles
- Cyber Security
- Artificial Intelligence
- Data storage and sharing

Formats for cooperation:

- CCAM and SNS Partnerships will exchange on their objectives and strategies, in order to reach coherence between their Strategic Research and Innovation Agendas and identify the potential synergies and cooperation domains. The CCAM stakeholder community already includes to some extent representatives of the telecom and network sector (GSMA, 5GAA, ETNO, etc). This link will be reinforced and their contribution will be strengthened during the definition of the SRIA. Further telecom companies and mobile network operators are invited to join the CCAM Partnership.
- The SNS proposal has already planned for Impact Assessment and Facilitation Actions (IAFA) to focus on interactions with adjacent Partnerships, initiatives and Associations to ensure relevance and synergies in both directions. These include the organisation of workshops, supporting the planning of Work Programmes. This will ensure transfer of valuable technical information among Partnerships (e.g. faced obstacles, key achievement, breakthroughs, etc.). Part of the IAFA activities will be related to the CCAM Partnership to exchange such information and have a level of coordination and synchronisation among the two Partnerships. In this context, information and links to related to CEF actions can be exchanged.

Cooperation between the CCAM and AI, Data and Robotics Partnerships

Interface and synergies

“Increased computing power, the availability of large amounts of data and progress in algorithms, smart devices and smart robots, are shaping Artificial Intelligence (AI) as one of the most strategic technologies of the 21st century”. Whilst being a horizontal activity covering all sectors, mobility has been identified as a key application domain where the AI technology enablers can be integrated into concrete systems. The SRIA of the AI, Data and Robotics Partnership has mentioned several topics related to CCAM and more widely to transport, which are incorporated in the table below as clear fields of activities where collaboration between the Partnerships would be very beneficial.

The EC referred in the communication Orientations towards the first Strategic Plan for Horizon Europe³⁰, “The objective is to ensure that all citizens will experience the advantages of AI in daily life, such as traffic optimization and autonomous driving to reduce citizens everyday stress and drastically reduce the number of road accidents, to truly intuitive AI-based systems

³⁰https://ec.europa.eu/info/sites/info/files/research_and_innovation/strategy_on_research_and_innovation/documents/ec_rtd_orientations-he-strategic-plan_122019.pdf

adapting to human needs, to support them in specific tasks, improving their working conditions...”.

The development of CCAM solutions builds upon the progress and directions taken in a number of key technologies addressed by the AI, Data and Robotics Partnership. These are linked to the CCAM Cluster 5 on Key Enabling Technologies. These horizontal technologies are mostly relevant for other application areas. For the specific use in CCAM solutions, dedicated approaches and development paths are needed related to the high risk and challenges in this application area. This includes the strict requirements for the safety, security and trustworthiness of the interactions between road users, vehicles and infrastructures.

The CCAM Partnership aims at a fast uptake of new and emerging knowledge fields identified within the AI, Data and Robotics activities. At the same time the CCAM partnership provides to the AI, Data and Robotics Partnership an early identification of user needs and new challenges raised by the deployment of CCAM solutions. Furthermore, cyber security architectures, harmonisation and a link to legislation in relation to data policy and ethics are needed.

Potential fields for cooperation:

CCAM R&I action areas:	Cooperation potentials with activities in AI:
Artificial Intelligence	Distributed sensing linked into networks in connected autonomous vehicles and AI for situational awareness and predictive perception Develop explainable concepts, techniques and models of Artificial Intelligence for CCAM Machine Decision Making: actions carried out autonomously by an AI-based system Navigation and tracking of autonomous cars Real-time traffic management, city planning Shared automated mobility solutions and logistics services, parking management
Data Storage and sharing	Important interactions on handling, sharing and storing data in a harmonized approach and in a multi-sectoral alignment and uptake Harmonised approach for data sharing based on open and interoperable programming interfaces (APIs) and access control by defined user rights
On-board decision-making	On-board safe, unambiguous, real-time decision-making for CCAM using complex in-vehicle systems with AI as key enabling technology
Cyber Security	Network based cyber secure components and interfaces, operating systems of devices, firmware, communication, application software– from vehicle parts up to the transport infrastructure including the related services

Formats for cooperation:

- The CCAM and AI, Data and Robotics Partnerships will exchange on their objectives and strategies, in order to identify the synergies and cooperation domains. Several stakeholders are engaging in both Partnerships, contributing to the shared visions and actions. Successful innovation is dependent on making connections; connections from market stakeholders to end users and to research and technical experts. These

connections are bi-directional; AI and data sharing are important enablers for CCAM, whilst CCAM is a relevant application area for the AI, Data and Robotics Partnership.

- Exchange of project results could be implemented via Partnership annual events, with dedicated sessions for the connection and collaboration with the other Partnership. This would also allow for a practical exchange of experiences and achievements of actors from both fields.

3.2 Estimated resources for the CCAM Partnership

CCAM will have a remarkable economic impact and therefore play a decisive role in global competitiveness and EU's industrial strategy. According to a 2016 PWC study³¹, connected car technologies generate around 45 billion \$ in customer spending in 2016. Safety and automated driving technologies are the largest categories, accounting for about 61% of the total. It is expected that the revenue from connected car technologies will grow to 156 billion \$ in 2022. Another study estimates that car manufacturers have an additional revenue potential of 30% in 2030 driven by connectivity services and new business models³². According to Boston Consulting Group, the autonomous car market could be a \$42 billion market by 2025, which could be around 12-13% of the total auto market. And the global market for components like cameras or sensors is estimated up to €35 billion and for advanced software and related services up to €18 billion by 2030.

The ambition is to make Europe a world leader in the deployment of connected and automated mobility, and making a step-change in Europe in bringing down the number of road fatalities as well as reducing harmful emissions from transport and reducing congestion. These objectives will not be reached by research and innovation actions alone.

After developing, testing and successfully demonstrating mobility services based on automated driving technologies and cooperative systems, the production and market penetration is the actual key to realize the expected impacts. Connectivity and automated driving bear great opportunities for the industry in terms of mass manufacturing as well as new business models or new mobility services. The technological evolution must meet market needs and customers' expectations.

These require a scale up phase, after the projects and programme finish, with investments in the range of 5 to 10 times the scale of the overall Partnership budget (public and private side contributions). These comprise technology development in high TRL levels (8-9), ramping up manufacturing capabilities and pilot lines, infrastructure investments, and investments in new jobs and skills required.

The Partnership will foster the collaboration of stakeholders in this domain and hence unlock otherwise unused synergies, e.g. in regard to testing:

- OEMs and suppliers will contribute with their fleets of test vehicles and equipment
- Research sector contributes with know-how, innovation and assessment capabilities
- Cities, regions and infrastructure operators provide the foundation for living lab environments to implement large scale testing and demos
- Public transport providers use their fleet and operations to test CCAM services
- Mobile network operators will address (5G) connectivity needs to offer seamless
- Transport industry supports CCAM with their expertise in heterogeneous and complex system landscapes

³¹ Connected Car Study 2016, PwC

³² Bernhart, W. et al., think act - Autonomous Driving, Roland Berger Strategy Consultants GmbH, 2014

This broad contribution leads to a significant larger proportion of in-kind contributions and a strong leverage effect towards market uptake. We estimate that budget commitment of the public side is matched by the financial contribution of the private side. Combined with the in-kind contributions this investment will trigger a leverage effect of at least 5 and hence maximizing the impact of the Partnership.

Beyond the financial dimension, in-kind contributions will also comprise e.g. the engagement in standardisation activities, consultancies, regulatory work and fostering research, public awareness by the partners, resulting in a much wider spread and extended impact of the Partnership.

The members of the CCAM Partnership commit to a common and coherent R&I strategy and the joint objectives (see chapter 2.2). This commitment includes the financial and in-kind contributions for the administration and execution of the work programme as well as the necessary actions to support:

- creating an innovation-friendly ecosystem for CCAM;
- removing barriers to implementation; and
- accelerating market-uptake.

As all the partners in this Partnership commit to the general and specific targets, their contribution to the association (membership fees) will be used to finance and facilitate these. Besides the R&I work programme for CCAM, this will involve

- actions to raise awareness with users, communities, regional and national level, and European level (EUCAD conference, TRA Conference, Digital Transport Days);
- dissemination addressing all relevant stakeholders across Europe (with special focus on EU13);
- accelerating implementation with specific dissemination towards high level decision makers for transport policies;
- guidance to education developments for (software) engineers in the area of CCAM; supporting re- and up-skilling of work force in related industries

Due to the nature of the Partnership setup and stakeholder community the core asset of the resources provided by the private side will be In-kind contribution for operational activities (IKOP).

Hence IKOP reflects the cash investment of these parties that is spend beyond the work that is foreseen in the SRIA. Depending on the stakeholder, this can be preparatory research that is conducted by to study perquisites of testing as well as access to essential test infrastructure to form a living lab. It is clear that all stakeholders need to invest their IKOP to provide a meaningful contribution to the Partnership. This commitment enables and ensures the collaboration within the Partnership.

IKOP contributions to the Partnership can be transparently quantified in a semi-standard procedure in the context of the reporting that is well established in existing partnership. This allows to assess and trace members commitment to the partnership.

To conduct the work that is outlined in the scope of the Partnership and to manifest the impact that CCAM will have an overall budget of EUR 1200 million is needed. This figure includes the contributions from both the public and private side.

3.3 Governance

The objective of the Partnership is to bring all the relevant stakeholders together around a shared vision, and to define together the objectives and the priorities. The governance of the Partnership shall enable this coordination, and do it in an efficient, open, transparent, timely and lean way.

The governance shall both organise the representation of the stakeholders of the Partnership within an association and set up the process for exchanging with the European Commission services. **The rules of a Co-Programmed Partnership operating under the Horizon Europe programme will be followed.** The governance described below presents its main structure and functioning: its detailed functioning and decision-making will be further elaborated during the setup of the Partnership, when the Proposal will be accepted, and in particular during the phase of creation of the association.

Governance of the association

All stakeholders of the Partnership shall be gathered within a non-profit association to be created for this purpose. For full openness, all stakeholders willing to contribute to the Partnership shall have the opportunity to join this association. Membership to the association will be open to all types of organisations listed in chapter 2.4. European associations will also be entitled to join the association.

All members will be gathered in the **General Assembly** of the association, which will be responsible for endorsing documents and decisions, ensuring information to all and the transparency of the activities. Its decision-making process will be governed by the Statutes of the association. The preparation of research recommendations, which is a key activity of the Partnership, will start at the level of the General Assembly, gathering input from all the members, before being processed through the Delegation (see below). Activities will follow the Vision and objectives of the Partnership and will work on the implementation of the Strategic Research and Innovation Agenda (SRIA). To fulfil its objectives, the General Assembly may decide to create specific working groups or task forces in order to address specific topics or to manage a specific activity.

The General Assembly will elect its **Executive Group**, composed of a Chair and Vice-Chairs, who will be responsible for the daily management of the association, to chair the meetings, and to represent the association towards the European institutions, and for any other external representation required for the operations of the association. The detailed nomination rules for this Executive Group will be governed by the Statutes of the association. Its composition shall reflect the different types of stakeholders represented in the association membership.

Out of the members of the General Assembly, a precise number of representatives will be selected to act as a Delegation of the association in the Partnership Board, the body where the stakeholders of the Partnership meet with the European Commission services (see below).

The **Delegation** will include representatives of the different sectors involved in the Partnership, ensuring a balanced representation of the different types of stakeholders. Its members will be selected from the General Assembly. The detailed nomination rules shall be governed by the Statutes of the association. The Delegation will include the members of the Executive Group, who will chair the meetings. Proposals for research topics to be funded by the Partnership will be collected from all members of the General Assembly, to guarantee openness, and the role of the Delegation will be to bring these proposals to the Partnership Board in order to discuss them with the EC services. The Delegation will report back to the General Assembly about the discussions and outcome of the Partnership Board meetings, in order to provide information to all stakeholders and guarantee the transparency of the process.

Governance of the Partnership

The **Partnership Board** will be the body formed by the Delegation of the association and representatives of the European Commission services. It will discuss the research priorities and provide recommendations for topics to be implemented by the annual Work Programmes. This exchange shall ensure that topics to be funded contribute to achieve the vision and the objectives of the Partnership, and follow the roadmap set in the Strategic Research and Innovation Agenda (SRIA). The Delegation will bring its expertise and knowledge of the latest R&D activities happening within their organisations and at national or local level where they are also active, while the European Commission services will ensure that the topics are in line with the public interest and with the latest European policies and strategies, and that there is coherence with the overall EU research framework. All partners should also look for complementarity and good coordination with other parts of the Horizon Europe programme, both within the Energy, Climate Change and Mobility cluster and with other clusters, especially with other Partnerships addressing where synergies have been defined, as explained in chapter 3.1. The meetings of the Partnership Board will be called by the European Commission services according to the planning of the Work Programmes definition, to allow a timely consultation and drafting work.

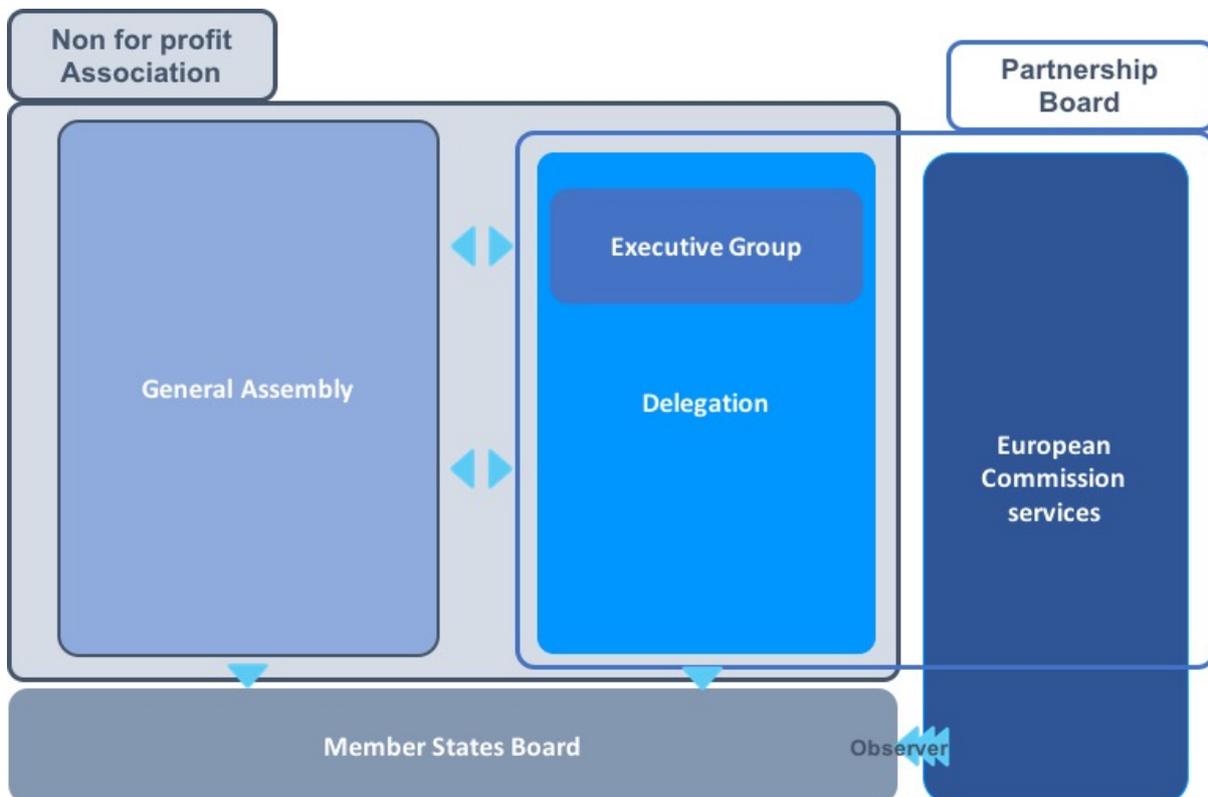


Figure 8: Governance of the Partnership

In addition to the meetings of its bodies and the process of identifying research priorities, the association will organise public events, open to non-members of the association, in order to publicise the activities of the Partnership, disseminate its results, and promote further collaboration with additional actors. Such public events could take the format of a conference or of thematic workshops, and could include external invitees and be open to international participants, as judged relevant. Such events will contribute to the openness and the transparency of the Partnership.

Joint activities could also be organised together with other Partnerships operating under Horizon Europe, in order to address common topics and promote coordination and collaboration across several research fields. Such joint activities will be decided and prepared in cooperation with the respective European Commission services.

Specific activities could also be organised towards the EU-13 countries, in order to disseminate information and promote participation. Through its openness, the association will welcome stakeholders from these countries within its membership. Existing networks (listed in chapter 2.4) already aim at involving them and will support this effort. In particular the European associations that are supporting this Partnership proposal have a wide geographic coverage in their membership, with many members from the EU-13 countries: they will provide information to them and encourage them to join the activities. Also the associations representing public authorities will help to reach that wide geographic coverage of the European Union, through their members in all countries. This includes the national level (such as road authorities represented in CEDR) but also the local and regional authorities, which are involved in networks such as POLIS and Eurocities. Authorities from southern and eastern Europe are active in these associations and will get informed and encouraged to join. The same goes for associations representing the researchers, such as ECTRI, FEHRL and EARPA: their membership include research institutes and universities from all over Europe, that will be informed thanks to their communication channels. Beyond this role of information sharing, it is by networking that a wide participation can be promoted: it is thanks to participation in the association meetings and public events that the different stakeholders will meet with each other and will identify potential partners to build collaborative research activities.

Involvement of Member States

The participation of national authorities in the Partnership is of high importance to reach further coordination and maximize societal benefits: the governance of the CCAM Partnership should therefore adopt a specific strategy to ensure their involvement. However, one has to acknowledge that there is a high variety of situations across the European Union. Firstly, the EU Member States have various levels of involvement in the field of CCAM, and they also have different focus interests, depending on their national strategies and policies. These national preferences need to be respected. Secondly, there are in each country a different set of institutions and actors involved in the management of CCAM activities, representing public authorities and road operators, as described in chapter 2.4. These different national portfolios require flexibility in the governance principles, to allow the participation of these various national actors, with a range of activities adapted to their needs.

The involvement of Member States and associated countries could take place in two ways:

- Participation of national Ministries or agencies **as partner** in the activities: both at the strategy level, by being member of the association and participating to its activities of roadmap (SRIA) update and regular monitoring, and at the operational level, by being partner in projects and performing research activities together with other stakeholders. In particular infrastructure managers and local authorities have a key role to play as direct partner in the Partnership because of their ability to mobilise infrastructures and actors of their local innovation ecosystem. They can join projects and provide their expertise on how to integrate technologies to the local mobility needs and constraints, and providing opportunities for testing and demonstration activities. As partners, a key interest of national authorities also comprises validation and verification of CCAM functions and the European framework for testing on public roads. For these objectives, the competent authorities within the Member States should coordinate their efforts with the help of appropriate Horizon Europe funding instruments, such as Coordinating and Support Actions (CSA).

- **Participation as member of a CCAM Member States Board** gathering representatives of EU Member States (and open as well to Associated Countries participating to the Horizon Europe programme). This Board of national representatives would be formed only by Ministry officials responsible for CCAM activities, or national public organisations formally nominated by these Ministries to represent them. This CCAM Member States Board shall meet once or twice a year, together with the Executive Group members of the association (Chair and Vice-Chair). Its objective is to develop a multidirectional dialogue and information sharing between the European and national levels: to receive reports about the European activities of the Partnership and to provide information about activities taking place at their national level. Exchange among Member States themselves is also of high interest: being aware about strategies, testing and demonstrations taking place in neighbouring countries can enable cross border collaboration. Thus, going beyond information sharing, this Member States Board would have a role of promoting coordination between the European and national R&I funding, and among national programmes.

Regarding legislation and regulations, the Partnership will not take itself an active role in legislative and regulatory actions, which are the responsibility of national, European and international bodies. The same goes for standardisation, where international standardisation bodies play a key role. This is necessary to avoid duplication of efforts or any question on underlying competences or responsibilities. However, scientific background, knowledge and recommendations resulting from projects (and the entire programme) will be disseminated³³ to responsible authorities, in particular through the MS Board, to all the participating Member States representatives. Moreover, the Partnership will support and promote international harmonisation by sharing information and dissemination of projects results to all the partners active in the Partnership, towards reaching a wide range of European Member States and Associate Countries.

The active involvement of the Ministries of the Member States as ‘partner’ and as ‘**Member States Board member**’ in the Partnership will ensure a less fragmented and a more coherent landscape of European and national R&I programmes for CCAM. The alignment with the CCAM Partnership on objectives and scope of activities, and the information exchange and cross-fertilisation of results, is an essential interest of national authorities for this Partnership. Many EU Member States representatives have already expressed their interest to be involved during the preparation phase of the Proposal and through the public consultation. The Member States which have expressed such support and willingness to be involved are so far: Austria, Belgium, Czech Republic, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Netherlands, Norway, Spain, Sweden, UK. More countries are expected to join this list in the coming months, towards ensuring a very large geographical coverage of the EU.

Member States also provide guidance on policies, societal needs and public expectations regarding CCAM, and host large-scale demonstration projects. Existing formats of exchange on these topics, such as the High Level Dialogue on Connected and Automated Driving, and the CCAM Platform, may provide important contributions to coordination. In so far as it is possible, the complementarities with these groupings will be used. However, they are not institutionalised for the full duration of the CCAM Partnership, and hence, to provide room for a Member States Board can complement these actions and be a significant contribution to the recognition and success of the Partnership.

³³ In addition to the usual channels of the EC and INEA for Horizon framework programmes

3.4 Openness and transparency

This Partnership has the objective to involve all the stakeholders involved in the development of CCAM technologies and services, so by nature such a Partnership cannot have a narrow composition of partners but in the opposite aims at bringing together the various actors that play a role in CCAM development and testing. It is the main objective of such a Partnership to enable this collaboration of players, and its multi-stakeholders nature represents its key added value compared to a standard R&D funding. Therefore, the governance will be designed as very open and lean, in order to enable a wide participation of all the needed stakeholders.

And since the field of connectivity and automation is evolving very fast and new unforeseen developments could happen in the coming years, the governance will provide the openness to allow additional stakeholders to join the Partnership during its lifetime. So the membership will not be fixed at the start but will stay open, so there will be no barrier to the involvement of newcomers.

The membership of the association will therefore be opened to all stakeholders willing to contribute to the Partnership. Since the aim of the EU R&I Framework Programme is to provide benefits to European citizens, the participation shall however be restricted to organisations performing activities in the European Union, or in countries associated to the Horizon Europe programme. So the members of the association shall respect the following basic criteria:

- share the common vision and objectives of the Partnership;
- demonstrate research activities within Europe (EU MS and Associated Countries to HE);

Membership to the association will be open to all the types of organisations listed in chapter 2.4. European associations will be entitled to join the association. So the association will take as members both associations and single organisations.

The association will aim at a very wide membership mixing researchers, industry and public authorities. This Partnership proposal is already supported by all the major European associations involved in CCAM research activities. Information about the Partnership and the setup of its governance will be disseminated through the communication channels of these associations, which are able to reach hundreds if not thousands of stakeholders all across Europe, with a wide geographical coverage also covering the EU-13 countries, as described in the previous chapter.

There will be a high diversity of actors. Industry will be involved both at the level of large industry players such as vehicle manufacturers, suppliers and telecoms as well as open for SMEs to join. To reach smaller automotive suppliers and SMEs, associations like CLEPA and its national members will have a key dissemination effect, allowing to reach small actors from their national networks. And the national and regional clusters and platforms active in the CCAM field will also help for this objective of reaching more actors. Several of these regional clusters have already communicated their intention to contribute to the Partnership. Moreover, the local testing organisations, which usually include small local players, will enable their involvement in the EU R&I activities through their own participation.

In addition to the automotive industry players, other industry sectors need to be involved as well, as described in chapter 2.4: in particular the ITS and telecom sector, whose large and smaller companies can be reached through the help of European associations such as ERTICO ITS Europe, GSMA, and ETNO. For other sectors where synergies with other Partnerships have been identified, as listed in chapter 3.1, a coordination with the CCAM Partnership will be developed, to promote participation of actors across the programmes. For researchers, all types of organisations will be welcomed: private research providers, publicly funded research institutes, and universities. Associations such as ERTICO, EARPA, ECTRI, FEHRL will help to inform them. For authorities, the different levels will be targeted: national bodies, such as

road operators and managers, will be very key players, as highlighted in previous chapters. But also regional and local authorities: existing networks for innovation at the regional and local level, such as POLIS and Eurocities, will be used to reach these local actors. For operators of public transport, the international association of public transport UITP is involved in the proposal and will inform its members about the Partnership and encourage them to take part in the R&I activities. For operators of commercial road freight and passenger transport, the IRU (International Road Transport Union) is involved in the proposal and will inform its members about the Partnership.

For representatives of users, associations will also be used to reach the users representation bodies, which are often organised at national level. For example, the FIA gathers national associations of mobility users from all the EU: the involvement of users' representatives in the setting of R&I priorities and within projects can ensure that the Partnership is well aware and assess systematically the aspects of users acceptance and involvement. Moreover, user representation bodies like the FIA and its members can help to raise awareness of CCAM amongst citizens and users. This can be achieved through general awareness raising in media or via more targeted awareness raising campaigns, showing citizens and users which opportunities new technologies and services can bring to them, offering them the opportunity to see and experience by themselves how the technology works, and nurturing public debate about its potential benefits and drawbacks.

To ensure openness, the association will be a new dedicated legal body, created to represent the stakeholders of the Partnership. It will take the legal format of an international non-profit association, registered under Belgian law. For the objective of openness, the annual membership fee will be as low as reasonable, only to guarantee the activities to be performed by the association, to reach a financial equilibrium and comply with legal and fiscal requirements, and to ensure the continuity of the activities along the lifetime of the Partnership. Membership fees will be differentiated between private and public organisations, and between large and small organisations, to represent a fair contribution for the different types of actors, and be a low entry point. A cost range between 500 and 5.000 Euros is envisaged at this stage. So, large industry players will pay the highest level of membership fee, while SMEs, universities and local authorities will pay the lowest level. But the exact amounts for the different membership categories will be discussed during the creation of the association, which is pending to the acceptance of the Partnership proposal. Anyway, such very low membership fee should not be a barrier for smaller players such as small universities, SMEs and startups to get involved.

During the implementation phase of the Partnership, for establishing research priorities and agreeing on recommendations to the annual Work Programmes, an open consultation of all members will be organised: so all stakeholders will have the opportunity to provide their research priorities and contribute to the design of the Partnership activities. This could be done via the collection of interest from the members for collaborative research activities they would like to be involved in the next years. Such exercise could be done every year, or every two years, depending on the needs of the Work Programme preparation. This approach is already implemented by public-private partnerships throughout Horizon 2020 and it is a good practice that can be applied for the field of CCAM. It helps to see what the main trends among the stakeholders are, and which priorities are highlighted by the stakeholders. It also supports the networking among actors, who through this exercise can see which other stakeholders are interested by the same research topics. So this activity has a high added value for the partners, and should be highlighted to promote the participation in the association.

It is only for the sake of efficient discussions that a Delegation with a limited number of representatives, representing the different types of stakeholders, will meet with the European Commission services at the meetings of the Partnership Board. This Delegation will report back about the discussions to all the members of the association, to provide transparent

information to all. The Delegation will include a fair representation of the different stakeholders represented in the association.

Beyond the involvement in the association, full openness is guaranteed by the nature of the Co-programmed Partnership instrument, which uses the normal rules of participation for open calls of the Horizon Europe programme. So being member of the association will be encouraged but is not a condition to participate to projects funded by the Partnership. Any organisation complying with the rules for participation in Horizon Europe can reply to the calls and submit a proposal. By experience from the Contractual Public Private Partnerships running under the current Horizon 2020 programme, one can see that a majority of partners in projects are not member of the association: so this approach ensures full openness and flexibility, and there is no restriction done for newcomers and small entities.

The Partnership commits to organise on a regular basis dissemination events such as public conferences or thematic workshop, in order to communicate publicly about the activities of the Partnership. Participation to such events will not be restricted to the members of the association, and there will be no registration fee. The objective of such events would precisely be to disseminate information wider than the already participating stakeholders, in order to reach actors not yet involved. So such events will contribute to both the transparency and the openness objectives. Workshops could for example be organised on priorities newly identified, which were maybe not very visible at the beginning of the partnership but found to have high importance later during the partnership lifetime. Such activities would then help to identify new actors, to call for coordination, or to get integrated within the activities.

Projects funded by the Partnership will commit to publicise their activities, via websites open to the public, social media activities, and any other means that will seem appropriate. Such activities will however depend and be described case by case by the individual project agreements, and will follow the provisions of the Horizon Europe programme.

Projects funded by the Partnership will also be encouraged to use and contribute to the EU-wide knowledge base on CCAM, to the common data exchange framework, and to the common evaluation framework, which are highly relevant activities to support the objectives of the Partnership and will therefore be further developed by the partners.

Regarding the involvement of international actors, links should be established through the public events such as conferences and workshops, where international representatives could be invited as speakers or guests.