

#H2020RTTR21

European conference Results from road transport research in H2020 projects

Summary Report

5th Edition

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CO-ORGANISED BY



1. ICT infrastructure for road transport



PROJECTS



ICONET



Summary from: Torsten GEISSLER (BASt)

The session has showcased the state-of-play and findings of three projects on ICT infrastructure for road transport. The ICT infrastructure is applied to various sectors, namely to logistics and Connected Cooperative and Automated Mobility (CCAM) contributing to better use of transport assets and vehicles, reducing empty kilometres, increasing load factors and reducing energy consumption, pollution and CO₂ emissions, increasing road safety and realising synergies between industries (e.g., automotive, telco) for adaptability, flexibility and interoperability of solutions that support CCAM.

The **ICONET** project has served as pioneering Physical Internet (PI) applications in the logistics sector. Services have optimised cargo flows against throughput, cost and environmental performance, introducing new business and governance models as enablers for the PI operation, formulating a Generic PI Case Study and validating the value of those services through the application of multiple simulation models. The project has validated the efficiency introduced through the application of PI concepts and best route calculations for end-to-end “packet” flows through the logistics chain. The project results have led to a number of patents, e.g., on Authenticated Container Access, Authenticated Document Container Access by Geo/Role/Time, Self-Auditing of Route by Container and Digital Twin Simulation of a Supply Chain Under a PI Framework.

PLANET builds on the ICONET achievements. It addresses the challenges of assessing the impact of emerging global trade corridors on the TEN-T network and ensuring effective integration of the European to the Global Network by focusing on two key R&D pillars:

- a Geo-economics approach, modelling and specifying the dynamics of new trade routes and their impacts on logistics infrastructure & operations, with specific reference to TEN-T;
- and an EU-Global network enablement through disruptive concepts and technologies which can shape its future and address its shortcomings, aligned to the Digital Transport and Logistics Forum (DTLF) concept of a federated network of T&L platforms.

The project makes use of living labs (including the ports of Valencia and Rotterdam) for demonstrating the innovation in improved logistics flows whereas advanced modelling and simulation tools underpin the KPIs proving the operational benefits (e.g. load factor +20%, operational costs -7%, paper-based process costs -15%, CO₂ emissions -15%).

ICT4CART brings together, adapts and improves technological advances from the telecommunication, automotive and IT industries to provide the ICT infrastructure to enable the transition towards road transport automation, shaping a connected future for automated driving. Key achievements comprise improved safety by making occluded traffic participants visible to others, increased precision of GNSS signals down to cm level and the successful interoperability demonstration of a fully hybrid coverage (short-range communication, long-range cellular communication), demonstrated at the Italian and Austrian test site (incl. cross-border handover).

Across all the projects, lessons learned from the presentations and the discussion comprise:

- Living labs are very important for verifying the potential of technologies and applications as well as demonstrating the improved collaboration of the actors across sectors.
- Tools (e.g. modelling and simulation) that are developed have to prove their robustness. This is relevant on a micro level (e.g. coping with congested routes in urban areas) as well as on a macro level (e.g. mitigating the impacts of external, geopolitical shocks).
- Both C's (connectivity and cooperation) are important to make automated mobility fly.
- The research and innovation results will be carried forward to standardization, patents, pilots and deployment, the latter strengthening the link with deployment-oriented co-funding programs (e.g. Connecting Europe Facility). At the same time, the projects' results also provide direction for further research, e.g. on exploring for more scalable and secured Blockchain Interoperability frameworks for use of the transport and logistics context, evolving on the TEN-T Corridor Connectivity Index including potential uses, requirements for availability and performance of connectivity and cooperation enablers.

2. Solid state batteries for mobility: the chemistry of tomorrow?



PROJECTS



Summary from: Silvia BODOARDO (POLITO)

The session was focused on the H2020 projects funded in the LCBAT19 call and all three are centered on solid-state batteries for automotive applications.

The projects presented were: ASTRABAT coordinated by Guinevere Giffin of Fraunhofer ISC, SAFELIMOVE coordinated by María Martínez-Ibañez of CIC EnergiGUNE, and SOLIDIFY presented by Maarten Debucquoy of IMEC.

ASTRABAT aims to find a better architecture with an all-solid-state electrolyte to design high-energy electrode materials and develop processes for mass production. These electrolytes, containing ionic liquids, are tailored for cells with silicon-based anodes and NMC-based cathodes.

SAFELIMOVE aims to produce hybrid polymer-ceramic solid electrolytes for high-energy cells that use lithium metal at the anode and a high-energy cathode based on NMC.

SOLIDIFY focuses on bringing the liquid-processed solid-state cell fabrication concept from lab scale to pilot line at TRL6. It focuses on lithium metal cells.

The presented results seem very promising and investigate different aspects of the possible configurations and choices of materials for future solid-state batteries.

The numerous questions have highlighted many promising aspects, bringing these new batteries that promise high energy densities but also high safety ever closer. Other questions were also focused on the recyclability of these cells at the end of their life, a theme addressed by the projects already presented with the choice of materials.

However, some issues remain and have yet to be overcome. These issues also deal with the need to obtain high power densities of these cells, which are particularly important for automotive applications. Moreover, much longer cyclability is strongly needed and guaranteed. These are certainly some of the challenges to which these projects presented here will try to give answers.

3. Boosting electric mobility in cities in Europe and around the world



PROJECTS



Summary from: Ian FAYE (Bosch)

This session included presentations from ASSURED (fASt and Smart charging solutions for full-size URban hEavy Duty applications) and SOLUTIONSplus (on Integrated Urban Electric Mobility Solutions in the Context of the Paris Agreement, the Sustainable Development Goals and the New Urban Agenda). ASSURED just recently hosted its final event in Brussels, but SOLUTIONSplus is currently midway through the project and will continue until the end of 2023.

Both projects are targeted at tackling the many challenges facing mobility in cities especially emissions and air quality, as well as the reduction of CO₂. Hence electrification of urban transport vehicles and their integration in the transport system is a priority path to reduce such emissions in European cities.

ASSURED has been able to demonstrate interoperability of fast chargers (up to 600kW) for HDVs for various power transfer concepts (inverted pantograph, roof-mounted pantograph, floor-mounted pantograph) in terms of mechanical and electrical interfaces, communication and standard test protocols. Highlights from the project also include a wireless power charger for an e-van with up to 94% efficiency at 100 kW charging power, as well as demonstrating energy savings in vehicles up to 35% in 12m buses and 45% in 18m buses, thanks to ECO-comfort and ECO-driving strategies in the energy and charging management pillar of the project. The project is expected to have an impact both in terms of significantly lowering CO₂ emissions, as well as improving the grid stability.

SOLUTIONSPlus has been launched from the call LC-GV-05-2019 – International Cooperation flagship on “Urban mobility and sustainable electrification in large urban areas in developing and emerging economies” in January 2020 and has the objective to accelerate transformational change towards sustainable urban mobility through innovative and integrated electric mobility solutions at multiple global sites: including Kathmandu (Nepal), Manila/Pasig (Philippines), Hanoi (Vietnam), Nanjing (China) Africa: Kigali (Rwanda), Dar es Salam (Tanzania), LATAM: Montevideo (Uruguay), Quito (Ecuador), Hamburg (Germany), Madrid (Spain). SOLUTIONSPlus has developed an E-Mobility toolbox that contains primarily valuable results and information from previous projects that are related to the objectives of SOLUTIONSPlus. SOLUTIONSPlus has also been successful at developing multiple Webinars and E-Learning materials available online to support capacity building at the multiple global sites involved. A start-up incubator is being established as well as the demonstration activities in the partner cities. A systematic overview of these activities has been presented.

4. Automated driving and the users



PROJECTS



levitate



Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs



Mediator

S A F E - U P



Author of the summary: Ingrid SKOGSMO (VTI)

CCAM - cooperative, connected and automated mobility - can play an important role in realising Europe's Sustainable and Smart Mobility Strategy. People and society's needs must be at the centre of the discussion. The session presented different angles on how to understand and cater for individual and collective needs, to support users and to develop futureproof and safe solutions.

RESULT HIGHLIGHTS:

Levitate - Societal Level Impacts of Connected and Automated Vehicles (CAV): The project has

- Developed a web-based Policy Support Tool for city planners and local authorities in relation to the likely impact of CAVs, e.g., to formulate policy recommendations.
- Established a method for impact analysis, containing a Knowledge module and Estimator modules that can be used to forecast impact or for backcasting societal impacts.
- Showed results from applying the developed methods on public transport, private cars and logistics, for e.g., effect on congestion.

HADRIAN - Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs: The project has

- Studied the impact of various innovations to improve the human driver role during automated driving and investigated AD predictability. Helpful time horizons for automated driving level (ADL) 2 were found to be 5 seconds and 15 seconds for ADL 3.
- Evaluated how ambient lighting in the vehicle could facilitate ADL mode awareness: blue and cyan for ADL 2 / 3, red / orange for driver engagement.
- Identified appropriate haptic icons to identify various AD state transitions.

MEDIATOR - MEdiating between Driver and Intelligent Automated Transport systems on Our Roads: The project develops:

- Guidelines for measuring degraded driver performance and for safe, user-centred HMI design.
- An intelligent, self-learning support system to mediate between human driving and automated driving in the SAE Levels 0 to 4; Deciding which is the best driver, switching modes between driver/autonomous mode. Also, assessing how well the driver can manage the car.
- The project aims for industrialization and has one scientific and one industrial advisory board.

SAFE-UP - proactive SAFEtY systems and tools for a constantly UPgrading road environment: The project

- Identified future safety critical scenarios.
- Developed prototypes for passive and active safety systems, and carried out 4 demonstrations:
 - in vehicle active system for enhanced VRU detection in bad weather
 - advanced vehicle dynamics intervention functions to avoid critical events
 - application for VRU's smart devices for real time safety warnings
 - new passive system with restraint and monitoring technologies for new seating positions.

CONCLUDING SUMMARY

The four projects presented are providing tools, methods and systems towards safe and useful development and deployment of CCAM. They contribute to backcasting and a higher degree of proactiveness - on the policy/societal impact level and in preparing drivers and vehicles.

Future needs discussed in the session include continuing to put people in the center and make sure to address diversity (for example persons with disabilities, gender aspects, go beyond city centers). Involvement of cities and linkage to SUMPs was also suggested.



5. Building resilient-proof infrastructure

PROJECTS



Summary from: Thierry GGER (FEHRL)

Three great R&D&I Projects were presented at the #H2020RT21 – 5th edition during the “**Building Resilience-proof infrastructure**” session.

The projects, entitled **RESIST**, **PANOPTIS** and **SAFEWAY** addressed the whole cycle of resilience, from the preparation phase to the recovery phase.

The projects encompassed not only the linear transport infrastructures but also the critical transport infrastructures, such as the bridges and tunnels, as well as the assets and the network level.

They offered solutions, whether they were technical solutions using drones or robots, but also more strategic solutions having a look at monetarisation and economic aspects of the resilience.

The projects covered the whole lifecycle of the infrastructure, starting from the design, the maintenance, and the decommissioning and recycling.

So we can thank the European Commission, 2Zero and ERTRAC for this excellent #H2020RT21 – 5th edition, and these four great projects for their great input about the Resilience of Transport Infrastructure.

Follow-up promotional activities are planned at the Connecting Europe Days 2022 and TRA 2022.

Follow-up exploitations are envisaged within Horizon Europe and CEF upcoming calls.

6. Improving chemistry of batteries, improving vehicle performance



PROJECTS



Summary from: Peter PRENNINGER (AVL)

The topic of session 6 was the improvement of chemistry of batteries and, thus, battery vehicle performance. Four projects were presented, two funded under call LC-BAT-5-2019 "Research and innovation for advanced Li-ion cells (generation 3b)" and two under call LC-NMBP-30-2018 "Materials for future highly performant electrified vehicle batteries".

Research activities in the frame of the LC-BAT-5-2019 call should foster system knowledge and next-generation lithium-ion battery technology (generation 3b), covering the full value chain and the capability to provide the most essential parts of them both at cell and at the system levels: the cells and their constituent components (anode and cathode materials, separators, electrolytes), the control and sensor systems and the assembly know-how. At the same time, competitiveness in terms of performance, safety, cycle and calendar life had to be achieved.

Michele De Gennaro (AIT) presented the project **3beLiEVe**, "Delivering the 3b generation of LNMO cells for the xEV market of 2025 and beyond," investigating 3b generation of Lithium Manganese Nickel Oxide LNMO cells for EVs of 2025 and beyond. In particular, the results achieved so far cover:

- a cobalt-free generation 3b LNMO cathode;
- a portfolio of internal and external sensors;
- an inline electrode inspection and quality control and
- a 2D modeling of process steps in battery production for 10 GWh/year.

The other project **COBRA**, "COBalt-free Batteries for FutuRe Automotive Applications", funded under the call LC-BAT-5-2019 was presented by Jordi Jacas (IREC). Generally, the project aims at Li-rich oxide cathodes with discharge capacities of 100 to 150 mAh/g at 3C, Si composite anodes with high and specific capacity, electrolytes enabling operation in a wide electrochemical window >4,5 V and a battery pack design with 50% weight reduction compared to steel along with an advanced BMS allowing fast charging at 3C. So far, the project has achieved:

- a cobalt-free cathode with ~100 mAh/g at 3C;
- a specific anode composite delivering 475 mAh/g at 3C;
- an electrolyte leading to full cell results with ionic liquid (selected cathode vs. graphite) of 210 mAh/g at C/3;
- a prototype battery pack manufactured with recycled and low environmental impact materials, including module design with integrated smart sensors and communications along with
- an advanced BMS with cell and module level sensors for monitoring and estimating battery state.

The other two projects **Si-DRIVE** and **LISA** introduced in session 6 are funded in the frame of the call LC-NMBP-30-2018, which general purpose is to strengthen further the global leadership of Europe's industry in environmental sustainability. Regarding battery technology, the objectives are the development of new materials and new technologies for energy storage leading to affordable and integrated energy storage solutions.

Si-DRIVE "Silicon Alloying Anodes for High Energy Density Batteries comprising Lithium Rich Cathodes and Safe Ionic Liquid-based Electrolytes for Enhanced High VoltagE Performance" was presented by Michela Ottaviani from the University of Limerick. The general project objectives are the achievement of a gravimetric energy density of 450 Wh/kg and a lifetime of 5000 cycles. This should be achieved with innovative cell chemistry such as Si-coated 3D NW anodes, high V Li-rich cathodes along with RTIL polymer solid electrolytes. Achievements until the actual final year of the project are:

- Increase of anode Si loading up to 0,75 mg/cm² and anode upscaling to 30 cm²
- Successful incorporation of IL electrolyte into a crosslinked polymer matrix
- Modelling and testing of full cells with high capacities and cycle life with IL-based electrolytes
- Pouch cell prototype with organic LRLO cathode, Si/Gr blend anodes and IL electrolyte
- Baseline recycling trials along with dismantling tests

Finally, Christophe Aucher (LEITAT) presented the **LISA project** – "Lithium sulphur for SAfe road electrification". In order to achieve new batteries for EVs with higher driving range, higher safety, and faster charging at lower cost, Lithium-Sulfur is a promising alternative to Li-ion, free of cobalt and nickel, with higher theoretical capacity and energy. LISA – being also in its last year - is focused on such LiS cell chemistries also incorporating manufacturability concepts enabling integration in future manufacturing lines. Some of the main achievements are:

LiS fully solid-state pouch cells with 400 Wh/kg or 450 Wh/L and 18Ah cells with

- >1.600mAh/g
- Upscaled DRYfilm processing and evaluation in pouch cells
- SoC estimator estimators using machine learning at 100% and 40% initial SoC

- SoH estimator during charge and discharge using Support Vector Machine
- LiS cell recycling processes based on environmentally friendly and additive-free water leaching

In conclusion, it can be stated that good progress was shown by all projects toward batteries with advanced and alternative chemistries of higher energy and power density for automotive applications. The technologies under development will also contribute to significantly safer batteries which is essential if the absolute energy content of batteries increases to allow higher driving ranges of future EVs. New chemistries will also allow further reduction of battery costs by avoiding expensive raw materials. Finally, the implicit consideration of sustainability and recycling aspects already during cell and battery development was one of the highlights of the presentations. This underlines the good position and progress of Europe in this technology field. Johan Blondelle (EC, DG Research and Innovation) summarized the session by saying "We are doing great work in Europe, but we have catching up to do with the rest of the world."



7. Protection of road users

PROJECTS



Summary from: Peter URBAN (IKA-RWTH)

Inclusive Protection of Users in the Future Road Transport System

Moving close to zero fatalities from all transport modes by 2050 is an important milestone set by the European Commission's Sustainable and Smart Mobility Strategy 2020. This is fully in line with the EU Road Safety Policy Framework 2021-2030 "Next steps towards 'Vision Zero', meaning a future road transport system in which no-one will be killed or severely injured anymore. With about 20,000 fatalities in its 27 Member States in 2021, the EU is still far away from this political target, though. Connected, cooperative and automated mobility (CCAM) has the potential to become a key enabler for substantial reductions in the number of collisions as well as in the number of injuries and fatalities. But even in future mixed traffic of highly automated vehicles and other road users (such as powered two-wheelers), crashes will happen; enhanced, inclusive protection will have to be provided so that Vision Zero can still become a reality. Providing such protection is the challenge that the three projects presented in this session addressed: **OSCCAR**, **VIRTUAL** and **PIONEERS**.

These projects have achieved important advances in the virtual testing of protective safety systems. As the result of a nice cooperation between projects, new Human Body Models are made available by OSCCAR and VIRTUAL via an open-access platform (the OpenVT platform) to describe more realistically the behaviour of the full diversity of human beings in road crashes. These models also show significant improvements with regard to their robustness, biofidelity, their ability to simulate muscle activity and their applicability to omnidirectional loading. They have been used, amongst others, to analyse the response of erect passengers to acceleration loads in public transport and develop advanced protection concepts for new sitting positions in future highly automated vehicles, thus enabling more flexible interior designs. Another interesting result of the VIRTUAL project is a cost-benefit analysis tool, which allows for the calculation of socio-economic costs and benefits of innovative automotive safety systems.

Easy-to-use protection systems for powered two-wheeler riders have been developed by the PIONEERS project, including a safety leg cover and lateral airbags, as motorcyclists still face a very high risk of being killed or severely injured in road crashes. The project has complemented these results by research on a pre-crash braking system and on a communication device connecting the motorcycle and the personal protective equipment of its rider. In addition, PIONEERS has delivered new test methods for the rider's ankle and torso protection, for protective garment as well as for the helmet-neck-brace fit.

In the coming years, more inclusive and more robust crash safety systems may be expected on European motor vehicles as an outcome of the afore-mentioned projects. The virtual testing methods and tools developed as well as the advances made in inclusive occupant protection also represent important enablers for the safety of CCAM. Moreover, the project results are expected to increase both the performance and the usage rate of protective equipment for powered two-wheeler riders as a group of road users exposed to particular risks in the transport system. The provision of project results on an open-access platform and their uptake amongst others in discussions at Euro NCAP and UNECE are promising steps towards these medium-term outcomes.

Future challenges clearly identified in relation to the project results consist of the need for harmonisation of test methods and injury assessments, the standardization of virtual testing procedures and the certification of virtual models. This would increase the leverage effect of a future predictive safety assessment framework and assist in the preparation of the regulatory framework for safe and inclusive operations of CCAM. The further improvement of personal protective equipment and on-board safety systems also for the benefit of the users of e-scooters and other micro-mobility devices was identified as another future research need in the discussion with the speakers and the audience.

As an additional conclusion from the discussion, the importance of virtual testing was highlighted as the only feasible solution to fully consider human heterogeneity, including disabilities, in the development of protective safety systems. Finally, yet importantly, speakers put emphasis on the potential of both European and international cooperation in road safety research, as the protection of citizens' health and well-being is a common interest all over the world.

8. Charging solutions for a user and environmentally friendly electromobility



PROJECTS



Summary from: Ian FAYE (Bosch)

This session included presentations from three projects: GreenCharge, Meister (Mobility Environmentally-friendly, Integrated and economically Sustainable Through innovative Electromobility Recharging infrastructure and new business models), and INCIT-EV (Large demonstratioN of user Centric urban and long-range charging solutions to boost an engaging deployment of Electric Vehicles in Europe). GreenCharge and MEISTER recently ended in February this year, but INCIT-EV will continue until the beginning of 2023.

There are still numerous obstacles inhibiting a widespread European network of charging infrastructure and seamless travel across the EU in electric vehicles. The availability of charging stations varies between countries, payment systems are not harmonised with minimum requirements, and there is inadequate information for users. R&I can help provide the path through by analysing, testing and demonstrating innovative solutions, and better detail most relevant business cases that can be brought quickly to the mass market. This is clearly in line with the objectives of the Green Deal, the Zero Pollution strategy, the Smart and Sustainable transport strategy and the fit for 55 proposal: road transport is asked for an "irreversible shift to zero-emission mobility". This session encompasses three relevant projects that tackle this from different perspectives. Also, be reminded that all activities under zero-emission mobility shall strongly help and support the REPower EU plan, to accelerate the deployment of cost-competitive solutions for the use of renewable electricity.

GreenCharge focused on cities and municipalities to make the transition to zero emission/-sustainable mobility with innovative business models, technologies and guidelines for cost-efficient deployment and operation of charging infrastructure for EVs – with a specific interest for “sharing economy”, so to enable the mutualisation of excess capacity of the system as a whole. Some highlights from the lessons learnt in the project are the need for standards in dealing with complex systems and data management, as well as the stability and immaturity of eMobility incentives. A surprising message is that smart energy management is not yet seen as essential for implementation and urban planning is not the number one priority.

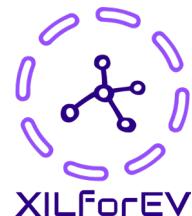
MEISTER aimed to change the paradigm in the electro-mobility market by providing interoperable platforms and services for easy, convenient, and barrier-free access to charging, billing and smart grid service, whilst also increasing the use of renewable energy sources and self-generation methods to power electric vehicles (EVs). Some of the highlights are the implementation and testing of e-car sharing services for public and private use as partner sites, as well as the implementation of smart charging services along with testing of Smart Park features. The project results are also expected to contribute to digitalising the management (including the use of blockchains) of parking spaces in front of charging poles.

INCIT-EV project aims to demonstrate an innovative charging infrastructure set to improve the EV users' experience. Seven demonstrators across Europe will serve as reference for eRoads, bidirectional charging and grid integration for charging infrastructure. It is a larger project and aims at demonstrating an innovative set of charging infrastructures, technologies and associated business models, ready to improve the EV users' experience in Amsterdam/Utrecht, Torino, Zaragoza, Tallin, and Paris area. It includes comprehensive work to capture the true user perspective on charging infrastructure, as well as different variations of innovative wireless solutions that achieve up to 95% power-transfer efficiency. In addition, both low power and high power charging systems will be installed and tested with the ambition of closing the loop on user perception with real-world testing.

9. Green Vehicles – Virtual product development



PROJECTS



Author of the summary: Aldo OFENHEIMER (Virtual Vehicle)

In this session, three projects were presented focusing on the implementation of digitalization for the development of electrified vehicles and complex electrified platforms. These projects and their outcomes represent some distinct steps that the transport research community has been taking towards climate neutrality. All three of them have the same goals: boosting quality, affordability, and sustainability of road transport of today and in the future. However, the paths to their goals were very different in terms of perspective and approach.

The **PANDA** project started in December 2018 and focused on modeling method for the development and testing of electrified vehicles in order to achieve a reduction of development time by 20%. Easy reuse of models for different development tasks and the reduction of physical testing of subsystems by virtual seamless testing are highlighted as the key outcomes; the main end goal is the digital models for seamless integration in virtual and real testing of all types of electrified vehicles and their components.

The **VISION x-EV** started in January 2019 and had a goal to resolve challenges that OEMs kept stumbling upon in order to comply with current and future emission legislation. A generic virtual component and system integration framework for the efficient development of future Battery Electric Vehicle and Hybrid Electric Vehicle powertrains have been set as one of the most important goals of this project. The outcomes supply the foundation for an expanded application of virtual prototyping from component to subsystem to powertrain/vehicle level to reinforce the efficient and successful development of future electrified/hybrid vehicles.

The **XilforEV** project started in January 2019, and it strived to develop a complex experimental environment for designing electric vehicles and their systems. It aims on remote, shared and distributed experiments by linking test facilities in various locations. This project also tackled the development of high-confidence, real-time capable models with automatic validation using experimental data.

For all projects, the following aspects were specifically highlighted in the presentations and the subsequent discussion:

- The importance of efficiency gains in the PANDA project was achieved by connecting remote testing infrastructures in a smart and sensible way.

- Portability of the simulation solutions of the PANDA project and the possibility of incorporation of different platforms and technologies in the modeling method as well as battery aging.
- The interconnection of the VISION x-EV with and the usage of the results also from previous EU-projects: the role of the already existent interfaces and their extension and adaptation to this project and its standards.
- The time step was managed to be maintained during the different simulations of the components interfacing with each other in XilforEV, therefore allowing acceptable computational efforts and time for such engineering activities.
- The advantages of collaboration between the projects, especially VISION x-EV and XilforEV, are reflected in the possibility of validating the concepts and the lively exchange of information regarding activities having in mind the different core elements of all three projects.
- The presented outlook into the reality of a future virtual product release.

10. New/future and inclusive mobility patterns



PROJECTS



Summary from: Suzanne HOADLEY (POLIS)

The session “**New/future and inclusive mobility patterns**” allowed participants to gain insight into the progress and results of the European projects DIAMOND and TinnGo, which aim to create a gender-balanced transport system. The projects are examining several issues, such as better participation of women in transport systems, both as users and employees.

The first speaker to take the floor was Maria Chiara Leva, **DIAMOND** dissemination manager. She emphasised the need for collaboration between data scientists and engineers to identify the relevant needs for a gender-neutral transport system. Improvements can be achieved by turning big and small data from different sources into actionable knowledge for addressing gender-specific needs in current and future transport systems. Data collection took place in three cities in Spain, Poland, and the UK through surveys covering several issues such as the difference between male and female criteria for judging public transport services, or factors influencing career choices for women in different groups and areas about working in transport. Key studies were carried out in four specific public and private transport sectors, representative of the main mobility modes: railways, automated vehicles, vehicle sharing, social responsibility, and employment.

Safety and security for the female population are high on the agenda. Traveling at night is not the same as traveling during the day, and also ethnic minorities are affected by this issue. Surveys showed that people who experienced discrimination on public transport have a low level of satisfaction with service provision.

Overcoming these challenges is accomplished by the implementation of some concrete safety measures, such as the use of cameras or the illumination of certain areas, but above all, it is achieved through the creation of a sense of community in the place where the affected categories live. The psychological impact is also crucial in childhood education, where using a bus or an e-scooter to go to school can have an impact on your travel choices for the rest of your life.

Afterwards, Andrea Woodcock from Coventry University presented the **TinnGo** project, aiming to create a framework and mechanisms for a sustainable game change in European transport through a transformative strategy of gender and diversity-sensitive smart mobility. The new concept of mobility should not replicate all the problems of the past but rather ensure greater inclusiveness through gender mainstreaming.

The main objectives of the project are to

1. evaluate barriers to employment and education in the smart mobility sectors;
2. develop actions and measures to remove barriers to the mobility of various groups and increase female employment opportunities;
3. create opportunities for developing gender-sensitive smart mobility products and services;
4. spotlight female entrepreneurship in smart mobility;
5. provide interrogable and easy accessibility, mobility data repository, and survey engine for gendered mobility data;
6. provide a one-stop observatory for policymakers, scholars, and citizens involved in Smart Mobility, which includes a learning centre, open mobility data platform, data repository, case studies.

TinnGo project researchers noted that motherhood, misogynistic language, a predominantly male environment, and the difficulty in combining work and family life are some major barriers hampering the creation of a gender-neutral environment within the transport sector. In order to ensure the above-mentioned goals will be achieved, it is necessary to develop Gender Diversity Action Plans (GADAPS), i.e. an integrated planning tool to include gender equality within a project, organization, or community. The project goes beyond the traditional women's perspective towards an intersectional perspective. The last speaker, Hilda Christensen, University of Copenhagen introduced the TinnGo charter, one of the solutions promoted by the project. It contains guidelines and policy recommendations, which can be used with GADAPS to create gender smart transport systems, and workplaces, and foster research about this topic.

In conclusion, gender smart mobility has to become one of the pillars of the smart cities concept, and its implementation has to be achieved through the inclusion and cooperation of the EU commissioners, national transport ministries in appropriate conferences in order to raise their awareness of the topic and to mainstream these procedures into future directives.

11. Urban logistics: on-demand, shared, connected and low emission



PROJECTS



Summary from: Fernando LIESA (ALICE)

Overview of the topic discussed and relevance of this R&I area according to the policy developments

The session Urban logistics: on-demand, shared, connected and low emission focused on urban freight and logistics^[1], particularly addressing topics such as: cargo bikes and zero-emission vehicles, urban consolidation centers, last-mile logistics supply-demand matching platforms, transformation of retail stores in electric mobility nodes, new distribution models, spatial planning and crowd shipping among others. The Physical Internet and Digital Twins concepts applications to urban logistics were addressed as well as the co-creation of solutions for on-demand economy (e.g. on-demand transport for passenger and freight combined transport). These projects were presented:

- **LEAD** - Low-Emission Adaptive last-mile logistics supporting 'on Demand economy' through digital twins. LEAD is creating Digital Twins of urban logistics networks in six Living Labs, to support experimentation and decision-making with on-demand logistics operations in a public-private urban setting.
- **ULaaDS** - Urban Logistics as an on-Demand Service. ULaaDs addresses the strong increase in e-commerce – leading to more and more delivery trips. The related problems range from congestion, space consumption, and emissions of various kinds to blocked sidewalks and cycle paths – it's an urgent call for innovative solutions: not on paper but on the ground.
- **CityChangerCargoBike**. The CCCB project has been working to exploit the limitless potential of cargo bikes (e.g., research shows that 51 percent of all motorised urban trips where goods are transported (either commercially or for personal leisure (i.e., shopping)), can be carried out using an (e-)cargo bike), promoting their usage amongst public, private, and commercial users. Supported by the Horizon 2020 programme, the project brought together 202 partners, including 15 cities, research institutions, NGOs, and industries from all over Europe, in the quest to achieve a faster, more cost-effective, and larger scale deployment of this sustainable mobility option.

[1] See definition at ALICE-ETP & POLIS (2021). Cities-Regions and companies working together. Guide for advancing towards zero-emission urban logistics by 2030. <https://www.ftp-logistics.eu/polis-and-alice-launch-their-joint-guide-for-advancing-together-towards-zero-emission-urban-logistics-by-2030/>

While CityChangerCargoBike is a finished project, LEAD and ULaaDs are still in their midterm.

Results highlight of LEAD project

- 21 digital twin models for logistics procedures as part of an open library to stakeholders.
- Agile schemes for urban freight and last-mile distribution, including crowdsourced shipping, capacity sharing, multi-echelon and Physical Internet approaches.
- Low and zero-emission delivery vehicles and integrated logistics solutions.

Results highlight of ULaaDs project

- Baseline for on-demand use cases definition, modelling, diagnosis, business development and trialing.
- Development of a toolkit for cities addressing these challenges: zero emission logistics, updated SUMP/SULP and guidelines towards SULP definition
- Online platform for local stakeholder's dialogue.

Results highlight of City Changer Cargo Bike project

- The project has accompanied the booming of usage of cargo bikes providing cities with tools, incentive definitions, environmental impact simulation models (e.g. implications of shifting vans and trucks to cargo bikes).
- 10,000 cargo bike test trials for private and commercial users.
- 500 trained multipliers for cargo bike adoption for different usages and applications.
- New procurement procedures for cargo bikes usage.

Conclusions / lessons learnt / future research needs

- The projects addressed or are addressing challenges and supporting important policy objectives.
- The projects aim for integrated solutions addressing those challenges and objectives by combining technologies, concepts, innovative business models and interaction between stakeholders.
- Further harmonization of city logistics frameworks in cities is needed to achieve European-wide

12. Green Vehicles – new vehicle design for new usage models



PROJECTS

DOMUS



Summary from: Aldo OFENHEIMER (Virtual Vehicle)

In this session, two projects were presented focusing on the design of new vehicles which not simply modified from an already existing internal combustion engine vehicle design, but are “born” electric.

The **DOMUS project** started in November 2017. It strives to reduce overall energy consumption of future electric vehicles (EVs) and it limits the losses due to heating and cooling, which are sapping the range of current vehicles by focusing especially on the inside of the cabin. The focus was on a plenitude of components, such as heating panels, windows that can defrost themselves electrically etc. The outcome was a potential 10% reduction of the losses. Part of it still needs to be proven in real vehicles. Some of the specific technical objectives of this project are:

- acquiring a thorough understanding of all factors influencing comfort perception and capturing the capability to improve EV energy efficiency while maintaining optimal user experience,
- the development of radical new cabin and EV designs and the methodology for virtual assessment of EV (cabin) designs that includes comfort perception, efficiency, well-being and safety
- the implementation and validation of the developed models, the cabin/EV designs, and the instrumental innovation of cabin components, systems and controls, and assessment methodology.

The **Multi-Moby project** started in December 2020 and offers an alternative approach to vehicle design. It concentrates on the real complete design of a new family of small vehicles, which are meant for passenger and freight applications. The main goal is to increase efficiency by keeping the weight low while keeping safety in mind. The testing for crashes and active control features, that avoid vehicles slipping out of the road, have already been successfully conducted. So, the outcome is a comparable small vehicle but with the features of a big one. Some of the specific technical objectives of this project are, for instance, the development of a fleet of electric vehicles (EVs) covering most of the current and forthcoming needs, the physical demonstration that the vehicles provide good crash resistance, by achieving the EuroNCAP 4-star car crash standards (improvements of the results of the European projects PLUS-MOBY and Steel-S4EV).

For both projects, the following aspects were specifically highlighted in the presentations and the subsequent discussion:

- The development of AI-based controller for the cabin comfort control system and implementation into the ECU of a vehicle, the development of tools that apply accelerated cabin comfort simulation into a broader spectrum of vehicle cabins, and the study of the different types of radiation and its effect on thermal comfort, all inside the framework of the DOMUS project
- The importance of making use of a whole set of different energy-saving features (like e.g., active glazing) to achieve the energy savings goal of the DOMUS project
- The advancement of active safety features in light electric vehicles, including forms of driving automation, as an impact of the Multi-Moby project
- The impact in terms of energy-efficient electric powertrains with limited content of rare earth materials
- The importance of hybrid energy storage systems for light electric vehicle applications and simple but smart, fully electric vehicles with best-in-class energy consumption (<100 Wh/km)
- Micro-factory concept for low-investment localised production.

13. Sustainable mobility in urban areas



PROJECTS



CIVITAS
Park4SUMP



CIVITAS
SUMP-PLUS

Summary drafted by Lorenzo Lorefice on behalf of Karen VANCLUYSEN (POLIS)

The session called “**Sustainable mobility in urban areas**” opened with a short introduction by Piotr Rapacz from DG MOVE from the European Commission, moderator of this session, together with Karen Vancluysen, Secretary General of POLIS. Mr. Rapacz highlighted the main priorities as stated in the EC’s recently launched Urban Mobility Framework.

The session’s main focus was on supporting cities with the creation of a sustainable mobility ecosystem that can become an effective reality by 2050. For this purpose, the Sustainable Urban Mobility Plan (SUMP) is considered a key support tool, since its long-term integrated vision and planning approach helps to set clear policy goals with the aim to improve accessibility and provide high-quality and sustainable mobility transport to, and within the functional urban area. Presentations focused on two key SUMP projects, PARK4SUMP and SUMP-PLUS, each addressing particular aspects of the sustainable urban mobility planning process.

Patrick Auwerx from Mobiell 2021 presented key findings and outputs of **PARK4SUMP** in his capacity as project coordinator. The project addresses parking management and how it relates to SUMP planning. Cars are stationary 95% of the time and thus unnecessarily consume urban space, which could be used for other purposes. Moreover, car parking spaces are often highly subsidised, which is very problematic when working towards more sustainable urban mobility. PARK4SUMP has been looking at how to transform parking spaces through implementing sustainable measures and how to elevate parking management and policies from an operational to a strategic function. It is no longer necessary to increase the supply of parking spaces according to the increasing demand but rather to integrate a more strategic approach into SUMP policies. PARK4SUMP developed an audit tool called ParkPAD to verify parking policies. This tool helps to bring politicians around the table and discuss parking issues rationally, based on facts and figures, with the aim of developing better parking policies. It helps to overcome the political sensitivity of reallocating parking space and the inertia resulting from fear of losing part of the electorate.

This can only be achieved through cooperation between private mobility companies and public authorities. Therefore, PARK4SUMP has been working with 16 cities and 14 national governments, creating the opportunity to discuss and facilitate the implementation of new parking measures, policy recommendations about parking standards, and EV charging stations. As a final project output, PARK4SUMP is producing SUMP guidelines for integrating parking management in urban planning.

For the second presentation, the floor was given to Charlotte Halpern, a researcher in the centre of European studies in Science Po, and partner in the **SUMP-PLUS** project. This project focuses on specific action areas in relation to SUMP development, including the imperative to achieve zero-emission mobility and the cooperation with private companies.

The mobility transformation pathways of the project focus on the needs of small and medium-sized cities in particular and support these cities in both the development and the implementation of their SUMP. The project also demonstrates how cities can develop stronger links with other components of the urban ecosystem, such as health, education, tourism, and logistics.

The project presentations were followed by a Q&A session. It was debated that some cities are not progressing with parking policies precisely because there is a lack of awareness among local authorities that these can enhance liveability and help to reduce car use. Parking management is not only about the supply side but also about tackling the demand side. People should be made aware of the real cost of parking and should pay for it. PARK4SUMP is also looking into bicycle parking policies and standards, further addressing the need to rebalance the use of public space. Furthermore, the addition of shared electric vehicles could bring benefits, as private cars would be replaced, and zero-emission shared mobility would be encouraged.

14. Inclusive transport system to meet the user needs



PROJECTS



Summary from: Ingrid SKOGSMO (VTI)

Connectivity has increased throughout Europe. However, the transport system remains insufficiently accessible for persons with low IT literacy, for persons with disabilities, and can be too expensive for those with low disposable income. At the same time, transportation is an enabler for integration into society and the labour market, and accessible, affordable and fair mobility is a critical contributor to social inclusion and well-being.

RESULT HIGHLIGHTS:

INDIMO - Inclusive digital mobility solutions:

The project has

- Investigated needs and requirements for users, including those without digital experience
- Co-created tools that can help engineers, developers, operators and policymakers to generate an inclusive, universally accessible, personalised digital transport system
- Developed a Universal Design Manual, as part of a digital mobility toolbox, focusing on ten identified vulnerable groups.
- Among important aspects to consider: space, time and expected waiting time, and human contact, especially for groups less familiar with digital tools.
- 5 Pilot projects are being conducted to try out and further develop the toolbox components.

DIGNITY - DIGital traNsport In and for socieTY:

The project

- Designs an approach that combines proven inclusive design methodologies with the principles of foresight analysis to co-create more inclusive mobility solutions and formulate user-centred policy frameworks.
- Is testing the approach in four pilot cities and regions (Barcelona -ES, Flanders -BE, Ancona -IT, and Tilburg -NL) and is proving how a structured involvement of all actors - local institutions, market players, interest groups and end-users - can help to bridge the digital gap.
- Developed Interactive Catalogue with good examples of mobility products for vulnerable groups.

TRIPS - TRansport Innovation for vulnerable-to-exclusion People needs Satisfaction:

The project

- Proposes and applies a co-design approach that allows persons with disabilities to take the leading role in designing accessible and useable transport systems and provides seven city case studies.
- Highlights for example that
 - Accessibility is an end-to-end journey issue, not a mode-by-mode issue.
 - Cycling infrastructure is not accessible and even dangerous for disabled bystanders.
 - Smart assistive technologies (e.g., wearables, AR, assistive robots) would be welcome if people could afford them and were taught how to use them.
- Has developed a Mobility Divide Index
- Proposes a MoU to be signed by disability NGOs, Citizen Service Operators, and transport ecosystem.

CONCLUDING SUMMARY

The session's three projects give examples of approaches to work towards an accessible, affordable and fair mobility for all users of the transport system. They have developed tools including design manuals for user interaction, interactive catalogues with good examples, and tools for mobility divide assessment. The projects "walk the talk" of user involvement by applying proposed approaches and tools in design of work-packages and in pilots.

15. Green vehicles – HDV of the future



PROJECTS



Summary from: Simon EDWARDS (Ricardo)

OVERVIEW OF THE TOPICS DISCUSSED AND THEIR RELEVANCE

Session 15, in the first parallel session on the second day, covered two recent, large, Green Vehicles projects related to heavy-duty vehicles of the future. These presentations were most relevant, given the ever more stringent air quality emissions and the new greenhouse gas (CO2) emissions regulations for heavier commercial vehicles, let alone the continuous economic and operational demands for improved effectiveness in on-road logistics.

RESULTS HIGHLIGHTED WITHIN THE AEROFLEX PROJECT.

The first presentation was by Ben Kraaijenhagen, the technical coordinator of the **AEROFLEX** project: "Aerodynamic and Flexible Trucks for the Next Generation of Long Distance Road Transport". The project (under EC grant number 769658) ran for four years (given the pandemic situation) with a broad range of consortium members (OEMs, suppliers, RTOs, SMEs and operators) and an even wider range of sounding board members. The project produced two long-haul trucks, capable of running in EMS2 (European Modular System) vehicle configurations and demonstrating: distributed powertrains (traction capable in the tractor unit, the trailer and the smart powered e-dolly); active and passive aerodynamic devices; active and passive safety features in the vehicle tractor units; new modular loading units; assisted with the PUZZLE software; and cargo volume detection; as well as being compatible with Truck2Train multi-modality. These results were of particular importance since 18 to 33% efficiency improvements in long-haul road freight transport were seen to be possible. Estimates of the impact of such on the growing long-haul freight activities in Europe, together with the next steps regarding regulatory frameworks, particularly regarding Intelligent Access Policies (IAP) were made.

RESULTS HIGHLIGHTED WITHIN THE LONGRUN PROJECT.

The second presentation was by Lukas Virnich, the technical coordinator of the **LONGRUN** project: "The Development of Efficient and Environmentally Friendly Long-distance Powertrains for Heavy-Duty Trucks and Coaches". This project (under EC grant number 874972) started in 2020 and will run for 3½ years, again with a broad range of partners (OEMs, suppliers (including fuel suppliers), RTO, SMEs and operators) from

many European countries. The project is looking at the near term (i.e., relevant for the CO₂ emission regulations from 2025 on) engine, fuel, after treatment and hybrid powertrain technologies; targeting 50% peak thermal efficiency, 10% Tank to Wheel (TtW) energy savings. The presentation gave the detailed breakdown of how the results to date, on both compression ignition and spark-ignition engines have been achieved.

CONCLUSIONS, LESSONS LEARNED AND FUTURE RESEARCH NEEDS.

The presented projects showed how all stakeholders in the European logistics industry can come together to demonstrate near and medium-term solutions addressing the climate change challenges facing the long-haul truck operation. They show that a holistic approach, considering, amongst others, existing powertrain technologies, future fuels and novel electrical drive systems can deliver significant efficiency improvements, CO₂ reductions, whilst operational advances and novel vehicle architectures have the potential to enhance logistical effectiveness. Large-scale demonstration of these technologies is needed now; the regulator aspects, to allow these gains to be realised, should be addressed.

16. Sharing the space and the service: new mobility patterns



PROJECTS



Summary from: Andres MONZON (UPM)

The five projects presented in the session have a common target: to explore the added value offered by the user-centric use of urban space. Urban space is limited and different competing activities want to use it. Therefore, creating new tools for selecting the best mix of activities to perform in each location means overcoming the traditional view of providing access to activities through different modes of transport.

Two of the projects paid special attention to the local environment. **SUNRISE** aimed to create more convivial neighbourhoods through a co-creation process in 6 cities. Its novelty approach consists in working both with people and with local authorities. **MORE**, in its turn, looked at how to distribute urban space in a better way to deliver proximity in 5 different cities. It formalized a participatory process for co-designing solutions. It highlighted the key role of combining regulation and governance.

The other three projects developed new tools for selecting the best solutions in each urban environment. **HANDSHAKE** appraised 60 cycling solutions in 13 different cities to build a self-assessment tool to transform them into cycling capitals. **SPROUT** investigated in 5 cities how to make cities the leading actors for innovation, harnessing new mobility solutions. The SPROUT tool strengthens policy response at local level. It identified the main actors through the process to ensure quality and innovative solutions. Finally, **HARMONY** built an interactive model suite to consider the dynamics of space and multimodal activities in 6 cities; it uses a tactical simulator of scenarios for passengers and goods, looking at introducing new technologies such as EVs and drones.

Four of the projects were part of the CIVITAS programme and all of them provide new insights for making SUMPs more creative and robust to deliver validated solutions in the urban context.

In total, 35 cities were involved in different developments aimed at building customised policies and tools to for more sustainable and carbon-neutral solutions. The projects look at European cities and beyond, setting links with other cities in the USA and other countries.

17. Green Vehicles – architecture, components and systems for electrified vehicles



PROJECTS



Summary from: Christof SCHERNUS (FEV)

This session featured projects of the H2020-LC-GV-01-2018 topic on “Integrated, brand-independent architectures, components and systems for next-generation electrified vehicles optimised for the infrastructure”. The call gave projects the possibility to put their emphasis on one or more of the following aspects:

Integrated electric/electronic architectures (incl. high voltage) and control systems for third-generation electrified vehicles powertrains,

Development of smart bus systems, electric motors, power electronics enabling drastic size and weight reduction, when integrated into batteries and motors and modular approaches, connectivity, and systems for enabling automated driving functions,

Modular and flexible onboard charging optimized for infrastructure capabilities taking into account variable power with up to 350 kW,

Breakthrough heating and cooling concepts to minimize the impact on vehicle range in extreme conditions.

The amount of funding allowed for a total of nine different projects that complement each other and together give a versatile perspective on next-generation electric vehicles, their architecture and powertrain components on system-level as well as on sub-system and/or component level. Five of these projects were presented in this session, four of them marked by an asterisk *) below, have joined the E-VOLVE cluster (<https://www.h2020-evolvecluster.eu/>).

sys2WHEEL *) deals with integrated components, systems, and architectures for efficient adaption and conversion of commercial vehicle platforms to 3rd generation battery electric vehicles for future CO2-free city logistics. The project aimed to bring as much of the powertrain components close to the wheels to make room for freight in commercial vehicles dedicated to last-mile delivery. An N1 vehicle was equipped with two in-wheel motors on the front axle, and an N2 vehicle was equipped with a fully modular e-axle. The projects addressed cost and weight reduction by reducing complexity, dedicated production lines and standardised modular design. Improved thermal management contributes to extending the electric range of the vehicles.

Beyond in-wheel motors and inverters, the technology package investigated by the project **EVC1000** *) includes brake-by-wire components and electro-hydraulic dampers as Electric Vehicle Components to enable electric vehicles for 1000 km daily trips. The project aims at increasing energy efficiency by 9%-12% to achieve a longer range on one battery charge. At the time of the presentation, the hardware validation in two different SUVs was still ongoing.

The **TELL** *) project aims Towards a fast uptake of mEdium/Low-voltage eLectric power trains. The 200V electric motor demonstrates a remarkably high efficiency suited to the operation of a M1/N1 light urban vehicles at vehicle speeds below 40 km/h enabled through silicon MOSFETs. The vehicles feature a 4WD propulsion, one with a 100V rear e-axle with integrated differential and the other 48V wheel motors. The 100V powertrain shows lower energy consumption versus vehicle speed than the 48V because of lower electric currents and ohmic losses. The most important contribution to cost savings was made by a new very light steel frame that fulfilled all necessary crash test requirements.

The fourth presentation showed the status of the project **i-HeCoBatt** about Intelligent Heating and Cooling solution for enhanced range EV Battery packs. It aims at a 5% powertrain efficiency increase and 20% production cost reduction for the thermal system. Among others, it uses printed thermal sensors and heating actuators. The mass of the battery pack could be reduced by 22 kg. Removing gap filler in the battery pack was the main contributor to cost reduction. Also, a lower temperature variation between modules of the pack could be achieved at an overall lower temperature level. The validation of target achievement was still ongoing at the time of the presentation.

The **FITGEN** *) project focuses on a Functionally Integrated E-axle Ready for Mass Market Third GENeration Electric Vehicles. It aims to achieve such an axle's maximum performance within a cost limit of 2000 €/unit. A permanent magnet electric synchronous motor with an 800V six-phase SiC inverter is connected to a 400 V battery using a bidirectional 800V DC/DC converter that also enables 800V fast charging of the battery. The e-motor with a power density of 6 kW/kg and 23000 rpm exceeds the targets of 5 kW/kg and 18000 rpm significantly. Rotor shape and formed litz were both patented, torque ripple and magnet weight are very low with the latter being about 40% below state of the art. A brand-new inverter design with SiC-MOSFETs with a housing volume of just 5.1 litres achieves a power density of 35 kW/litre. The components are integrated for TRL 7 demonstration in an A-class vehicle.

18. Understanding and reducing harmful emissions for human health



PROJECTS



Summary from: Simon EDWARDS (Ricardo)

OVERVIEW OF THE TOPICS DISCUSSED AND THEIR RELEVANCE

Session 18, in the final parallel session on the second day, the understanding and means to reduce road transport related emissions harmful to human health, as derived from recent Horizon 2020 projects, were presented and discussed. Given the recent reports from the UN, the importance of health effects related to road transport is ever present: these presentations address this topic from various perspectives.

RESULTS HIGHLIGHTED WITHIN THE TUBE PROJECT

The first presentation was by Topi Rönkkö, a work package leader within the **TUBE** project: "Transport Derived Ultrafines and the Brain Effects". The project (under EC grant agreement number 814978) will run for four years: the ideas for the project, its organization (with 17 or more multidisciplinary partners) and some preliminary results were shown (from three academic publications). The project looks at the effects on the brain and lungs in combination, using, for example, biomarkers for the early detection of brain disease as a result of air pollution, e.g., ultrafine particles from road transport.

RESULTS HIGHLIGHTED WITHIN THE MODALES PROJECT

The second presentation was by Andrew Winder, on behalf of the **MODALES** project: "Modify Driver's Behaviour to Adapt for Lower Emissions". The project (under EC grant agreement number 815189) looks at the co-variability between driver behaviour and vehicle emissions (from the engine, brakes and tyres) in order to modify behaviour via awareness and training; as well as touching upon OBD, inspections, tampering and retrofits. The consortium consists of 16 partners within Europe and two in China; it will run for four years, ending in 2023. Good progress has been made and it is expected that significant reductions in vehicle-related emission can be achieved through the application of the techniques: for example, a 5 to 10% reduction of emissions is expected by applying the MODALES low emission driving guidelines.

RESULTS HIGHLIGHTED WITHIN THE DIAS PROJECT

The third presentation, by Dimitrios Kontses, also touched upon tampering as part of the **DIAS** project: "Smart Adaptive Remote Diagnostic Antitampering Systems". The project (under EC grant agreement number 814951) is completing in 2022 after three years in a consortium covering testing, security, the IoT,

legislation, policy, diagnostics, OBD and OBM. Up to 10% of EU5/V & 6/VI vehicles are estimated to have tampered with environmental protection systems, yet even a small percentage can lead to a huge increase in fleet emissions. Therefore, the project concentrates on detection, prevention and reporting means to make tampering economically unattractive and reduce fleet emissions. This will have implications for future emissions regulation, support authorities, and regulatory bodies as well generating climate and public health benefits.

RESULTS HIGHLIGHTED WITHIN THE NEMO PROJECT

The **NEMO** project was presented by Cecilia Mattea: it is running for three years, until April 2023 having a consortium of eighteen partners. As well as developing an autonomous remote sensing technology for vehicle exhaust emissions, the project is developing noise measuring technology and negative emission solutions for road infrastructure. As such, the project hopes to achieve a 30% reduction in exhaust emission and a 20% reduction in roadside noise in targeted zones.

CONCLUSIONS, LESSONS LEARNED AND FUTURE RESEARCH NEEDS.

Following the presentations, an extensive and lively discussion ensued. It is clear that, whilst over the last few decades, significant reductions in the air quality-related and noise emissions from road vehicles have been achieved, techniques are being developed that will allow "outliers" to be identified, their effects minimised. Further, that the understanding of the health effects continues to progress, such that future impacts can be better understood and responded to.

19. Introducing Connected Automated Mobility in real traffic conditions



PROJECTS



Summary from: Bastiaan KROSSE (TNO)

The session “**Introducing connected automated mobility in real traffic conditions**” gave an overview of four state-of-the-art research projects, focussing on demonstration of different CCAM applications in real traffic conditions, based on different vehicle types, ranging from passenger cars (L3Pilot), shuttles (SHOW) and trucks (ENSEMBLE). These three projects are matching with the three development paths that have been defined within the previous ERTRAC roadmaps: passenger cars, commercial vehicles and urban mobility. Next to these three projects, in which tests, demonstrations, and pilots on real roads have taken place, the HEADSTART project was presented, in which new testing and validation procedures of CAD functions have been developed.

The **L3Pilot** project had a clear focus: piloting Automated Driving, with 1000 drivers, 100 cars, on 10 different European roads, on 4 different application areas: Traffic Jam, Motorway, Parking and Urban. Eventually, the different partners piloted the different applications in various regions across Europe. An important aspect that the project has been pushing for is “a common language”: a common technology understanding amongst the different project partners, that acted as a basis for development. As an example, part of these definitions has been used as an input for DIN/SAE Terms and Definitions Related to Testing of AV Technologies. Moreover, the project also contributed to the description and taxonomy of Automated Driving functions in relation to the Operational Design Domain (ODD). An upgrade of the CoP (Code of Practice) for the development of Automated Driving Functions was made within the project as a successor of the previous AdaptIVe project. Another important delivery of the project for broader use was the FESTA methodology, which was brought to the next level to make it applicable for automated driving tests. The European-wide COVID situation made the pilot execution very challenging, but more than 75% was done. The Hi-DRIVE project was shortly touched upon, in which the challenges towards the deployment of Higher Automation will be addressed.

ENSEMBLE showed how the objectives of the project are paving the way to the adoption of multi-brand platooning in Europe i.e., by standardization of multi-brand specifications, implementing the platooning functionality in differently branded trucks, and demonstrating that under real-world traffic conditions. Assessment of the impacts, based on tests and demonstrations, are completing the key objectives of this project. Key in the project was the fact that the platooning technology was agreed by all leading European truck OEMs and as such, ready for standardization. The project delivered two ways of platooning, i.e., a

specified, implemented and demonstrated support function (PSF), as well as a specified Autonomous function (PAF).

Like L3Pilot, ENSEMBLE gave input to (pre-) standards (ISO, ETSI), mainly on the communication protocol, and in this way supported the future deployment. Within the project, specific attention was paid to the infrastructure impact of platooning (road, tunnels, bridges), fuel consumption, the business case, impact on traffic flow and other road users. In many cases, the insights were differentiated for the two ways of platooning as described above. The remaining challenges after the project are the lack of a legal framework to drive at shorter distances and without a driver in following trucks, as well as the need for future research on brake performance estimation.

The **SHOW** project is, in short, about Shared automation Operating models for Worldwide adoption. The project's purpose is to support the deployment of shared, connected, and electrified automated vehicles to advance sustainable urban mobility by means of 70 partners from 13 EU countries (until the end of 2023) and by having real-live urban demos in 20 cities across Europe. It was explained how the project aims to be the biggest ever real live CCAV urban demonstration initiative by developing technical solutions, deploying fleets of AVs, and conducting the demonstrations. The project is more than halfway and is moving from rehearsals to real-live demonstrations, of which a number have already started. Next to the preparation of the demonstration, a lot of other activities are going in the context of the demos, such as surveys, simulations, realized infrastructure, etc. A special highlight was that a number of cities became follower sites of the SHOW project, from various places all over Europe, SHOWing the big interest for the project. Like the other two projects, the SHOW project is also creating connections beyond the project by means of concertation with other EU projects as well as twinning activities around the globe. Last but not least, SHOW indicated its ambitions to have long-term impacts in real-life conditions, by making the demos part of a bigger picture and by contributing to standards.

Unlike the other three projects that included (large-scale) demos and pilots, the **HEADSTART** project focused on the definition of testing and validation procedures of CAD functions. Special attention was paid to key enabling technologies in the field of communication, cyber and positioning. Another strong element has been the testing in different ways, by simulation, proving grounds and real-world field test. All of this, with the goal to be able to validate safety and security performance according the needs of tech. developers, consumer testing, and type approval parties.

In order to come to the HEADSTART Methodology requirements, an extensive gap analysis was done based on different existing methodologies, toolchains, legislation, etc. But also the very important input by user groups, with the major challenge to come to harmonization of existing testing and validation approaches. HEADSTART used the input from existing projects and applications (such as truck platooning and passenger car automation functions) as a basis to demonstrate the developed methodologies, procedures and tools by testing. Key for the project, and also beyond the project, was the creation of consensus through the creation and management of an expert network of highly relevant and impactful stakeholders. It is concluded that standardization is in infancy on this topic, and it is therefore needed to move to the next level of standardization, to work to a commonly accepted Safety Assurance Framework (SAF) for the safety validation of CCAM systems. Furthermore, it was concluded that w.r.t. scenario databases, a single concrete approach should be used, dealing with scenarios of any variations, including the creation, editing, parametrization, etc. in a universally agreed manner. Future initiatives of the EC inside HORIZON 2021 are moving in this direction.

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All projects together showed significant achievement in the field of passenger cars, commercial vehicles, urban shuttles and, as such, covering a major part of the different road transport modes. Many different stakeholders were involved, both public and private, essential for getting connected and automated mobility deployed in real traffic conditions. These achievements have had their impacts within and outside the projects, and as such they have a strong contribution to accelerating the deployment of CCAM.

20. Battery design, modelling and manufacturing



PROJECTS



Summary from: Marlena VOLCK (AVL)

In the session “**Battery design, modelling and manufacturing**” intermediate and final results of 4 different projects were presented:

1. **GHOST**: InteGraed and PHysically Optimised Battery System for Plug in Vehicles where the main goal was to extend the electrical vehicle diffusion through the improvement of Battery System in terms of: range, lifetime, functional safety, reliability.
2. **MODALIS**: MODelling of Advanced LI Storage Systems. Here, a new simulation toolchain was developed to provide stakeholders (raw material - cell manufacturer, OEMs) with necessary information. The main focus is on new technologies (Silicon based anodes, solid-state electrolytes and Li metal), which require new modelling.
3. **DEFACTO**: Battery DEsign and manuFACTuring Optimization through multiphysics modelling, generating integrated software tools that achieve the maximum accuracy and robustness to describe cell behavior and manufacturing processes.
4. **IMAGE**: Innovative Manufacturing Routes for Next-Generation Batteries in Europe, where the development of generic production techniques for next-generation lithium battery cells was executed.

The main achievements highlighted during the session and reported by the projects were the following: Dealing with reduction of development time and cost of battery due to

- Modelling tools, which allow a better understanding of cell behaviour
- Standardization
- Optimization of cell development along the whole value chain

As a second point, the development of new tools and knowledge dealing with next-generation batteries was reported. And last but not least, to give EU a competitive advantage a new simulation toolchain was developed and a production framework was set up.

Based on the activities performed by these projects, the following improvements can be expected in the years to come:

- Extend the battery lifetime and reduce the environmental impact. This is achieved by maximum accuracy in cell modelling at reasonable computing costs.
- Increase the cells energy density, which leads to a longer driving distance.
- Less energy-intensive and less complex manufacturing leads to lower costs.

However, there is still the necessity for the EU to further do research and to set up a development and production framework to be competitive in the future.

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