D6.4

Update of Plans, targets and activities on international level for implementing connected and automated vehicles

SCOUT

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Executive Summary

A coherent funding strategy for Connected & Automated Driving will accelerate progress in deployment of Connected and Automated Driving worldwide. Furthermore, to keep Europe competitive it is important to be up to date on funding strategies worldwide, with emphasis on the US, Japan and China. A prerequisite for this is an analysis of existing international funding programmes for the development and implementation of connected and automated driving technologies. This report looks at the currently available funding budgets on an international level in light of the global competition.
European funding in Horizon 2020 and the Connecting Europe Facility amounts to approx. €240 million per year together as shown in Deliverable 6.1. In comparison, the US spends around USD137 million (€122 million) per year for research related to connected and automated driving. Most funding is undertaken by the Department of Transport; other awarding authorities include the Department of Energy and the National Science Foundation, but there are also effort taken on a state level. Japan invests JPY2.45 billion (€20 million) annually in connected and automated driving related to the major funding programme (SIP-ADUS). In China, the “Made in China 2025” programme, the equivalent to Europe’s “Industry 4.0”, is a USD300 billion-heavy programme that also partially tackles connected and automated driving.
The present report delivers input for the update of the Roadmaps on Automated Driving of ERTRAC and EPoSS.
In 2018 there are now big new funding programmes known, but several initiatives were identified in the respective countries. The content of these programmes and initiatives strive to advance the harmonization of automation and communication technologies (across different transport modes) in the US and Japan. Japan has extended a testing project with a consortium of European and Japanese firms until 2022. They also address the interaction of humans and the technology especially in the US. There is a strong highlight by the US government to enable people with disabilities to use automation technologies, increase the accessibility for all and allow the completion of journeys without any barriers. China issued a new strategy to become the global product leader in the sector of intelligent vehicles by 2035.

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1 Introduction

Connected & Automated Driving (CAD) promises dramatic benefits and exciting competitions. It will change our way of living as well as the entire nature of transportation but co-operation along the value chain and across sectors is a prerequisite for this. As a consequence intense and useful competition arises not only between technologies or companies but as well between legal systems, countries or even multi-national markets. Further global trends like urbanization, higher sustainability standards or ageing population increase the demand for innovation and strategic thinking.
A coherent public strategy for Connected & Automated Driving can accelerate progress and deployment through sharing of knowledge and resources also in an international context and to achieve political and socio-economic goals and it is also important to stay competitive in a global context. The basis for such a strategy is the "big picture" of existing strategies and initiatives on global activities in the most relevant regions such as the US, Japan and China. The objective of SCOUT and in particular of this report is to contribute to this big picture an overview of recent or current funding activities as well as approaches for the involvement of users, businesses and public authorities in the strategy development for automated driving[1].

2 Private and public investments in R&D

In the EU, besides public funding schemes related to connected and automated driving, the automotive industry is also a big investor regarding R&D in Europe.

In the US there is also a lot of R&D money coming from private investors. Considering, that information technology is a key competence for CAD it is noteworthy that worldwide and in particular in the US, the Software & Computer Services sector shows the highest one-year growth rate (12.8% and 13.1%, respectively). This sector is clearly dominated by the US companies which account for 77% of the total world R&D. Large companies such as Facebook and Google, showed big changes in their R&D investments (88.4% and 24.3% respectively). Also many software companies from China showed double digit R&D growth, e.g. Baidu (69.9%) and Tencent (52.2%).

The financial resources for ongoing and increasing R&D investments are far from running dry: Just the five US companies Apple, Microsoft, Google, Cisco and Oracle are holding cash reserves of nearly € 500 billion together. Apple alone holds more than €200 billion: Much more than the stock market value of many European automotive core companies.

[1] An up-date of this report is scheduled in month 20 of SCOUT.

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3 International public funding

3.1 United States

In January 2016 during the Obama administration the proposed budget to be spent over the next 10 years on R&D on driverless technologies and related infrastructure developments was USD 4 billion[2]. It is uncertain whether these bold investments will be continued in the current administration. As a reaction federal states, e.g. California, might counteract locally.

Multiple policy efforts set different targets, roadmaps, plans and outlooks on automation and connectivity of vehicles. Responsible for most of the federal funding schemes is the Department of Transportation (DOT) and its sub-organisations such as the National Highway Traffic Safety Administration (NHTSA), the ITS Joint Program Office (ITS JPO) and the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Transit Administration (FTA). Further major awarding authorities include the Department of Energy (DOE) and the National Science Foundation (NSF).

3.1.1 Department of Transportation

The US DOT published its ITS Strategic Plan 2015-2019 describing “Realizing Connected Vehicle Implementation” and “Advancing Automation” as the primary technological drivers of current and future ITS work. The Automation Program is organised along 5 major tracks (Figure 1).[3]

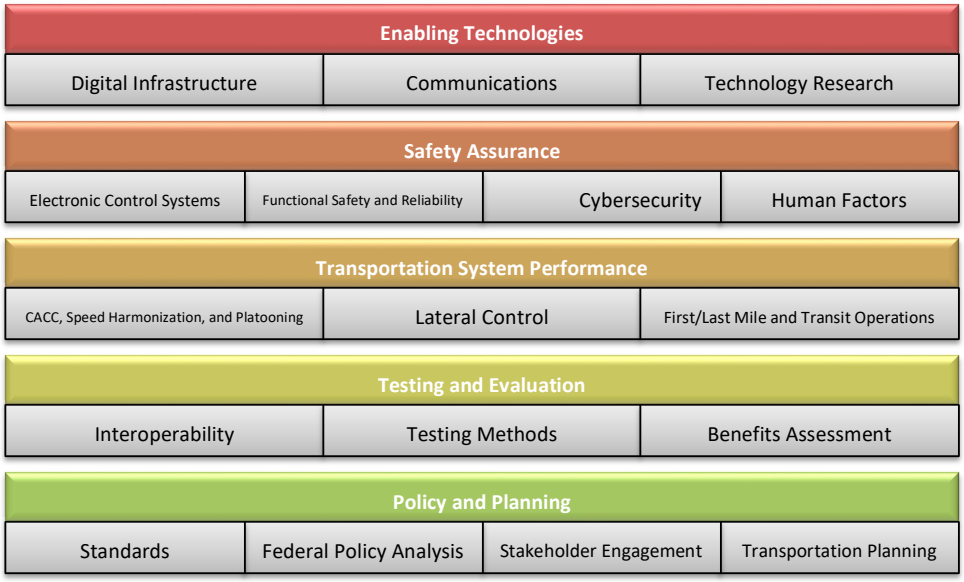

Figure 1: US DOT ITS JPO Automation Program research tracks

[2] https://www.nytimes.com/2016/01/15/business/us-proposes-spending-4-billion-on-self-driving-cars.html?_r=0

[3] Dopart, Kevin (2016): U.S. DOT Automation Program Update – EU-US-Japan Trilateral Working Group on Automation in Road Transportation. Presentation at Automated Vehicle Symposium 2016 on July 22, 2016 in San Francisco, USA.

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3.1.1.1 Strategic programmes

Federal Automated Vehicles Policy

The policy was issued on September 20, 2016 and puts forward a uniform set of rules for all 50 states. Its goals are to boost automated/autonomous driving technologies to reduce human error and address infrastructure problems. It is based on the following four pillars:

1. Vehicle Performance Guidance for Automated Vehicles
2. Model state policy
3. NHTSA's current regulatory tools
4. Modern regulatory tools

In January 2017 10 cities were designated automated vehicle proving grounds that are foreseen to openly share best practices on automation research to accelerate the safe deployment of automated cars. A further focus is put on the optimal big data use. The 10 proving grounds are:

5. City of Pittsburgh and the Thomas D. Larson Pennsylvania Transportation Institute
6. Texas AV Proving Grounds Partnership
7. U.S. Army Aberdeen Test Center
8. American Center for Mobility (ACM) at Willow Run
9. Contra Costa Transportation Authority (CCTA) & GoMentum Station
10. San Diego Association of Governments
11. Iowa City Area Development Group
12. University of Wisconsin-Madison
13. Central Florida Automated Vehicle Partners
14. North Carolina Turnpike Authority[4]

Beyond Traffic 2045*

Beyond Traffic 2045 is the US DOT's 30-year framework on the nation's transport and traffic system. It is a non-binding policy brief that was formulated in early 2015 after inviting the American public – including users, developers, owners, and operators of the transportation network and the policy officials – to involve in a discussion on the shape, size, and condition of that system and how it will meet the society's needs and goals. It focuses on the critical decision points that the US face, through the analysis of data-driven, research, expert opinions, and public participation.

The themes covered are:

- How we move (automated shared use vehicles)
- How we move things (urban freight delivery)
- How we adapt (inductive wireless charging)
- How we move better (connected vehicles)
- How we grow opportunity (free public WiFi in public transportation)
- How we align decisions and dollars (unified traffic or transportation data analytics platform)[5]

The Road Ahead – The National Highway Traffic Safety Administration (NHTSA) Strategic Plan 2016-2020*

Driven by the need to reduce the number of traffic fatalities and increase the overall traffic safety, the NHTSA has formulated five overarching strategic goals to pursue between 2016 and 2020:

1. Safety
   - Objective 1: Reduce fatalities and injuries

[4] https://www.transportation.gov/briefing-room/dot1717

[5] https://www.transportation.gov/BeyondTraffic

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- Objective 2: Increase survivability from crashes
- Objective 3: Reduce economic costs

2. Proactive Vehicle Safety
   - Objective 1: Promote the Proactive Safety Principles
   - Objective 2: Retool recalls
   - Objective 3: Inform and empower consumers
   - Objective 4: Coordinate global road safety
3. Highly Automated Vehicles
   - Objective 1: Provide national leadership for the safe deployment of automated vehicles
   - Objective 2: Provide federal leadership for the deployment of vehicle-to-vehicle communications
   - Objective 3: Enable a robust, layered framework for vehicle cybersecurity
   - Objective 4: Democratize safety technologies
4. Human Choices
   - Objective 1: Promote innovative solutions for behavioral safety
   - Objective 2: Leverage law enforcement partnerships
   - Objective 3: Provide oversight and guidance to state highway safety offices
   - Objective 4: Provide assistance and oversight to state departments of motor vehicles
5. Organizational Excellence
   - Objective 1: Properly identify human capital needs
   - Objective 2: Improve NHTSA's ability to deliver quality data and analysis
   - Objective 3: Ensure NHTSA has state-of-the-art information systems
   - Objective 4: Improve financial performance[6]

Additions in 2018:

Accessible Transportation Technologies Research Initiative:
The initiative addresses accessibility-for-all in automated transport through research and development. People with disabilities comprise 20% of the US-population. Still today, they face many challenges in transport and mobility. To complete trips, people with disabilities in the US shall benefit from new technologies, simplifying the access and exit of vehicles, the planning of trips as well the operation of vehicles and the safe and ensuring safe intersection crossing for pedestrians with disabilities.

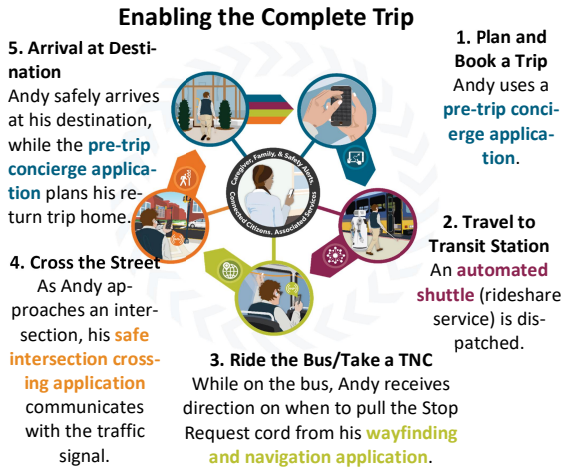

Figure 2 Enabling the complete trip (USDOT 2018)

[6] U.S. Department of Transportation National Highway Traffic Safety Administration: The Road Ahead – National Highway Traf- 016

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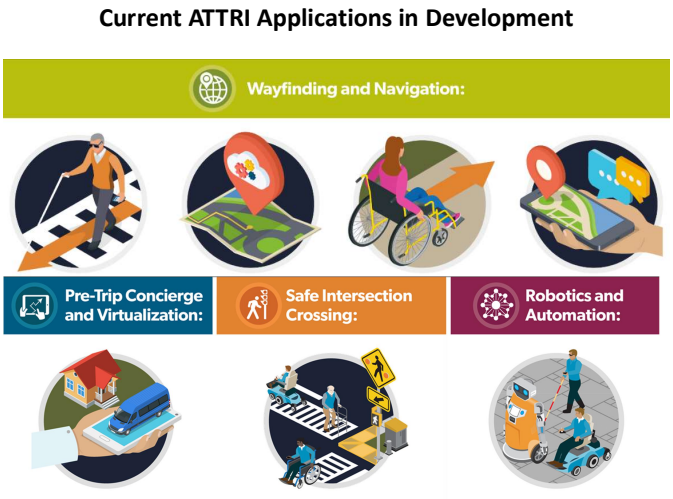

Figure 3: Current ATTRI Applications in Development

Data for Automated Vehicle Integration

Voluntary data exchanges to accelerate the safe integration of AVs around a framework for commercial and private users. The initiative is aiming at increasing cybersecurity.[7]

Automated Low-Speed Shuttles

Figure 4: Working Group Member Communities (US DOT 2018)

[7] https://www.transportation.gov/av/data

*not entirely related to C&AD

The initiative aims at promoting shuttles in small, early-deployer-communities. The initiative monitors and documents the impact and application to learn from the early-deployment pilots.

Impact Assessment

The impact assessment covers topics such as

- energy emission, Mobility/energy/emissions modeling on a freeway
- Safety baseline development
- System dynamics of broader impacts
- International collaboration on Key Performance Indicators
- Economic factors (GDP growth, exports)
- Workforces impact (employment, wages)

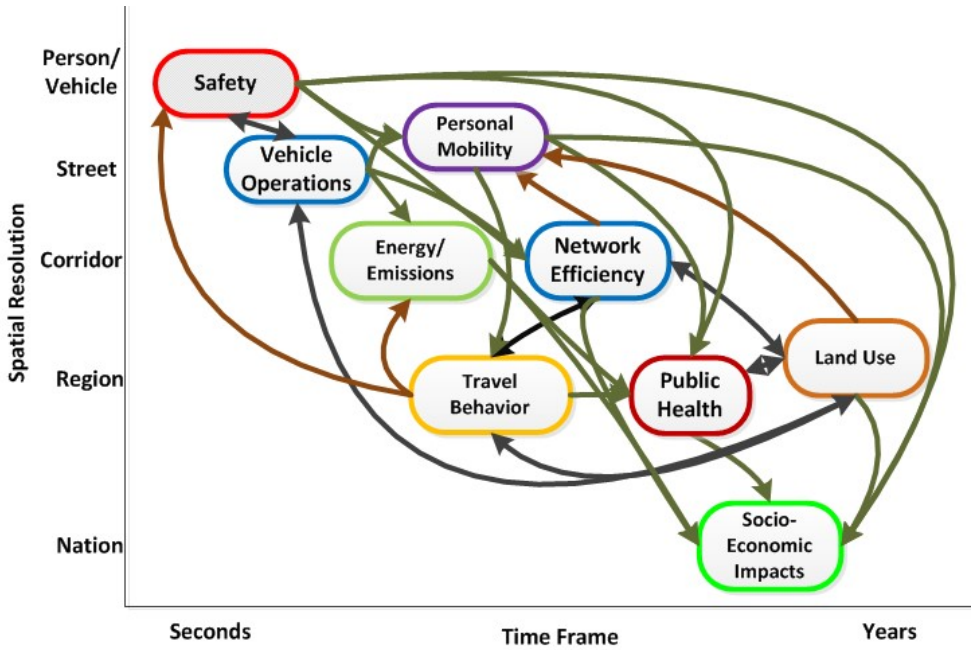

Figure 5: Impact Assessment (US DOT 2018)

FHWA: Cooperative Automation Testing

In corporation with VDOT and Transurban, the FHWA is testing trucks in platooning to find out about combination of speed harmonization, vehicle platooning of five vehicles, and cooperative merging at an entrance ramp for a single-lane test facility.

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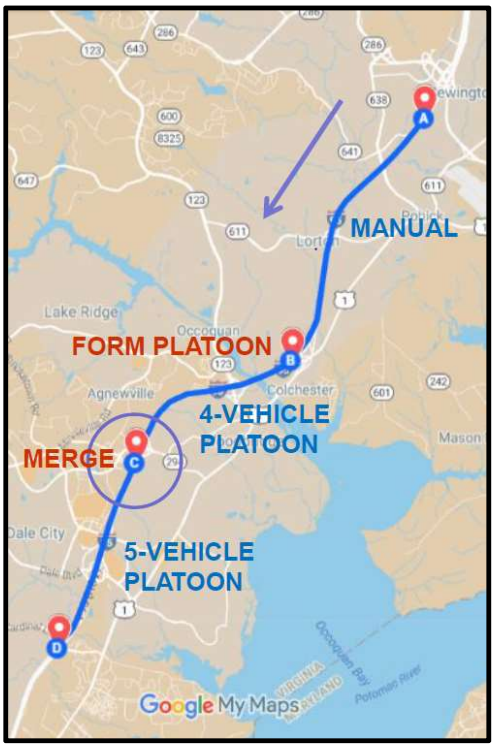

Figure 6: FHWA-Test Track (US DOT)

FHWA: Scenario Planning for Connected and Automated Vehicles

Through workshops scenarios shall be constructed, that will help to elaborate a Practitioner guidance/guidebook, with a qualitative assessment of impacts. This allows the derivation of policy implications.

Figure 7: Scenario Building Blocks

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FMCSA: Development of Baseline Safety Performance Measures for Automated CMVs
The goal of this initiative is the creation of a baseline against which the safety of automated commercial mid-sized vehicles can be tested.

FMCSA: Sensor Guidelines for Automated CMV Applications
The aim of this initiative is to carry out performance and maintenance research for add-on sensors supporting various levels of automation on CMVs

FRA: Automated Vehicles at Highway-Rail Grade Crossings
The Federal Railroad Administration wants to find out, how automated cars could perform safe railcrossings by communication with trains.

Strategic Transit Automation Research Plan
There are seven demonstrations planned through 2022 for automated transit. Therefore, today the initiative has research progress in user acceptance and human factors for the design, requirements of test facilities, a policy review as well as in the technology necessary to conduct testing of automated transit busses.

MARAD/FMCSA: Feasibility Study: Low-Speed Automated Truck Queue at Ports and Warehouses
MARAD/FMCSA are about to explore application of automation to low-speed commercial vehicle operations at port terminals and warehouses.

NHTSA: Driving Automation Communication of Intent with Shared Road Users
The initiative researches on the necessities for communication between vehicles and shared road users. Especially, social interaction strategies are created and conduct studies in order to test the solutions.

NHTSA: FMVSS Considerations for Vehicles with Automated Driving Systems
The aim is to research and identify barriers for self-certification without human control and compliance verification. Four possible designs are translated into regulatory text.

PHMSA: Carriage of Hazardous Materials by Automated Vehicles
The initiative from the Pipeline and Hazardous Materials Safety Administration aims at applying automation for hazardous materials transportation. For this purpose, risks of paring automation technologies and hazardous materials need to be defined in a study in the framework of this initiative.

3.1.1.2 Funding programmes

Connected Vehicle Pilot Deployment Program
Sponsored by the ITS JPO the DOT awarded three cooperative agreements collectively worth more than USD 45 million to initiate a Design/Build/Test phase of the Connected Vehicle Pilot Deployment Program on 1 September 2016. The three sites chosen are Wyoming, New York City, and Tampa. The program aims at deploying, testing, and operationalizing cutting-edge mobile and roadside technologies and enabling multiple connected vehicle applications. In phase 2 the three selected pilot sites will embark on a new 20-month phase to design, build, and test the nation's most complex and extensive deployment of integrated wireless in-vehicle, mobile device, and roadside technologies (see Figure 8).

The goals of the program are: accelerate the early deployment of CV technology, understand and estimate benefits associated with deployment, identify and solve key issues related to technical and institutional barriers, reducing congestion and greenhouse gas emissions, and cutting the unimpaired vehicle crash rate by 80%.

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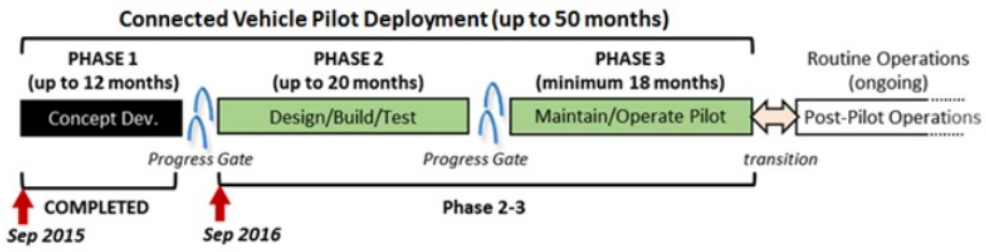

Figure 8: Program schedule of the Connected Vehicle Deployment Program[8]

Budget: USD 45 million

Smart City Challenge*

Building on the Beyond Traffic 2045 framework the DOT launched the so-called Smart City Challenge in December 2015 asking mid-sized American cities to develop ideas for an integrated, smart transportation system that would use data, applications, and technology to help people and goods move more quickly, cheaply, and efficiently. Out of the 78 applicant cities that initially applied by sharing the challenges they face and ideas for how to tackle them, seven cities – Austin, Columbus, Denver, Kansas City, Pittsburgh, Portland, San Francisco – were short-listed and asked to sharpen their concepts. An overall USD 40 million were granted to one winning city: Columbus, Ohio.

Despite of the fact that there was only one winner, the participating cities leveraged an additional USD 500 million in private and public funding to help make their Smart City visions real as well. In addition, in October 2016, the Department announced an additional USD 65 million in grants to support community-driven advanced technology transportation projects in cities across America, including 4 of the finalists in the Smart City Challenge.[9]

Based on the themes put forward within the Beyond Traffic 2045 framework the participating cities conceptualized their ideas along the framework's themes. In the following it can be seen that automation and connectivity are the themes tackled most:

- How we move (automated shared use vehicles) – 44 cities
- How we move things (urban freight delivery) – 11 cities
- How we adapt (inductive wireless charging) – 17 cities
- How we move better (connected vehicles) – 53 cities
- How we grow opportunity (free public WiFi in public transportation) – 9 cities
- How we align decisions and dollars (unified traffic or transportation data analytics platform) – 45 cities[10]

Budget: USD 40 million

Road to Zero Coalition*

The Road to Zero initiative was launched in October 2016 by the National Safety Council (NSC), Federal Highway Administration, Federal Motor Carrier Safety Administration and National Highway Traffic Safety Administration with the goal of eliminating roadway deaths within 30 years. The NSC is dedicating USD 1 million over three years for the program.

[8] https://www.its.dot.gov/pilots/pilots_overview.htm

[9] https://www.transportation.gov/smartcity

[10] https://www.transportation.gov/smartcity/six-themes

*not entirely related to C&AD

The grant program was announced in December, and NSC received 62 applications amounting up to more than USD 8 million. The top seven, totaling USD 1 million, were chosen for the first Safe System Innovation Grants awarded in mid-2017.

The coalition set itself the task to:

- Examine and promote current behavior-change strategies and improve their effectiveness
- Be more intense and coordinated in its response
- Develop a zero-traffic-deaths scenario through strategic deployment of self-driving cars; this will reveal needs that haven't been considered and create a planning tool for policymakers and traffic safety organizations
- Provide funds to traffic safety organizations on a competitive basis for work on priority programs[11]

Budget: USD 1 million

<u>Additions for 2018:</u>

Consolidated Appropriations Act 2018:
The Congress has passed modifications for the federal budget of the year 2018. Within the amendments, the Congress declared a spending of USD 38 million into direct research for automated and connected driving. There will be a total of USD 60 million granted for demonstrational projects as well as USD 1.5 million for the analysis of impacts on drivers, operators of commercial motor vehicles. The latter will be carried out in consultation with the Department of Labor.[12]

3.1.2 Department of Energy

3.1.2.1 Funding programmes

<u>Next-Generation Energy Technologies for Connected and Automated On-Road Vehicles (NEXTCAR)</u>
The projects that make up NEXTCAR all focus on enabling technologies that use connectivity and automation to co-optimize vehicle dynamic controls and powertrain operation, thereby reducing the energy consumption of light - , medium - and heavy - duty vehicles. The USD 30-million program is among the first to consider energy in CAV applications, coordinating vehicle dynamic controls and powertrain operation to maximize vehicle efficiency under real-world driving conditions. The NEXTCAR Program emphasizes applications for vehicles that are not yet fully automated (NHTSA/SAE levels 0-3), or not yet capable of operating without a human present to intervene in certain situations.[13]

Budget: USD 30 million

<u>Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility Initiative*</u>
The SMART initiative is part of the overall USD 10-million heavy program Smart Cities Initiative that promotes energy efficiency and the reduction of GHG emissions in urban contexts. The initiative is made up of three pillars: (1) smart building technologies, (2) smart grid integration, and (3) smart mobility. Out of the USD 10 million, USD 5 million were set aside for smart mobility. The smart mobility part focuses on five interrelated topics:

- Connected and automated vehicles
- Mobility decision science
- Urban sciences

[11] http://www.nsc.org/learn/NSC-Initiatives/Pages/The-Road-to-Zero.aspx

[12] https://www.congress.gov/bill/115th-congress/house-bill/1625

[13] https://arpa-e.energy.gov/sites/default/files/documents/files/NEXTCAR_Project_Descriptions_FINAL.pdf

*not entirely related to C&AD

- Vehicles and infrastructure
- Multi-modal transportation

Although represented as one of the five pillars, fully connected and automated vehicles are a driving force in all pillars. "CAVs alone, in isolation from the other pillars, provide significant vehicle level opportunities for energy efficiency advancements. When intersected with the other pillars, CAVs become both a disruptive business force as well as an accelerant of potential energy impacts from other perspectives. For this reason CAV technology is treated not only as a foundational pillar, but also frequently discussed in other pillars as a system level catalyst."[14]
Budget: USD 5 million

3.1.3 National Science Foundation

3.1.3.1 Funding programmes

Smart and Autonomous Systems
The Smart and Autonomous Systems program has a budget of USD 16.5 million and focuses on Intelligent Physical Systems (IPS) that are cognizant, taskable, reflective, ethical, and knowledge-rich. The program only funds universities and non-profit organizations and welcomes research on IPS that are aware of their capabilities and limitations, leading to long-term autonomy requiring minimal or no human operator intervention. Example IPS include robotic platforms and networked systems that combine computing, sensing, communication, and actuation.[15]

Budget: USD 16.5 million

3.1.4 Funding schemes on state level

Apart from above mentioned federal funding there are quite some differences on state-level funding and support. Some states, such as California, Nevada, Michigan and Florida, put great importance on the advancement of connected and automated driving with a supportive legal framework. In addition. these states also foster co-operation between public and private stakeholders as well as between academia and industry. This has led to the establishment of testing and demonstration sites with real-traffic circumstances, such as MCity[16] in Ann Arbor, Michigan and GoMentum[17] in Concord, California, shared by universities, automotive corporations and telecommunication companies to further develop related technologies.

3.2 Japan

In Japan for most of the funding for vehicle automation and connectivity the responsible authority is the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The Cabinet Office, the office to the nation's government sets overall strategic framework and guidance.

3.2.1 Strategic programmes

[14] Sarkar, Reuben & Ward, Jacob (2016): DOE SMART Mobility: Systems and Modeling for Accelerated Research in Transportation. In Meyer, Gereon & Beiker, Sven (eds.): Road Vehicle Automation 3. Springer, Switzerland

[15] https://www.nsf.gov/pubs/2016/nsf16608/nsf16608.htm

[16] https://mcity.umich.edu/

[17] http://gomentumstation.net/

*not entirely related to C&AD

5th update of Science & Technology Basic Plan (2016-2020)*

The Cabinet Office in Japan has adopted the 5th Science and Technology (S&T) Basic Plan for the years 2016-2020. Japan's S&T administration operates under the basic policies of the Council for Science, Technology and Innovation chaired by the Prime Minister, and works to promote S&T in co-ordination with related ministries. These basic plans are made every 5 years since 1996.

The 5th plan particularly emphasizes the importance of realizing a "super smart society" or "Society 5.0". For this purpose, the Japanese government stresses the significance of developing cutting-edge ICT technology for IoT as one of the top-priority S&T policy targets, while paying particular attention to three other countries' IoT-related technology promotion policies, namely Germany's "Industry 4.0", the United States' "Advanced Manufacturing Partnership", and China's "Made in China 2025. To realize a super smart society, the Japanese government will promote the creation of a common platform or "super smart society service platform" that allows for collaboration between multiple ICT or IoT systems and for a wide variety of data (e.g., web data, human activity data, 3D geographical data, transportation data, environmental observation data) to be collected, analyzed and applied across all the co-ordinating systems to produce new value and services. The Basic Plan particularly mentions ITS and Quasi-Zenith Satellite Systems as areas to focus on. In this regard, the Japanese government will further promote the development of technologies for IoT, big data analytics, high-speed processing device, artificial intelligence, networking, edge-computing and cyber-security. The importance of solving energy-related issues in the "Society 5.0" is particularly emphasized in the final draft of the Innovation Strategy for Energy and the Environment published by the Cabinet Office of Japan in March 2016.[18] [19]

ImPACT (IMpulsing Paradigm Change through disruptive Technologies)*

As part of the 5th update of the Science & Technology Basic Plan (see above) the ImPACT (Impulsing PAradigm Change through disruptive Technologies program) R&D project shall act as a model case for extending similar schemes to the R&D projects that may not have a high probability of yield (high-risk research) but that can be expected to have a significant impact if successful. In line with the S&T Basic Plan the overall focus is put on the development towards a Society 5.0. Therein, ICT is expected to further evolve to connect separately functioning things into systems using cyber-space. Thus, separate systems in various fields (energy, transportation, manufacturing, and service) will be able to coordinate and collaborate, widening the range of autonomy and automation, and creating new value throughout society. This shall be made possible by the comprehensive incorporation of ICT advances and networking involving standardizing the interfaces, data formats, etc. Priority areas include an efficient and effective infrastructure, ITS, and transport system resilience.

Additions in 2018:

The government is revisiting the safety regulations and conformance testing for type approval as well as road traffic rules. Further the current insurance framework needs to be changed to ensure an elaborated for liability questions.[20]

3.2.2 Funding programmes

Cross-ministerial Strategic Innovation Promotion Program Automated Driving for Universal Service (SIP-ADUS)*

The programme was launched in 2014 in a joint undertaking between the Council for Science, Technology and Innovation; the Cabinet Office; the Government of Japan, and industrial partners. The pro-

[18] https://www.tillvaxtanalys.se/download/18.36a7c6515478fc61a479ce2/1463050071286/Japans+fem%C3%A5rsplan.pdf

[19] http://www8.cao.go.jp/cstp/kihonkeikaku/5basicplan_en.pdf

[20] Amano (2018). SIP-adus: Field Operational Tests and Regulatory Issues. ITS.

*not entirely related to C&AD

gramme director is Seigo Kuzumaki from Toyota Motor Corporation. Out of the JPY 50-billion Cross-Ministerial Strategic Innovation Promotion Program (SIP) programme, ADUS receives JPY 2.45 billion annually.

The Innovation of Automated Driving for Universal Services (ADUS) has been defined as one of ten key themes. Being implemented from 2014 to 2018, it receives JPY 2.45 out of the overall budget to influence R&D until 2030. The goal of the program is to reach level 2 automation by mid-2010s, level 3 by early 2020s and level 4 by 2030. Furthermore, the program seeks to establish and harmonize standards, nourish social acceptance, and show the rest of the world what a level 3 automated transport system looks like at the Olympic Games in 2020.

With the programme the Japanese government aims at developing and verifying automated driving systems, develop basic technologies to reduce traffic fatalities and congestion, foster international co-operation, and deploy next-generation urban transportation. SIP-ADUS fosters not only R&D at all stages incl. academia and industry but also testing and demonstration as well as implementation. It thus covers technological development from the early stage through to market penetration. As for the development and verification of automated driving the program separates between driver and vehicle. When it comes to the driver it funds research in all stages including recognition, judgment and operation of self-driving technologies, for the vehicle it focuses on recognition and leaves judgment and operation to the industrial competion. The program unites research, testing and demonstration as well as implementation in one single governmental program and thus manages to bring together a multitude of different stakeholders. An overview of the program is given in Figure 9.

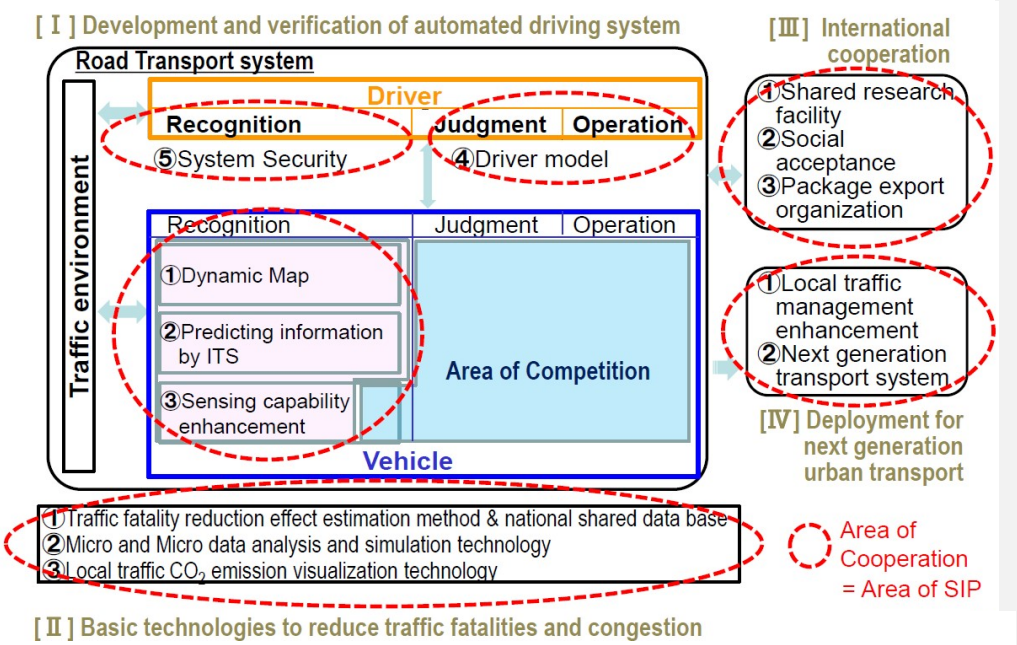

Figure 9: Scope of governmental program SIP-ADUS

Budget: JPY 2,45 billion

<u>Additions for 2018</u>

The test track expands over 300km in the area of Tokyo. The partners of the project are Alpine, BMW, Bosch, Calsonic Kansei, Continental, Daihatsu, Honda, Mazda, Daimler, MLT, Mitsubishi Electric,

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Nagoya University, Nissan, Omron, Pioneer, SAITAMA Institute of Technology, Suzuki, Subaru, Toyota, Valeyo, Volkswagen AG, ZMP.[21]

There is a second phase of SIP-ADUS planned from 2018-2022.[22]
The objectives of the second phase are:

- Extension of operational domain
- More focus on mobility services including public transportation and logistic operations
- Pursuit of societal benefits for safety, efficiency, inclusive society and enhanced economy

3.3 China

With regard to vehicle automation and connectivity funding from the central government is driven by the Ministry of Industry and Information Technology and the Ministry of Transport. However, it is limited to state-owned universities and institutes. In addition, small-sized programs are granted by local governments to locally registered companies (cooperation possible).

A centralized technical organization of the auto industry and the technical supporting body to the relevant national government departments – the China Automotive Technology and Research Centre (CATRAC) – assists the authorities and enterprises regarding research on industry policy and stakeholder involvement also in the area of connected and automated driving.

In October 2016, China's "Technology Roadmap for Energy-Saving and New Energy Vehicles" was released. This roadmap includes intelligent and connected vehicles (ICV) as an important future mobility solution. Furthermore, the Chinese government and Society of Automotive Engineers of China (SAEC) have issued a roadmap for intelligent and connected vehicles that could have semi- or fully autonomous vehicles on sale as early as 2021.

Recently, China has also set up three national test sites for connected and self-driving cars in Shanghai, Beijing and Chongqing which aim to facilitate R&D, standardization and policy formulation, as well as to test and certify connected car technologies. The government plans to expand the number of testing programs to 100 by late 2017. From 2018-2019, 5,000 automated vehicles will be deployed in an expanding testing area of 100 square kilometres. Eventually, China plans to launch a self-driving vehicle demonstration city near Shanghai in 2020.

3.3.1 Strategic programmes

<u>13th Five-Year-Plan (2016-2020)*</u>
In March 2016, China released its 13th Five-Year Plan (FYP), a national strategy set by the country's top leaders to guide the social, political, and economic development. To achieve the goal, the party has underlined five guiding principles:

- Innovation
- Coordination
- Green development
- Opening up
- Sharing

In the 13th FYP intelligent transportation was defined one of ten key transportation themes. It comprises "Internet of Vehicle", "Internet of Ship", maintenance, intelligent dispatching system, autonomous

[21] Amano (2018). SIP-adus: Field Operational Tests and Regulatory Issues. ITS.

[22] Amano (2018). SIP-adus: Field Operational Tests and Regulatory Issues. ITS.

*not entirely related to C&AD

driving, the establishment of a comprehensive public information platform, and transportation big data centre.

In terms of transportation the FYP for the first time also specifically mentions low carbon transport development. It points out that an efficient, intelligent, green, and connective infrastructure network should be built to contribute to the overall economic and societal development and support the national strategies: (1) One Belt, One Road; (2) the Beijing-Tianjin-Hebei integration initiative; and (3) the Yangtze Economic Belt Initiative.[23]

Society of Automotive Engineers of China (SAEC) roadmap

The Society of Automotive Engineers of China roadmap which is backed by the Ministry of Industry and Information Technology (MIIT) has outlined four steps for the realization of autonomous driving (see Figure 10):

1. Driver Assistance (DA)
2. Partial Automation (PA)
3. Conditional Automation (CA)
4. High Automation (HA)/Full Automation (FA)[24]

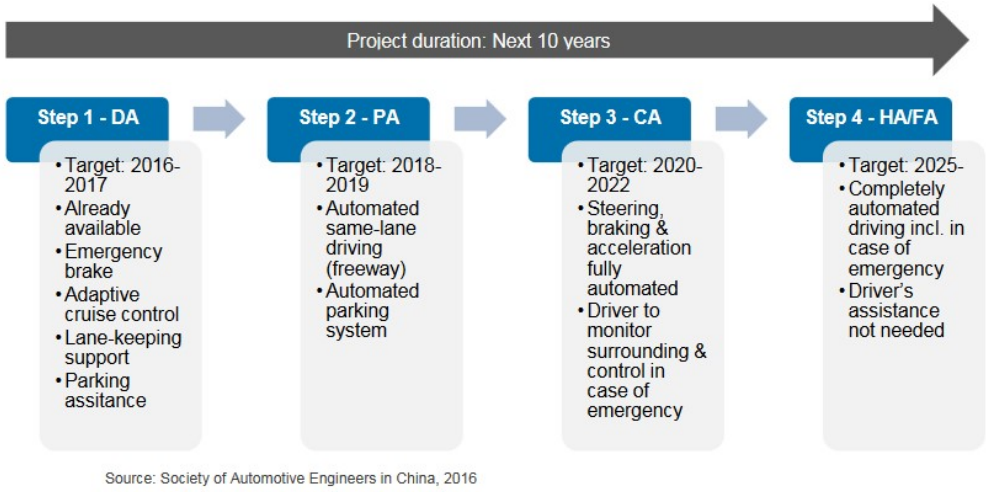

Figure 10: Four-step implementation of autonomous driving in China[25]

Addions for 2018:

The National Development and Reform Commission has issued a "Draft Strategy" underlying the economic importance of automated cars, chips, big data, artificial intelligence and telecommunications.

In front of this background they formulated a vision[26]:

[23] http://sustainabletransport.org/13-five-year-plan/

[24] http://www.business-sweden.se/contentassets/dfd94f9060af4d499f98de5237bae251/industry-insight---autonomous-driving.pdf

[25] http://www.business-sweden.se/contentassets/dfd94f9060af4d499f98de5237bae251/industry-insight---autonomous-driving.pdf

*not entirely related to C&AD

By 2020:

- systematic framework for standardized intelligent vehicles
- infrastructure network including 90% coverage of all Chinese highways with LTE for V2X
- product regulatory
- 50% of all new vehicles shall be intelligent (with no further definition)

By 2025:

- almost a share of 100% intelligent vehicles that are produced
- market adoption of high level intelligent cars
- new generation of wireless telecommunications network (5G– V2X)

By 2035
Chinese standard intelligent vehicles will earn its global reputation so China will become leader in these products across the globe.

3.3.2 Funding programmes

Made in China 2025*
The National Plan "Made in China 2025" is the Chinese answer to Europe's "Industry 4.0". It was introduced to evoke economic development in emerging industries by providing USD 300 billion in low-cost loans, research funds and government aid in for 10 sectors.[27] It has made self-driving cars a key priority and foresees to set up a connected car development platform supported by the Ministry of Information and Industry Technology (MIIT).[28] Figure 11 shows the projected domestic market share for the years 2020, 2025 and 2030 in seven key technologies for connected and automated driving. In addition to these goals specific milestones were set for "intelligent connected vehicles":

2020: Driving assistant/partially automated vehicles account for 50% market share

2025: Highly automated driving vehicles account for 15% market share

2030: Fully automated driving vehicles account for 15% market share[29]

Budget: USD 300 billion (not entirely for C&AD)

[26] https://www.chinalawinsight.com/2018/01/articles/corporate/ndrc-issues-development-strategy-for-autonomous-vehicle/

[27] https://www.nytimes.com/2017/03/19/business/china-trade-manufacturing-miao-wei.html

[28] http://knowledge.ckgsb.edu.cn/2016/11/21/technology/self-driving-cars-china/

[29] China Automotive Technology and Research Center (2017). Presentation at the Executive Committee Meeting of the Technology Collaboration Programme on Hybrid and Electric Vehicles (HEV TCP) of the International Energy Agency. Beijing, April 2017

*not entirely related to C&AD

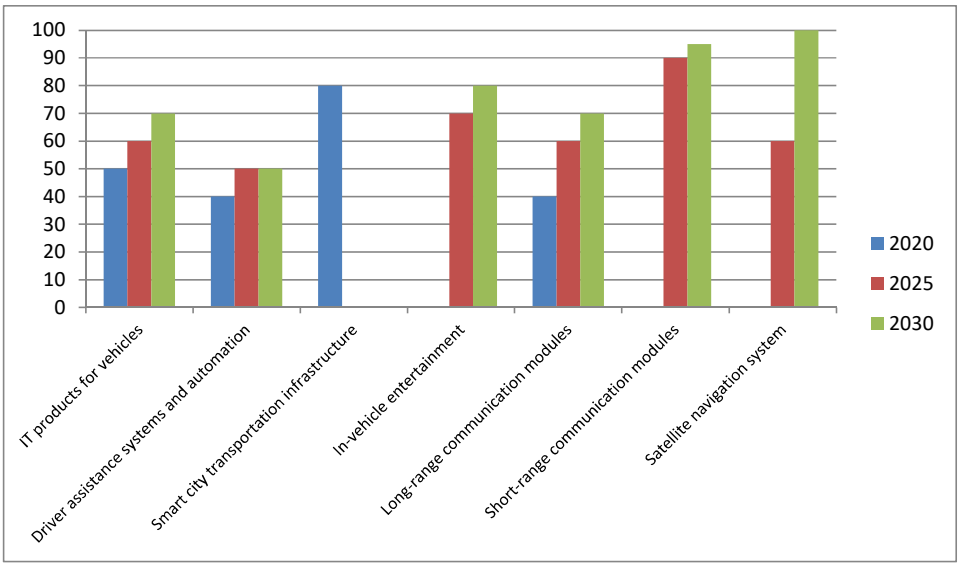

Figure 11: Made in China Key Technologies Roadmap 2015 – projected market share of Chinese technologies in per cent[30] [31]

Additions in 2018:

China Integrated Circuit Industry Investment Fund:
The USD 29 billion fund shall support national chip manufactories to cope with international competitors like NVIDIA or Mobileye.[32]

3.4 Trilateral EU-US-Japan Automation in Road Transportation Working Group

The European Commission (EC) Directorate-General for Communication Networks, Content and Technology, Smart Cities and Sustainability (DG-CONNECT), the United States Department of Transportation (USDOT) and the Road Bureau of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) of Japan focus on the information exchange on the current status of vehicle automation research and development, and governmental initiatives and interests in each of the three regions.

The mission of the Automated Road Transport Working Group (ART WG) is to establish a contemporary information flow between those different regions to keep all parties up to date regarding CAD related research programs and policy developments. Therefore, the ART WG addresses CAD topics with respect to public authorities and their relation to all stakeholders, develops and disseminates reports of the impacts, policy and operation issues of automated vehicles. Finally, needs and actions to harmonize and standardize the development und deployment of CAD in an international context are identified.

To date, few areas of shared interest have been agreed upon as candidates for ART WG cooperation. Topics are taken up for bilateral or trilateral work within the ART WG according to the interests and resources of the parties.

[30] http://www.cae.cn/cae/html/files/2015-10/29/20151029105822561730637.pdf

[31] http://www.merics.org/fileadmin/user_upload/downloads/China-Monitor/MERICS_China_Monitor_31_End_of_the_road_for_international_car_makers_in_China.pdf

[32] Bloomberg (2018): China Is Raising Up to $31.5 Billion to Fuel Chip Vision. https://www.bloomberg.com/news/articles/2018-03-01/china-is-said-raising-up-to-31-5-billion-to-fuel-chip-vision

Feldfunktion geändert

*not entirely related to C&AD

- Digital infrastructure: to identify the role of digital maps for automation
- Human factors: to identify solutions for driver and other road user interactions
- Roadworthiness Testing: to define the necessary or appropriate tests required to allow the safe and reliable operation of automated vehicles on public roads
- Evaluation of Impact – Impact assessment: to establish a unified list of potential direct and indirect socio economic impacts ,and jointly try to quantify them
- Accessible transport: to identify transformative automated transportation solutions for all people, including those with disabilities, and demonstrate operational solutions.
- Connectivity
- System Reliability and Security (including cybersecurity)
- Legal Issues (ad hoc): to monitor the activities in the different regions[33]

[33] ERTRAC Automation Roadmap (to be published in 2017)

*not entirely related to C&AD

Figure 6: Trilateral EU-US-Japan Automation in Road Transportation Working Group Meeting July 2018.

3.5 International Energy Agency Technology Collaboration Programme on Hybrid and Electric Vehicles – Task 29: Electrified, Connected and Automated Vehicles

Task 29 on electrified, connected and automated vehicles was launched by the Hybrid and Electric Vehicles Technology Collaboration Programme of the International Energy Agency (HEV TCP). The convergence of technologies for connectivity and automation with the electrification of road vehicles may offer a multitude of synergies in both performance of the technical systems and added values for users and businesses. Interdependencies between the development and innovation processes in automation and electrification are likely, due to similarities in the electronic architecture both technologies rely on. Furthermore, functional complementarities as well as commonalities in the systematic character of the operating environment enlarge synergetic effects. Thus, the combination of the three technologies may define novel products, designs and services and, along these lines, new market opportunities for the merging automotive and IT sectors.

Task 29 will focus on following objectives:

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- Analyze the potential technological synergies of electrification, connectivity and automation of road vehicles and derive research, development and standardization needs.
- Study the business models by combining electrification and connectivity/automation of road vehicles and identify action fields for companies and/or governments.
- Assess the impact of user/driver behavior on the combination of electrification, connectivity and automation and conclude on needs for measures in awareness and legislation.[34]

4 Conclusion

Due to the fact that connected and automated vehicles are not only expected to help reduce traffic induced emissions but also increase road safety all countries under study have anchored connected and automated driving within their overall political and socio-economic goals.

With respect to funding mechanisms, all analyzed countries have introduced programmes that either specifically target connected and automated driving technologies or have an overarching purpose that includes CAD. Depending on the funding institute instruments also have different focuses, spanning from basic research over close-to-market efforts towards infrastructural activities. In the US, most funding is undertaken by the Department of Transport; other awarding authorities include the Department of Energy and the National Science Foundation. Apart from funding mechanisms on national level, efforts to push related technologies vary greatly on state level. States that put a reasonably high importance to the topic include California, Nevada, Michigan and Florida.

As for Japan connected and automated driving was named a key technology to build the so-called "Society 5.0" in their 5th update of Science & Technology Basic Plan (2016-2020). Within SIP-ADUS, the major funding programme for connected and automated driving, an annual JPY 2,45 billion (EUR 20 million) are spent on the advancement of intelligent transportation. In China's 13th Five-Year Plan intelligent transportation was named one of ten key themes. The "Made in China 2025" programme, the equivalent to Europe's "Industry 4.0", is a USD 300 billion-heavy programme that also tackles connected and automated driving. To compare these with European figures, the EU expenditure amounts to EUR 220 million (Horizon 2020 + EU CEF) as shown in Deliverable 6.1.

To accelerate the technological progress of connected and automated driving the Trilateral EU-US-Japan Automation in Road Transportation Working Group has been established. The working group foresees to share knowledge and harmonize international standardization efforts in order to be able to deploy technologies on a global scale. A further cross-country initiative was taken by the International Energy Agency's Technology Collaboration Programme on Hybrid and Electric Vehicles. The programme set up a task that specifically deals with the synergies between electrified, connected and automated vehicles.

[34] http://www.ieahev.org/tasks/task-29-electrified-connected-and-automated-vehicles/

*not entirely related to C&AD