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Executive Summary

This deliverable presents the E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) virtual Cluster that brings together 8 independent R&D projects on EVs developments jointly and complementarily addressing the 4 technical scope areas of the Green Vehicle calls.

The first part of this report, chapter 1, introduces the SELFIE project, the E-VOLVE Cluster and its objectives.

Chapter 2 presents an overview of the communication and dissemination strategy of the Cluster.

Then, chapter 3 showcases the newsletter published during the E-VOLVE Cluster operation.

Finally, conclusions are drawn in chapter 4.

The list of cluster dissemination activities performed during the project are reported in detail in D8.6 Report on cluster level optimization.

Attainment of the objectives and explanation of deviations

No deviations or delays have occurred in tasks and activities related to the specific deliverable.



1 Introduction

1.1 SELFIE and its objectives

SELFIE - 'SELF-sustained and Smart Battery Thermal Management Solution for Battery Electric Vehicles is a project funded under Horizon 2020 programme by the European Union (Grant agreement no: 824290).

SELFIE intends to develop and demonstrate a novel self-sustained compact battery system, consisting of:

- **A smart modular battery pack**, which has excellent internal thermal conductivity properties, a refrigerant cooling system and thermal storage system (heat buffer) capable to absorb excess heat due to fast charging, and which is thoroughly insulated from the outside;
- **An advanced battery thermal management system** capable to keep the battery temperature effectively within the optimal window and to prevent overheating (and battery degradation) due to fast charging.

Successful implementation of the project will significantly increase user acceptance of EVs by enabling fast-charging and offering significant cost reductions and elimination of range anxiety compared to other propulsion technologies.

1.2 E-VOLVE Cluster presentation

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is developing, implementing, realizing and monitoring synergies between eight projects.

The purpose of the Cluster is to execute joint dissemination and exploitation activities.

E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster aims at virtually bringing together 8 independent R&D projects on EV developments, jointly and complementarily addressing the technical scope areas of the Green Vehicle topic. In order to connect parallel R&D activities in complementary areas and to implement a higher potential produced by intersectoral cooperation, the E-VOLVE virtual Cluster has been set up. The Cluster will produce greater impact acknowledging the importance of connecting parallel R&D activities funded on complementary areas, as stated by the European Commission. The member Projects in the E-VOLVE Cluster have decided to prove the higher potential of synergies between projects. As a result, E-VOLVE Coordinators trust that together as a virtual Cluster they will produce a greater impact by delivering innovations that cover a wide range of EV components, designed especially for the new (3rd) generation of EVs to meet the future mobility needs in both the urban environment and inter-city trips, while meeting as well, the requirements in energy efficiency, usability and cost that the market demands.

At this time, the Cluster members are eight: six founding projects (ACHILES, SELFIE, CEVOLVER, EVC1000, SYS2WHEEL, FITGEN) and two newest members, TELL and MULTI-MOBY that joined the Cluster early 2020. Detailed presentation of the Projects can be found on the [Cluster website](#).



2 Communication and dissemination activities

2.1 Communication Strategy

The E-VOLVE initiative was set to motion once the Projects were approved and began their implementation. A clearer strategy of action for the Cluster was set and a Gantt Chart was developed to ensure a smooth monitoring of the set goals.

As part of the dissemination strategy, the Cluster identity was developed by VUB with the design of a logo, the definition of a colour palette and the establishment of templates.

In parallel, a Dissemination Plan in D7.2 and in ACHILES' D6.8 Cluster dissemination and communication strategy was developed, defining the guidelines, methodology and approach to ensure a smooth implementation of the Cluster's communication activities. The strategy includes:

- Roles and responsibilities;
- Target audiences;
- Key messages;
- Appropriate channels and tools;
- Key Performance Indicators.

In addition, specific goals and objectives have been set:

- To communicate Cluster activities, news and developments;
- To disseminate Cluster results and outputs;
- To attract and involve different audiences (stakeholders, EU agencies, projects, industry, general public) and engage them in the communication activities to further maximise the impact and raise awareness regarding the Cluster results;
- To attract projects to join the Cluster.

The communication and dissemination strategy are monitored bases on specific KPIs.

2.2 Common dissemination activities

The table below reports the list of evnets in which E-VOLVE participated or submitted an application as a Cluster.

Type	Title	Date	Place	Description
Other/ Workshop	<u>GHOST & iModBatt workshop</u>	October 18, 2019	St. Sebastian, Spain	Cluster and Projects were presented and represented by CEVOLVER (M11). E-VOLVE also participated in the Poster session.



Conference	<u>2019 IEEE ICCVE</u>	4-8 November 2019	Graz Austria	–	EVC1000 represented the Cluster and presented the Cluster and Projects
Scientific Publication	<u>2019 IEEE ICCVE</u>	4-8 November 2019	Graz Austria	–	1 Armengaud E., Hegazy O., Brandstätter B., Ivanov V., Tatschl R., De Gennaro M., Sornioti A., Van Mierlo J., Schernus C., 23 January 2020, European Innovation for Next Generation Electrified Vehicles and Components, IEEE, [https://ieeexplore.ieee.org/document/8964843]
Conference	<u>14th International A3PS Eco-Mobility 2019</u>	14-15 November 2019,	Vienna Austria	–	CEVOLVER represented and presented the Cluster and Projects
Conference	<u>EARPA Spring meeting 2020</u>	3-4 March 2020	Brussels Belgium	–	Cluster and Projects' presentation
Other/ Exhibition	<u>GoMobility 2020</u>	11-12 March 2020	Gipuzkoa Spain	–	A Cluster and Projects' presentation and participation to the poster session.
Conference	<u>CO2 Reduction in Transportation Systems Conference</u>	July 9th, 2020			Cluster was presented and represented by CEVOLVER, powerpoint and video available.
Conference	<u>FISITA World Congress</u>	September 14-16, 2021	Online		Cluster was presented and represented by CEVOLVER, ACHILES, EVC1000 and FITGEN.



Other/ Round table	E-VOLVE Round Table	November 18th, 2021	Online	Cluster members came together to organize a round table where the Working Groups presented project results and developments. The event brought together 51 persons in total, to discuss EV barriers and opportunities and how H2020 projects work towards the EU objectives.
Conference	<u>WCX SAE World Congress Experience</u>	April 5-7, 2022	Detroit, USA	E-VOLVE presented their scientific publication (see below).
Scientific Publication	<u>WCX SAE World Congress Experience</u>	April 5-7, 2022	Detroit, USA	The second publication for the Cluster came in the context of the SAE WORLD CONGRESS 2021: a paper was submitted, accepted and published in 2022: Armengaud, E., Brandstätter, B., Biček, M., Buh, J. et al., "Towards Brand-Independent Architectures, Components and Systems for Next Generation Electrified Vehicles Optimised for the Infrastructure," SAE Int. J. Adv. & Curr. Prac. in Mobility 4(5):1906-1922, 2022, https://doi.org/10.4271/2022-01-0918 .
Other/Proje ct event	<u>CEVOLVER Final event</u>	September 27th 2022	Aachen, Germany	Cluster participated in the poster session and was represented by VUB and Achilles.
Conference	<u>EARPA Autumn meeting 2022</u>	October 19th 2022	Brussels – Belgium	ACHILES represented the Cluster and presented the results.



Conference	<u>Transport Research Arena TRA2022</u>	November 14-17, 2022	Lisbon, Portugal	The Cluster members decided to submit an application and participate in the TRA2022 with the Invited Session (Tuesday 15th, 15:00-16:30). During this session "European Innovation for the Next Generation of Electric Vehicles by E-VOLVE Cluster", the E-VOLVE Projects did a pitch of their results and contributions towards the future EV, under the five Working Groups.
Conference	<u>TRA2020</u>	April 2020	Helsinki Finland –	The application was rejected on the grounds that the Projects were still immature
Conference	<u>3rd European Conference on Results from Road Transport Research in H2020 projects</u>	4-5 December 2019	Brussels Belgium –	The application was rejected on the grounds that the Projects were still immature (only Projects after 1 ½ year of implementation are accepted)
Conference	<u>TEN-T Days 2020</u>	May 2020	Sibenik – Croatia	E-VOLVE was accepted to participate but the event was cancelled due to COVID-19.
Conference	<u>EUCAR Reception and Conference 2020</u>	November 17th, 2020	Online	Cluster submits an application to participate in the exhibition, however the event took place virtually with no possibility of exhibition.
Conference	<u>EARPA FORM Forum 2020</u>	October 12-14, 2020	Postponed to 2021	EARPA FORM was only held virtually, so the agreed upon application to participate in the exhibition as a Cluster was not submitted.



Conference	<u>33rd IEEE Intelligent Vehicles Symposium</u>	5-9 June 2022	Aachen, Germany	An E-VOLVE workshop was planned to be organized with the title <i>The EVOLVE Cluster of EU H2020 projects about Electric Vehicles Optimised for Life, Value and Efficiency</i> . In the end, E-VOLVE withdrew as the conference took place on public holidays and the impact would have been too low.
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Table 1. List of applications and/or participation of E-VOLVE at events

3 Newsletters

The communication strategy defines one common newsletter every six months and this has been achieved, as presented in the table below:

#	Date
1	August 2019
2	December 2019
3	May 2020
4	December 2020
5	May 2021
6	December 2021
7	May 2022

Table 2: Newsletter publication dates

Seven newsletters in total have been published during the E-VOLVE Cluster operation during the period May 2019 - November 2022. The content focuses primarily on the Cluster members results, developments and announcements and on E-VOLVE Cluster news, e.g. common dissemination activities or expansion.

The newsletter is being prepared 4 weeks before its publication: three weeks to collect and adjust contribution and one week to finalize the format. The format and template uses the Cluster's visual identity, displays the logo of the Cluster and the ones of the projects. It also includes the official contact channels and links to the project members websites.

The newsletters are published on the EVOLVE Cluster website and then posted on the Cluster social media accounts (LinkedIn and Twitter).



3.1 1st newsletter

The first newsletter was published in August 2019, as the operation of the Cluster went in motion practically in May 2019. It was published on the [E-VOLVE website](#) and can be [downloaded for free](#).

E-VOLVE CLUSTER NEWSLETTER

E-VOLVE
EV for Life, Value, Efficiency

E-VOLVE
Cluster
Newsletter

The E-VOLVE Cluster is here!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between six projects from the GV 01 Horizon 2020 call to execute joint dissemination, exploitation and standardisation activities.

The Concept
The purpose of the Cluster is to execute joint dissemination and exploitation activities. In order to connect parallel R&D activities in complementary areas and to implement a higher potential produced by intersectoral cooperation, the E-VOLVE virtual Cluster has been set up. The Cluster will produce greater impact acknowledging the importance of connecting parallel R&D activities funded on complementary areas, as stated by the European Commission. The

The Project Members
ACHILES
The objective of ACHILES is to develop Advanced Architectures Chassis/Traction concept for Future Electric vehicles. ACHILES will enhance new parts and functionalities in a new E/E system architecture by developing and further integrating four technological concepts. Each of the four concepts are a technological paradigm shift and breakthrough on their own, but together they will significantly reduce weight, system complexity, and cost while increasing reliability, and user comfort and safety/security.

SELFIE
SELFIE, a European research and innovation project, aims to develop a novel self-sustained compact battery system for next generation electrified vehicles (EVs). A significant increase of user acceptance of EVs by enabling

fast-charging, cost reductions and elimination of range anxiety compared to other propulsion technologies will be the user benefits of SELFIE.

FITGEN
FITGEN aims at developing a functionally integrated e-axis ready for implementation in third generation electric vehicles. It is delivered at TRL and MRL 7 in all its components and demonstrated on an electric vehicle platform designed for the European market (A-segment reference platform). The e-axis is composed of a latest generation Buried-Permanent-Magnet Synchronous Machine, driven by a SiC-inverter and coupled with a high-speed transmission. It is complemented by a DC/DC-converter for high voltage operation of the motor in traction and for enabling super-fast charging of the 40kWh battery (120 kW-peak) plus an integrated AC/DC on-board charger. The e-axis also includes a breakthrough cooling system which combines the water motor/inverter circuit with transmission oil.

CEVOLVER
CEVOLVER takes a user-centric approach for optimizing the development and operation of electric vehicles and uses cutting edge technologies, components and systems for achieving the

ambitious targets of the call topic. In both cases, the project exploits opportunities of connectivity to computational capabilities of big data.

SY82WHEEL
Would you like clean air in the city? How can we get rid of noise and exhausts from delivery vans in the city? Addressing the issues of urbanisation, transportation, and rising greenhouse gas emissions is one of the biggest challenges of the future. In particular, the electrification of road transport is high on the political agenda of all major world economies. In sy82WHEEL give answers to these questions by developing sustainable city logistics and improving mobility and quality of life of European citizens.

in terms of active safety, packaging and drivability, EVC1000 focuses on in-wheel drivetrain layouts, as well as a wheel-centric integrated propulsion system and EV manager.

Exciting News!
E-VOLVE is proud to announce that it will be presented at the GHOST and iModBatt Workshop, October 18th at Cidetec offices in San Sebastián, Spain.
E-VOLVE has been invited for a five-minute presentation and to participate in the Poster Section!
Connect with us and stay tuned!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

Figure 1: First E-VOLVE Newsletter

The second newsletter was published in December 2019, with the contribution of all project members. It was published on the [E-VOLVE website](#) and can be [downloaded for free](#).



3.3 3rd Newsletter

The third newsletter was published in May 2020, with the contribution of all project members. The newsletters started growing in size, as the projects implementation was progressing. A maximum limit size was set to five pages. It was published on the [E-VOLVE website](#) and can be [downloaded for free](#).

E-VOLVE MAY 2020

E-VOLVE
EV for Life, Value, Efficiency

E-VOLVE Cluster Newsletter
May 2020

A full year of success!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between six projects from the GV-01 Horizon 2020 call to execute joint dissemination, exploitation and standardization activities.

The Project Members
ACHILLES, SELFIE, FITGEN, CEVOLVER, SYS2WHEEL and EVC1000 are the Founding members of the E-VOLVE Cluster. They form the Executive Board, which plans and implements all the Cluster activity.

A new addition
2020 brought the first Cluster expansion: H2020 TELL Project was welcomed in the Cluster and is now a proud member.

te-ll

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

E-VOLVE NEWSLETTER MAY 2020

develop new chassis components, namely innovative Brake by Wire and active suspension systems; integrated controllers designed to improve efficiency on long journeys, while ensuring relaxed, comfortable and safer driving.

EVC1000 will showcase the effectiveness of the integrated wheel-centric propulsion architecture and EV management in two second generations of Electric Vehicles – the Audi e-tron and JAC IEV6S.

The EVC1000 project, led by the Austrian company AVL List GmbH, receives a total funding of €5.15 million over 3 years. The consortium includes partners from six European countries: Audi Gesellschaft (DE), Jac Italy Design Center Srl (IT), Brembo S.p.A (IT), Elaphe Poggenske Technologie Doo - Elaphe Propulsion Technologies (SI), Ideas & Motion Srl (IT), Tenzeco Automotive Europe Bvba (BE), Fraunhofer Institute for Electronic Nano Systems ENAS (DE), Technische Universität Ilmenau (DE), University of Surrey (UK).

Figure 1: e-axle concept

SELFIE: First Year Results
Throughout the last year (December 2018 - November 2019) the SELFIE partners focused on the requirements and specifications of the battery thermal management system, as well as on a first preliminary concept design on components and system level. The requirements and specifications at vehicle level have been identified in terms of vehicle performances (max power, max speed, etc.) and driving range, considering the target to remain inside an interval of 60min - 90min more concerning the driving time of an equivalent vehicle with an internal combustion engine for long duration trips of 700-1000 km. Starting from such vehicle requirements, detailed specifications for the battery system have been defined in terms of volume, weight, energy, charging rate, charging power (140 kW) and the lifetime of the pack. After this important milestone, the work could focus on the concept for the design at components and system level, for example, a multi functional sandwich battery housing (Fig.1). An important part of the SELFIE project is the design and engineering of a battery housing which besides of mechanically supporting the battery cells provides heat storage, heating and cooling capability. It will mainly be made of a sandwich structure consisting of glass-fibre reinforced polymer face sheets and a polymer foam core. The battery cells will be arranged on PCM loaded aluminium foam plates to buffer the heat generated during fast charge cycles to avoid an energy consuming high power cooling system. Furthermore, cooling plates between the battery rows and in thermal contact with the aluminium foam/PCM plates will remove the heat from the battery pack.

Figure 2: Battery housing structure

An ultra-compact cooling module and a cold storage device to optimize cabin comfort while fast charging was also designed.

Outlook on future activities:
The final design of the components of the battery system will be validated by simulation models in terms of functional performance, weight and volume. Furthermore, manufacturability and costs will be taken into account. Once the design is approved and the manufacturing technologies are selected, the manufacturing of prototypes and testing will start. In the meantime, the SELFIE partners are working on the development of an optimal thermal management system control strategy for the battery system. Once the models have been validated, an optimal control strategy for the thermal system will be identified and taken into account a compromise between the thermal performance and the energy consumption for different use-cases.

TELL Project: Optimisation and large scale manufacturing of low and medium voltage electric powertrain solutions
The TELL project addresses the optimisation and large-scale manufacturing of low and medium voltage electric powertrain solutions, with focus on high efficiency, compact packaging and low cost. Three main applications

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

E-VOLVE NEWSLETTER MAY 2020

are targeted: i) Small-to-medium segment electric cars; ii) Hybrid electric cars with a low voltage add-on electric propulsion system; iii) The lightweight urban mobility sector, e.g., electric quadricycles.

The TELL powertrains will be demonstrated on two electric vehicle platforms: i) a four-wheel-drive (4WD) vehicle operated at a nominal voltage of 100 V by a Si MOSFET based inverter; and ii) a two-wheel drive (2WD) vehicle operated at a nominal voltage of 48 V by an inverter based on GaN semiconductor technology.

Figure 3: First TELL vehicle prototype (4WD)

In the past months the TELL participants have achieved important goals together, assembling their first vehicle prototype. The 4WD vehicle, first of the two envisaged in the project, was tested successfully on the rolling road at the I-FEVS facilities and it even moved the first "steps" outside the workshop, for some preliminary performance tests as well for assessing the various sensors and a newly integrated vehicle control system architecture. The second (2WD) vehicle is already on its way.

The choice of a small consortium has revealed very manageable and effective to achieve TELL ambitious targets, with excellent results in the first project period. Some of the impressive technologies, such as part of the

electric/electronic architecture were presented early this year at the renowned MOVE 2020 exhibition in London (UK).

For more information:
Visit our project web page: <https://horizon2020-tell.eu/>
Follow us on our LinkedIn page: www.linkedin.com/company/ev-project-tell

FITGEN at the technology development stage
During the last General Assembly held @BRUSA, the Fitgen consortium discussed the progress in the design of the e-axle complex. The targets and specifications of the final e-axle were completely defined in Autumn 2019, and the project is now at the technology development stage.

The design of the motor geometry and winding is in a good shape, together with the development of the six phases inverter based on the latest SiC power MOSFET technology.

The development of the transmission gear is also proceeding well, and different options for the advanced cooling system are under evaluation, as well as control strategy solutions. The project also includes the study of innovative on-board charger solutions, which are demonstrating promising results. Also, the activity for the D&C is ongoing and the Dissemination manager is working for organizing in October the first foreseen workshop, in cooperation with E-VOLVE Cluster and other H2020 projects in the same field of application. Several publications

have been presented in scientific conferences worldwide and others are currently under review. Even if the project is facing the Covid 19 pandemic, the consortium has quickly learned how to cope with the new restrictions and pushing hard to make FITGEN a European success.

Figure 4: FITGEN GA in Sarnold, @Brusa

Our Year SYS2WHEEL sustainable city logistics
In the first year of the project, one major achievement was the development of requirements covering the wide range of different electric powertrains. It's the basis for the next steps, especially the basic simulation and tool development in Work Package 2, where development of controls and virtual validation of solutions is carried out.

A major challenge for the upcoming months is the development of the different powertrains and its components, thermal management, NVH investigations and advanced control fulfilling the different requirements for our 2 main approaches for electric driving in a fleet application (e-axle and in-wheel motor).

NEW TORQUE VECTORING CONTROLLER
The University of Surrey will implement new torque-vectoring controller for the prototype SYS2WHEEL Fiat Tofas Doblo with front in-wheel motors.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

E-VOLVE NEWSLETTER MAY 2020

State-of-the-art implicit nonlinear model predictive control technology is being developed and compared with conventional stability controllers from equivalent production vehicles, based on the actuation of the friction brakes.

Figure 5: Simplified block diagram of the torque-vectoring control structure

CEVOLVER: Connectivity interface for simulation
Within the CEVOLVER project an important role is played by advanced strategies that operate testing the prototype demonstrators using connectivity as sources of real time information.

Figure 6: Connectivity architecture

The results of the discussions between the partners are available. In short we can say that the advanced features such as optimal thermal management, eco-routing with assured charging functionality, and eco-driving will rely on connectivity to improve, on one hand, the energy consumption (that will impact the vehicle range), and on the other hand, increase user confidence in electric vehicles.

The complete report can be found [here](#). A simplified version of the connectivity architecture agreed on is sketched in the figure.

Setting the scene for a connected energy and thermal management concept

The CEVOLVER scene for a connected energy and thermal management has been set! The connected management functionalities make use of several connectivity features to optimise the route selection, driving behavior, charging stops and charging process. This is made possible due to the cloud-based data and the cloud computing capabilities to perform resource intensive calculations that cannot be otherwise implemented on a Vehicle Control Unit (VCU).

The main activities on this part of the project included specifying brand-independent interfaces for Electric Vehicle (EV) components, system and cloud. Including connectivity requirements for simulation supported testing, [read more](#)

ACHILLES: Halfway there!
After one year and a half since the ACHILLES project started (December 2018), the full requirements and specifications for the Battery Electric Vehicle (BEV) have been defined; focus has been given to the powertrain and chassis with support of the brake system by the powertrain. The requirements are based on the Audi Q2 BEV, which will be used as a baseline to be improved through the project.

The overall architecture for this next generation EV has been

optimized to include various subsystems, mainly the brake, powertrain and chassis. Subsystems are being finalized to allow higher reliability, safety, security and energy efficiency with proper signal interfaces. The models and control strategies adaptations to integrate the innovative technological concepts – for a new wheel concept design, a centralized computer platform, an out of phase control and a new torque vectoring algorithm – have been thoroughly discussed within the consortium and have been delivered.

Figure 7: Audi Q2 BEV demo vehicle on which the ACHILLES concept will be tested and verified

Finally, important design and development steps have been taken towards the implementation of the new wheel concept and brake system within the chassis and powertrain. The integration phase will then follow with the Audi Q2 BEV being dispatched to the project partners.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

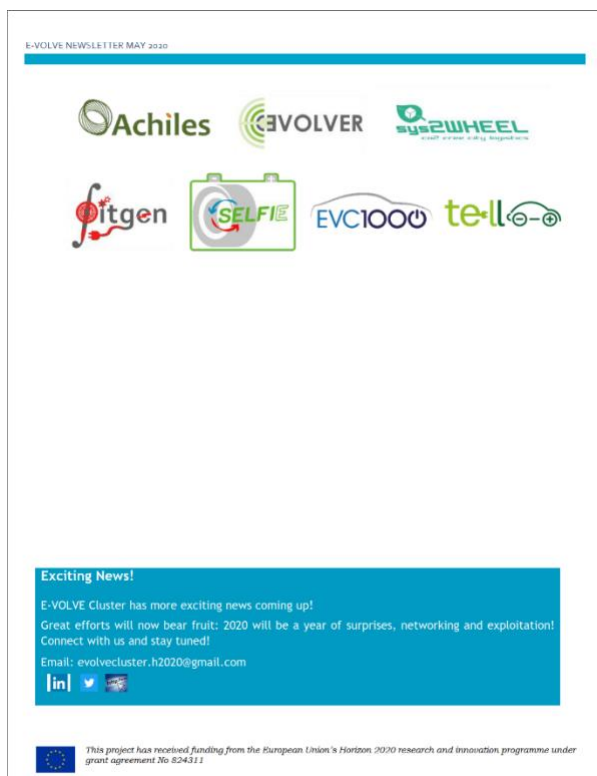


Figure 3: Third E-VOLVE Newsletter

3.4 4th Newsletter

The fourth newsletter was published in December 2020, with the contribution of all project members. It was published on the [E-VOLVE website](#) and can be [downloaded for free](#).

E-VOLVE DECEMBER 2020


E-VOLVE
 EV for Life, Value, Efficiency

E-VOLVE Cluster Newsletter

December 2020

2021: Demos, testing & prototyping!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between seven projects from the GV.01 Horizon 2020 call to execute joint dissemination, exploitation and standardization activities.

The Project Members

ACHILES, SELFIE, FITGEN, CEVOLVER, SYS2WHEEL and EVC1000, TELL are the members of the E-VOLVE Cluster.

Interested in learning more about our Cluster members? [Visit our website!](#)

WCX APRIL 15-15 2021 DETROIT

Figure 1: SAE Congress April 13-15, 2021, Detroit

E-VOLVE NEWS

Dissemination of project results takes off!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824311

E-VOLVE NEWSLETTER DECEMBER 2020

battery pack to low DC voltage of 12 V and on-board charger for converting the input three-phase AC voltage of 400V from the grid to DC voltage of 210-400 V.

A novel and modular battery system model developed by VUB, based on cell specification and innovative characterization techniques for determining both the electrical and thermal models and the lifetime model.

A vehicle multi body model, developed by TECNALIA, including chassis, steering and suspension and wheels modelling.

A Torque path model, also from TECNALIA, covering from the acceleration pedal interpretation to the torque command for each in-wheel motor after the torque vectoring strategy and taking into account the vehicle dynamics and other constraints coming from e-drive, energy storage system and the MC switch.

[Find out more!](#)

Figure 2: Achiles Break Disc & Schematic of the battery model

ACHILES: ACHILES at the H2020RTR conference

Dr. Thomas Geury, the technical manager of ACHILES has presented the concept and results of the project at the H2020 road transport research results conference on 1 December. After the presentation a lively discussion took place between the >50 attendees and the representatives of the E-VOLVE

cluster projects, SYS2WHEEL and FITGEN, chaired by Christof Schermus, the Coordinator of CEVOLVER.

On the same day, at an earlier session 3 other projects from the E-VOLVE cluster (EVC1000, CEVOLVER, TELL) were also presented and discussed, chaired by Luca Feola, INEA project officer. If you have missed the conference, you can still look at the recording of the ACHILES presentation [here](#) and all other sessions here!

The E-VOLVE cluster is managed by ACHILES and consists of 7 H2020 projects. [Find out more](#) about it!

ones are selected for implementation in the demonstrator base vehicle, which is a Ford Transit Van with battery electric propulsion system.

The resulting effects on the key performance indicators as e.g. energy consumption, range accuracy or travel time are assessed by means of real world driving and testing in a controlled environment. Finally, the selected technologies are also assessed economically by carrying out a Total Cost of Ownership analysis.

Figure 3: Dr. Thomas Geury presenting ACHILES at H2020RTR

Figure 4: Ford Demonstrator Vehicle

News on the status of H2020 EVC1000

The EVC1000 project has been running for more than one year and a half now. After the completion of important components, among which the e-traction axle system leveraging on the latest Elaphe in-wheel motor technology and the electric wheel dual drive (eWD) by I&M, the consortium focused on finalising the Brembo brake-by-wire, and the Tenuesco suspension systems respectively. The former consists in the development of new rear callipers and disc, integrated in the in-wheel motors, plus a pedal feel emulator, and an electro-hydraulic actuator. The latter in the design of two advanced suspensions adapted to the

CEVOLVER: Ford Demonstrator Vehicle

Ford's main task in the project is the development of a demonstrator vehicle system through a user-centric approach, selection and right-sizing of components and integration of novel connected control strategies and functionalities. For that purpose, commercial vehicle specific user scenarios and use cases were defined in a first step, considering EU typical boundary conditions as e.g. temperature ranges, velocity profiles, range requirements and charging infrastructure characteristics. Based on this framework, relevant strategies and thermal system components are analyzed and the most promising

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E-VOLVE NEWSLETTER DECEMBER 2020

demonstrator and able to meet the energy efficiency objectives.

With all the components being currently in the final stage, the next steps will be devoted to their integration in the AUDI and JAC vehicles. This activity will be carried out in work packages 5 and 6 led by TUIL and Elaphe respectively, with the participation of partners among which AVL, Tenuesco, Fraunhofer, and the University of Surrey. To finish off, next to the performance assessments and prototype demonstration, control strategies will be also developed.

Figure 5: H2020 EVC1000 video

The EVC1000's objective to create two electric vehicles fitted with the latest component technology in terms of energy efficiency and drivability, which allow for long distance daily trips of up to 1000km, is now coming to reality. For a comprehensive overview on the project, you can watch the [EVC1000 video](#).

H2020 FITGEN project mid-term results

The main scope of the FITGEN project is to develop and deliver a functionally integrated e-axle ready for implementation in 3rd generation electric vehicles by exploiting the potential of a portfolio of electric drivetrain technologies and components. Its objectives can be summarised as follows:

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E-VOLVE NEWSLETTER DECEMBER 2020

Figure 6: CAD model of the FITGEN e-axle

SELFIE: Second year results and outlook for 2021

During the 2nd year of the project (December 2019 – November 2020), SELFIE project focused on the final design and engineering of the battery housing which provides heat storage, excellent heating and cooling capability as well as a strong mechanical support for the battery cells. The battery housing consists of two compartments comprising together 18 battery modules (30 cells each, Fig.1). Furthermore, each compartment is equipped with a) cooling plates between the modules and in thermal contact with the aluminum foam/PCM plates to remove the heat from the battery pack; b) PCM heat buffer underneath the modules to absorb the heat generated during fast energy cycles in order to avoid an energy-consuming high power cooling system. The battery pack design was validated by simulation models in terms of functional performances, weight and volume reductions.

Here the CAD model of the FITGEN e-axle from left to right: inverter box, motor housing and transmission, with mechanical links to the drive shaft and to the vehicle chassis:

Figure 7: Picture of the large component of the battery housing

Additionally, the design of the 1st group of components belonging to the Battery Thermal management (BTM) system was finalised. You can find more information in the Report ["1st set of prototypes" \(D3.2\)](#).

The plan for 2021 is quite ambitious and it will focus on a) prototyping of the different components and assembly of the battery system; b) optimisation of system thermal strategies and hardware test bench development; c) complementary testing of the baseline vehicle & integration.

Although the COVID-19 pandemic is causing cancellations of physical events, SELFIE partners are disseminating the project results via website, social media channels and publications in scientific conferences and journals.

SYS2WHEEL enters 2nd part of implementation

The SYS2WHEEL project has entered now the second half of the project and three of the most important technologies have been developed: the efficient e-axle (Figure 8) has been designed and virtually verified.

Figure 8: E-axle for the IVECO 7t MCV demonstrator vehicle

Currently, the e-axle system is assembled and will be shipped to IVECO at the beginning of 2021. Then it will be installed in the rear axle of the IVECO 7t MCV demonstrator vehicle and tested. The second technology, which is also ready for the installation in the second demonstrator vehicle (Fiat Doblo) is the in-wheel motor system (Figure 9). It has been adapted for the requirements of the Fiat Doblo and will be installed in the front-axle. The third technology is the in-wheel suspension, which will be installed on the rear axle of the Fiat Doblo. Both the in-wheel motors and the in-wheel suspension save space due to their compact design focused on the wheel area. The additional space can be used for additional cargo space, which is an important factor for commercial vehicles. The second possibility would be to increase the size of battery, which would increase the driving range.

Figure 9: In-wheel system for the Fiat Doblo demonstrator vehicle

The next important steps in the project will be the installation of the mentioned technologies in the two demonstrator vehicles followed by a thorough vehicle testing. Further, dissemination and exploitation activities will be intensified.

Figure 10: Example of efficiency map resulting from a motor optimization over WLTP Class 3 driving cycle, 4WD vehicle demonstrator case.

Figure 11: Finalised design of the 100W vehicle demonstrator powertrain incorporated in the TELL demonstrator chassis

Some of the achievements, were presented in December at the RTR 2020 virtual conference organised by the European Commission.

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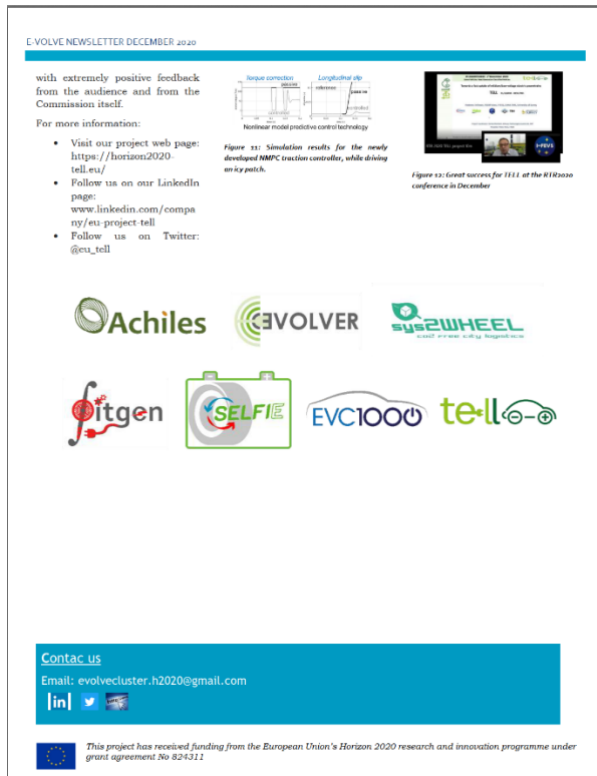


Figure 4: Fourth E-VOLVE Newsletter

3.5 5th Newsletter

The fifth newsletter was published in May 2021, with the contribution of all project members. It was published on the [E-VOLVE website](https://www.evolve-project.eu/) and can be [downloaded for free](#).

E-VOLVE Cluster Newsletter

May 2021

The EVolve future is now!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between seven projects from the GV 01 Horizon 2020 call to execute joint dissemination, exploitation and standardisation activities.

The Project Members

ACHILLES, SELFIE, FITGEN, CEVOLVE, SYS2WHEEL and EVC1000, TELL are the members of the E-VOLVE Cluster.

Interested in learning more about our Cluster members? [Visit our website!](#)

PROJECT NEWS

ACHILLES: Testing plan to validate demonstrator.

Two years and half after the beginning of the ACHILLES project (December 2018), the integration into the Audi Q2 BEV demonstrator is well under way. The modelling, design and prototyping of the powertrain and chassis components have been successfully achieved with a new wheel concept, an out-of-phase control for the brake system and a new torque vectoring algorithm for enhanced vehicle motion control. The physical integration of the components into the Achilles vehicle is ongoing at the different facilities of the consortium.

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Figure 3: Power loss reduction achievements for the new inverter by DANA TM4 using state of the art Infineon components.

Figure 4: The newly designed motor and inverter from DANA TM4 for the 4WD vehicle demonstrator. The inverter testing recorded a 38.8% of peak and a 32.4% of average efficiencies.

For more information:

- Visit our project web page: <https://horizon2020-tell.eu/>
- Follow us on our LinkedIn page: www.linkedin.com/company/en-project-tell
- Follow us on Twitter: [@eu_tell](#)

Learn more about [TELL](#)

2 years SYS2WHEEL: despite pandemic good progress.

The year 2020 was dedicated to developing components and controls that can be integrated into the demonstrator vehicles. The architectures of the 2 demonstrators are well described in 2 deliverables that can be downloaded via the project's homepage. Another publicly available deliverable deals with

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Figure 5: The in-wheel energy harvesting device offers the possibility to transmit signals, stored in the wheel, with very high data rates to a controller at the chassis.

Figure 6: The visual BOM

Learn more about [SYS2WHEEL](#)

SELFIE: Towards the finalization of the battery pack CAD design and safety concept.

The project is now in its 3rd year of research and despite challenges in light of Covid-19 pandemic, the Consortium made great efforts over the past months to keep the project on track. While the battery pack CAD design (see Fig. 7) is going to be finalised by end of May and the first components are ready for prototyping, a functional safety concept for the SELFIE battery system has been elaborated.

Figure 7: CAD drawing of SELFIE battery pack with cradle

The most important hazard for the battery system is the emission of gas, emergence of fire or explosion of the battery because of overheating issues. In addition, there is a risk of electrocution and the unexpected loss of traction in

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Figure 5: Fifth E-VOLVE Newsletter

3.6 6th Newsletter

The sixth newsletter was published in December 2021, with the contribution of all project members. It was published on the [E-VOLVE website](https://www.e-volve.eu) and can be [downloaded for free](https://www.e-volve.eu).



E-VOLVE Cluster Newsletter

(December 2021)

The EVolve future is now!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between eight projects from the Horizon 2020 programme to execute joint dissemination, exploitation and standardization activities.

This 6th Newsletter comes together with a new project member: Multi Moby!

Cluster expansion: The Multi-Moby Project!

Future urban electro-mobility requires the development of a new generation of light, affordable and functional electric vehicles, including smart solutions for enhancing user experience. This topic is addressed by Multi-Moby, which is an ambitious Horizon 2020 project aiming at quickly finalising the results of a cluster of previous and ongoing European projects – addressing the development of technologies for safe, energy-efficient and affordable urban electric vehicles.



Figure 1: Multi-Moby passenger vehicles and multi-purpose vans by I-FEVS

The passenger vehicles and multi-purpose commercial vans of Multi-Moby will assure:

- Best in class safety for occupants, and vulnerable road users (VURs) protection as required by the M1/N1 regulations
- Driving automation capabilities by adopting the most extensively tested sensing and computing platforms, with the addition of low-cost scanning and night vision functionalities
- Highly efficient 48 V and 100 V powertrains
- Robust battery packs based on on-board charger integrating a DC/DC converter optimized for the two voltages of interest
- Efficient AC charging through an on-board charger integrating a DC/DC converter optimized for the two voltages of interest
- DC charging at 48 V and 100 V
- Advanced electric and electronic (E/E) architecture with secure procedures for remote updates and upgrades of the firmware, and predictive maintenance, by applying advanced artificial intelligence (AI) methodologies



- Application of low-cost, flexible, agile and lean manufacturing through a low-investment micro-factory concept
- Competitive price positioning with respect to existing and forthcoming fully electric urban passenger and commercial vehicles

In the last 6 months Multi Moby has achieved several important results, e.g. i) experimental assessment of the pre-emptive braking control function on the ZEBRA vehicle of the University of Surrey, ii) experimental assessment of the pre-emptive traction control function, based on the knowledge of the tyre road friction profile ahead, on the ZEBRA vehicle and the Multi-Moby prototype vehicle by I-FEVS, and iii) full-scale Multi Moby vehicle crash tests, carried out at the CIDAUT facilities.



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Figure 6: Six E-VOLVE Newsletter

3.7 7th Newsletter

The seventh and most recent newsletter was published in May 2022, with the contribution of all project members, mainly focusing on finalized results and developments. It was published on the [E-VOLVE website](#) and can be [downloaded for free](#).



E-VOLVE Cluster Newsletter

May 2022

The EVolve future is now!

The virtual E-VOLVE (Electric Vehicle Optimized for Life, Value and Efficiency) Cluster is realizing and monitoring synergies between eight projects from the (EV) Horizon 2020 programme to execute joint dissemination, exploitation and standardization activities.

This 7th Newsletter comes together in a time when projects are close to ending and results are in place.

Another E-VOLVE publication

The E-VOLVE partners once again came together to present their advancements.

H2020 projects **ACHILES**, **EVC1000**, **FITGEN**, **SYS2WHEEL**, **CEVOLLER** and **MULTI-MOBY** worked on and delivered a scientific publication about e-mobility in the context of WCX SAE World Congress Experience.



Figure 3: The E-VOLVE Cluster members

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E-VOLVE Cluster Newsletter

May 2022

framework has been completed to enable model calibration and hardware-in-the-loop verification. The powertrain and chassis components have been successfully prototyped and tested and are being physically integrated into the vehicle. The torque vectoring and BMS integration into the novel Centralized Computer Platform (CCP) has been achieved, together with the required interfacing with other subsystems. The focus will now be on finalizing the full vehicle physical integration to enable track testing and performance evaluation of the complete Achilles AUDI Q2 BEV.

Check out our project video to get to know the project objectives: https://www.h2020-achilles.eu/wp-content/uploads/2022/03/achilles_h2020_advanced_architectures_chassis_traction_concept_for_future_electrified_vehicles-1080p.mp4



Figure 4: SMP tests

Learn more about **ACHILES**.

TELL: Ended but still alive!

The TELL project addressed the optimisation and large-scale manufacturing of low and medium voltage electric powertrain solutions, with focus on high efficiency, compact packaging and low cost. Three main applications were targeted: i) Small-to-medium segment electric cars; ii) Hybrid electric cars with a low voltage add-on electric propulsion system; iii) The lightweight urban mobility sector, e.g., electric quadricycles.

By the end of the project in November 2021, TELL has achieved several important results, e.g.: i) installation and testing of the VALEO 48V system using Si Mosfets on the TELL vehicle demonstrators and development of power module based on GaN transistors; ii) installation and testing of the DANA TM4 Medium Voltage (100Vdc) powertrain including an innovative inverter and a novel synchronous reluctance electric motor assisted by permanent magnets; iii) energy efficiency experimental testing of the TELL vehicles designed and manufactured by 1 PEVS, including the different powertrain solutions, and completed by the Infineon chips and sensors; iv) experimental testing of the state-of-the-art vehicle dynamics control strategies (including pre-emptive traction control and axle torque vectoring developed by University of Surrey).

Watch our latest video featuring the testing of the newly developed vehicle control features on the TELL demonstrator! <https://youtube.com/watch?v=telldemo>

Learn more about **TELL**.

SYS2WHEEL

SYS2WHEEL will finalize its activities to build up and test the demonstrator vehicles in N1 and N2 category until end of September 2022.



Figure 5: Fiat Doblo (N1) with in-wheel motors in the front and rear to wheel damping system ready to be evaluated

Regarding dissemination, SYS2WHEEL submitted one at the 10th Automotive Technologies Congress (OTECON) in September 2021. Another conference paper for the SAE Conference in 2022 was successfully submitted at the end of year 2021 (Armengaud, E., Brandstätter, B., Bieck, M., Bub, J. et al., "Towards Brand-Independent Architectures, Components and Systems for Next Generation Electrified Vehicles Optimised for the Infrastructure," SAE Technical Paper 2022-01-0918, 2022, doi:10.4271/2022-01-0918).

Furthermore, there were 3 conference presentations at both APTS conferences (Eco-Mobility) in November 2019 and November 2020 and at the #12020TR21 (<https://youtube.com/watch?v=telldemo>). At these conferences, intermediate project results were presented to a broad audience covering research, industry, EU representatives and governmental bodies. They were accompanied by LinkedIn postings and individual postings by SYS2WHEEL partners.

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E-VOLVE Cluster Newsletter

May 2022



Figure 4: Electrical fully modular e-axle for N1-type vehicle ready to be integrated into the TELL demonstrator

Learn more about **SYS2WHEEL**.

SELFIE: Towards the finalisation of the battery assembly

SELFIE project is in its 4th year of development and facing a crucial phase of demo vehicle integration in which the developed battery pack assembly and advanced thermal management system are being integrated into the Fiat Doblo demonstrator vehicle.

In details, the smart battery pack and advanced battery thermal system components which are cooling plates for active cooling and PCM packs for passive cooling has been delivered to IMECAR for the assembly. Figure 1 below shows the placement of the battery modules into the small compartment of the battery housing. The most common, economical, and light weight mechanic and electronic components and materials have been selected for the battery system assembly to be able to reach the modular and economic objectives of the project.



Figure 5: Small has been part assembly

The cold storage device (CSD) including PCM buffer, refrigerant pump and control strategy will be finalised by end of June.

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E-VOLVE Cluster Newsletter

May 2022

The talk "Towards brand-independent architectures, components and systems for next generation electrified vehicles optimised for the infrastructure", co-authored by AVL, Virtual Vehicle, Elaphe, University of Saint, FEV, Virje Universität, and Technische Universität München, has received very positive feedbacks from the audience and established several links between the cluster and international partners for further cooperation in the area of e-mobility.

The paper based on the talk will be published soon in Open Access on the website of EVC1000 and SAE International.

To follow the cluster's dissemination strategy, the Special Session "Electric Vehicle Drivetrain Dynamics" will be organised next year again in the SAE WCX™ 2023 event: <https://www.sae.org/attend/wc-x/call-for-papers>. We are encouraging our community to prepare your submissions and promote your research results together with us.



Figure 6: FIT team at the SAE WCX™ World Congress Experience

Learn more about **EVC1000**.

CEVOLLER: Investigating a new A-class vehicle in relation to fast-charging

Like other projects CEVOLLER struggled with the COVID-19 situation that affected the progress of the project in 2020. It turned out that we were unable to implement parts of the project in the time frame as laid down in the EC Grant Agreement. To make sure we could fulfil all objectives we requested to extend the project which was granted by the European Commission. Instead of the 42 months duration of the project we now have a 48-month duration. Currently, validation measurements are ongoing on all demonstrator vehicles. More peer reviewed papers will be published at the CO2 Reduction in Transportation Systems Conference in June and at the TRA2022 in November. With the amended duration, the project will be able to complete all obligations by the end of October 2022.

Multi-Moby - Passive safety optimisation

In Multi-Moby, in the last few months special attention has been paid to passive safety. Small vehicles are hindered by the reduced space available to absorb the energy in the event of a crash. This disadvantage has two direct consequences: i) the design of the structure is more challenging; and ii) the requirements of the restraint system to protect the occupants are more demanding.

To ensure the safety of the occupants, the Multi-Moby methodology has consisted of an optimisation of the vehicle structure, carried out by 1 PEVS and CUBAUT, with three main targets: a) to maintain the integrity of the cabin; b) to ensure that the battery compartment does not suffer relevant deformation; and c) to obtain Occupant Load Criterion (OLC) acceleration values lower than 45 g. After achieving these three targets for different frontal and lateral crash configurations, the following step has been to design a restraint system suitable for the acceleration pulses obtained in the different analysed crash scenarios.

The resultant vehicle structure is based on a tubular solution composed of SHSS (super high strength steels), optimised with advanced virtual modelling (Fig. 1(a)). Several iterations have been used to obtain the most suitable geometry of the structure, and to decide the quality of the high strength steel used in each of the tubular elements. In parallel, for the structure optimisation, stiffness and fatigue criteria have been considered. Subsequently, the structural design of the vehicle has been frozen, and the restraint system has been optimised according to the acceleration pulses (Fig. 1(b)). The design of the restraint system mainly covers the seat belt, airbags, seat, and steering wheel, and the parameters to be optimised are related to the relative position of each item, the capacity of the

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4 Conclusions

The targets set for the dissemination activities and newsletters at the beginning of the Cluster were achieved. The newsletter channel has been successfully used to promote and disseminate project and cluster news. Specific mailing lists were not created; this however was decided after the realization that the cluster website and social media were addressing large numbers of audiences (e.g. over 1.500 unique visitors on the website). Also, the amplification resulting from the projects websites was important and ensured the circulation of the newsletters to different audiences. In addition, the communication and dissemination strategy were fully adapted to the requirements of the Cluster. The power of numbers -bringing eight projects together- led not only to economies of scale but also to amplified dissemination results. As a result, the original targets were met.



References

SELFIE D7.2 Dissemination Plan

SELFIE D8.6 Report on Cluster level optimization

ACHILES D6.8 Cluster dissemination and communication strategy



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