SAFE-UP

proactive SAFEty systems and tools for a constantly UPgrading road environment

SAFE-UP driving key research for Euro NCAP's future vehicle safety assessment

Adriano Palao Bernal (Euro NCAP)

Recently we chatted with the technical manager for ADAS and automated driving at Euro NCAP, Adriano Palao, ahead of the release of the Euro NCAP 2030 roadmap. Hear his thoughts on the programme's vision for future vehicle safety in Europe and how SAFE-UP's innovations support their work.

Q: In which way do SAFE-UP's outcomes relate to the 2030 Euro NCAP roadmap?

A: SAFE-UP's project deliverables are promising. To achieve the goal of shifting towards scenario-based assessment and tackling ADAS (Advanced driving assistance systems) robustness in real-life situations, it is essential for Euro NCAP to rely on solid facts and data, ensuring we understand aspects such as:

a. Accidentology: addressing relevant scenarios based on magnitude (number of killed or severely injured) and selecting the appropriate parameters after understanding the most common accident types (e.g., delta speed, overlap/impact point, occlusions…).

b. Testability: implications of introducing additional variables in a scenario, and the feasibility of harmonising the procedure across labs.

c. Awarding real performance: fact-based understanding of which variations are a challenge to ADAS perception in the real-world – eventually closing the gap between true positive ratio in current track scenarios (which is high on average) and real-world scenarios (low on average). This will help to differentiate the truly robust systems from the ones that are...

Read the full interview

IN THIS ISSUE

Update from the Coordinator

Núria Parera (Applus IDIADA)

Dear reader,

It's already been six months since our last newsletter, and many milestones have been achieved so far. Milestones that support the project's overall goal of contributing to the EU's Vision Zero – by understanding and reducing current and future crashes through vehicle automation, connectivity, and improved occupant protection.

In early April, Thessaloniki welcomed the entire SAFE-UP consortium for the first-ever face-to-face General Assembly (GA). This time, our Greek partner HIT-CERTH hosted the three-day event at their facilities. It was a great opportunity to discuss challenges, solutions, and get a clear overview of the developments made across the consortium.

So far, the partners have developed realistic road user models (for pedestrians, cyclists, AVs, human drivers, and powered-two-wheelers), and new safety metrics to detect safety-critical scenarios, which have been integrated into the Aimsun Next simulation platform.

SAFE-UP's novel systems are now being integrated into four demonstrators: 1. New passive safety system with restraint and monitoring technologies for new seating positions, 2. In-vehicle active safety system for enhanced VRU detection in bad weather, 3. Advanced intervention functions to avoid critical events, and 4. Safety solution based on V2X to enable timely warning provisions. The safety-critical scenarios needed to test the demos have been defined, and have already started undergoing their final tests, which will continue into Autumn 2022.

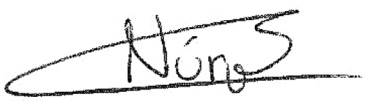
New seating positions have also been defined for Level 3 and Level 4 autonomous vehicles and a new adaptative restraint system will be assessed through simulation and sled testing to evaluate the occupant protection performance.

Training and awareness strategies to transfer knowledge to both technical audiences and the general public are now being established, and infographics based on EU crash data can already be found on the SAFE-UP website: www.safe-up.eu/resources.

All public deliverables can be read on the Resources page of our website too – so please have a browse!

If you haven't already, I invite you to **subscribe to our mailing list to receive our future newsletters** and follow us on both Twitter and Linkedin!

Sincerely,
Núria



SAFE-UP's Demo scenarios: a breakdown

SAFE-UP is developing innovative passive and active safety systems with the help of 4 demonstrator vehicles. These new technologies aim to improve specific safety-critical scenarios with the goal of reducing fatalities and injuries in line with the European Union's Vision Zero.

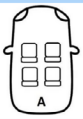
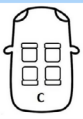
In order to claim that a safety system is effective, testing activities (both physical and virtual) within SAFE-UP are recreating existing safety-critical scenarios and analysing the impact of introducing these new systems.

DEMO 1

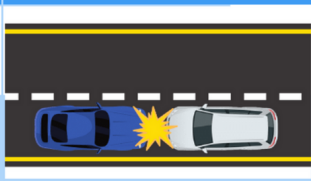
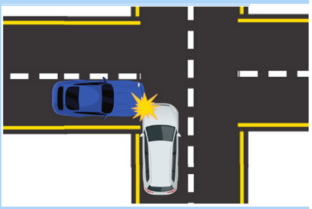
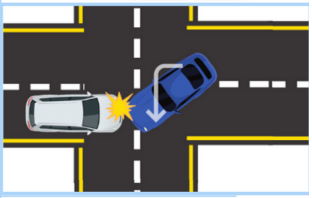
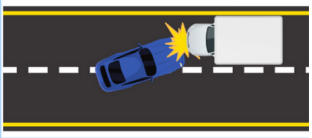
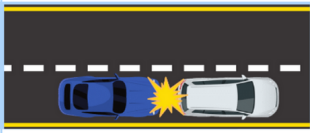
For the passive safety systems, Demo 1 applies. The testing scenarios explore the crash configuration and the vehicle interior configuration. Three use cases have also been defined:

- Peri-urban use case with an L3 vehicle driving in manual mode
- Peri-urban use case with an L3 vehicle driving in automated mode
- Highway use case with an L4 vehicle driving in automated mode

In the table below you'll find the description of the crash configuration, as well as the details of the interior configuration, seat positions, and occupant posture. For more details, check out SAFE-UP deliverables 4.1 and 4.2.

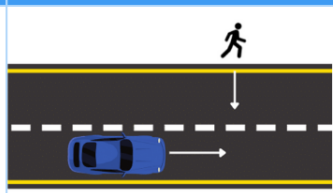
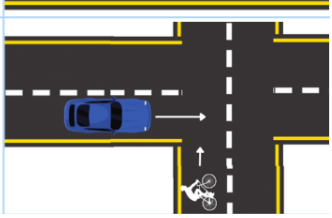
	Peri-urban use case: Manual mode L3	Peri-urban use case: Automation mode L3	Highway L4 use case
Crash configuration	Car-to-Car head on crash Car-to-Car intersection crashes Car-to-HGV head on crashes		Car-to-Car Rear-end Car-to-HGV Rear-end
Interior configuration			
Seat back angle	23° to 35°	23° to 45°	23° to 60°
Seat cushion angle	10°	10° to 20°	15° to 35°
Seat movement	Conventional	Extended fore-aft up to 400mm	Rotation/swivel: up to 20°
	 	 	 

The virtual testing parameters for the crash configurations can be found in the table on page 10. More details on the characterisation of C2C scenarios can be found here. Additionally, in deliverable 2.6, further details of C2HGV scenarios can be found.

Crash configuration (D4.1)		Speed (km/h)		Weight (t)		Collision angle (°)	Overlap (%)	Crash representation
		VUT	Opponent	VUT	Opponent			
C2C-HO		40	0	1.717	Rigid	0	100	
		56	0	1.717	Rigid	0	100	
C2C Intersection	SCP	63	58	1.717	1.717	89	~20	
	LTAP OD2	66	19	1.717	1.717	214	~60	
C2HGV-HO		39	36	1.5-2.5	10-18	10	50	
C2C-RE		40	0	1.717	Rigid	0	100	
C2HGV-RE		0	29	1.5-2.5	10-18	0	100	

DEMO 2

Moving onto the active safety systems, Demo 2 will focus on improved VRU detection under bad weather conditions. The scenarios to be tested were defined in D3.2. Based on the analysis done in D2.6, scenarios can have different parameters depending on whether the crash consequence is a KSI, or if it takes into account all kinds of injuries.

Crash configuration (D2.6)		Speed (km/h)[1]		Cases with precipitation[2] (%)	Crossing type	Crash representation
		VUT	VRU[3]			
P-CLwoSO	KSI	48	8	23.1	55.4% non-intersection-related 58.8% non-designated crossing	
	All injuries	43	5	21.5		
B-CR	KSI	26	15	7.7	9.7% non-intersection-related 27.2% bicycle path not present	
	All injuries	15	15	7.2		

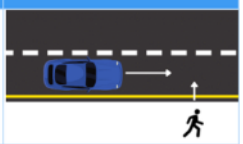
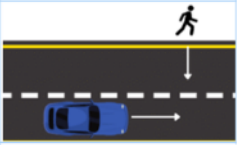
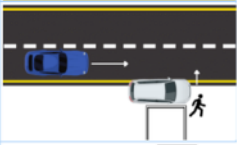
1 Median 2 Rain, snow, hail, or sleet 3 Pedestrian or bicyclist

Other scenarios involving turns were also initially considered interesting for analysis (P-PCTurnL, B-PCTurnL - see D2.6), as they are significantly affected by adverse weather conditions. However, since it's not possible to perform such turns at THI's test hall, they won't be analysed in SAFE-UP.

DEMO 3

With the main goal of developing advanced safety systems including autonomous emergency steering (AES), Demo 3 will focus on understanding the potential field of effect of such a system, compared to current state-of-the-art active safety systems -mainly autonomous emergency braking (AEB). The relevant scenarios in which this technology could have a positive impact are defined in D2.6 and presented in the table below. In addition to these, partners from Demo 3 will look into obstruction cases for bicyclists.

Currently, BOSCH and ViF are simulating and analysing a full-factorial variation of parameters (scenario type, initial car speed, pedestrian impact speed, lateral impact location, longitudinal impact location, lateral car position on road, and lane width) to define the definitive scenarios. Updates will follow soon.

Crash configuration (D2.6)		Speed (km/h)		Crash representation
		VUT	VRU	
P-CRwoSO	KSI	48	5	
	All injuries	38		
P-CLwoSO	KSI	48	5	
	All injuries	43		
P-CRwSO	KSI	40	6	
	All injuries	35		
P-CLwSO	KSI	40	6	
	All injuries	35		
B-CR	KSI	26	15	
	All injuries	15		
B-CL	KSI	30	15	
	All injuries	20		

DEMO 4

Demo 4 will use C-ITS communication to exchange information and generate warnings both for the vehicle and the VRU. The demo will focus on scenarios that are related to KSI injuries and where C-ITS technology may have a safety benefit potential compared to current state-of-the-art systems with VRU detection (like when there are obstructions that hinder VRU visibility from the vehicle). Following this line of thought, in D3.4, the relevant scenarios for Demo 4 were defined. For each test case, there will be 3 runs:

- Baseline without V2X
- Roadside unit (RSU) and not-connected VRU
- Complete V2X

When it comes to **car-to-pedestrian crashes**, 4 scenarios have been selected...

Read the full breakdown on the SAFE-UP website

MEET THE SAFE-UP PARTNERS

AUDI

Audi AG

Mr. Volker Labenski

Mr. Markus Köbe

Mr. Johann Stoll

Who belongs to your SAFE-UP team?

The Audi colleagues involved in SAFE-UP have **profound knowledge of accident research, crash data analysis, and the development of test procedures for pedestrian/cyclist detection systems and automatic braking systems.** Mr. Volker Labenski, project leader from Audi, coordinates the work within SAFE-UP and contributes with crash data analysis results as a basis for the SAFE-UP demonstrators set up in work packages 3 and 4. Mr. Markus Köbe has profound expertise in methodology development and simulative effectiveness evaluation. Besides crash data analysis, he contributes with an additional analysis of a Naturalistic Driving dataset and considers requirements for the simulation for results based on all considered datasets. Mr. Johann Stoll has vast experience in the development of test procedures for pedestrian/cyclist detection systems, automatic braking systems, and universal target dummies for automatic driving systems. With this knowledge, he supports work package 3. All work is done **in close cooperation with SAFE-UP partner CARIAD** to transfer insights from crashes directly into the simulation.

What does AUDI bring to the project?

We have our own accident investigation team gaining knowledge on crashes, their emergence, and their outcomes. The company therefore has many years of experience using in-depth crash data and other related data sources. That's why Audi mainly brings **expertise from accident research - both investigation and analysis** - into SAFE-UP. Audi contributes to WP2 and WP3 which involve the identification of current safety-critical scenarios based on crash and naturalistic driving data. This step is important to understand the current situation as the basis for simulations done in SAFE-UP. Providing input and accompanying the simulations with the development of metrics under the consideration of simulation requirements is mainly done in WP3.

Why did you want to take part in SAFE-UP?

The automobile industry is going through profound change. Audi is moving forward with a clear strategy for an electrical, digital, and connected future. Analyzing critical traffic scenarios while considering future developments - especially connected and automated vehicles - is part of parallel developments in assisted and automated driving at Audi. **Participating in a project where the focus is on active and passive safety systems for use in real traffic scenarios is highly important for this evolution.** Our close partnership with CARIAD within SAFE-UP plays a significant role in that as well.

Which other related initiatives are you involved in?

The Audi Accident Research Team is involved in **multiple projects related to accident research throughout the world, including China, the USA, and Germany.** Based on our primary objective to contribute to the improvement of general traffic safety, our activities gather input to improve the product attributes of Audi vehicles. Many aspects are important for our work, such as understanding the emergence of crashes. Analyzing mechanisms and the outcomes of crashes provides valuable insights from which we can derive relevant measures for the development of Audi vehicles. The support of development departments regarding product safety, active and passive safety and automated driving, and the communication of analysis results, are major goals of the Audi Accident Research Team.

www.audi.com/en/

www.linkedin.com/company/audi-ag/

www.twitter.com/audiofficial

MEET THE SAFE-UP PARTNERS

ViF

Virtual Vehicle Research GmbH

Stefan Kirschbichler

Christoph Klein

Peter Wimmer

Harald Kolk

Dominik Breitfuß

Oliver Zehbe

Jonas Pucher

Werner Leitgeb

Who belongs to your SAFE-UP team?

In SAFE-UP, VIF is **leading the development of safety assessment methodologies** (WP5). Our team includes WP leader Stefan Kirschbichler, alongside Christoph Klein, Peter Wimmer, Harald Kolk, Dominik Breitfuß, Oliver Zehbe, Jonas Pucher and Werner Leitgeb, who all **combine their expertise from the Vehicle and Road Safety department.** Our main focus is on the optimisation of Human Body Models (HBMs) in the active safety systems phase, which includes a series of tests with volunteers in reclined seating positions, and controller development. We're also **leading the overall impact assessment task** in which we're working closely with all other WPs involved in the demonstrators and utilising their methods and know-how to demonstrate the benefits of the developed SAFE-UP

What does ViF bring to the project?

VIF is mainly working in two areas: **HBM modelling and impact assessment.** Based on our many years of experience with human body models, we're focused on the verification and validation of occupant models, particularly on pre-crash occupant kinematics. Furthermore, based on the knowledge and experience from other national and international projects, as well as our key experience with simulation, **VIF will set up an overall assessment method for demo 3** and support the method development for a systematic combination of simulation and test results with the rest of the SAFE-UP team.

Why did you want to take part in SAFE-UP?

The ambition to work in SAFE-UP was **to collaborate on a highly ambitious research project with innovative objectives and a strong, highly-qualified consortium**. Furthermore, the project addresses

all topics that we cover in the ViF Vehicle and Road Safety Department, so we can bring our special know-how. ViF addresses smart mobility and, in particular, the vehicles of tomorrow, which shall be safe, environmentally friendly, and affordable. Hence, **cutting-edge research and technology development is essential, and simulation is key to opening new possibilities.** ViF provides a close linkage of numerical simulation and experimental validation and offers comprehensive system simulation up to the complete vehicle. The Vehicle and Road Safety department has many years of experience in developing passive and active safety simulation methods for - amongst others - HBMs, Anthropometric Test Devices (ATDs), Vulnerable Road Users (VRUs), restraint systems, full vehicle structures and component testing, test bench development, and integrated simulation and impact assessments.

Which other related initiatives are you involved in?

ViF is currently working in close collaboration with over 80 industrial partners and, in addition to our principal scientific partner, more than 40 international university research institutes. We're involved in several EU projects and also have experience in coordinating such initiatives, like **OSCCAR (**www.osccarproject.eu**)**, which ended in November 2021 and dealt with future occupant safety in AD vehicles. The comprehensive results of this project will contribute to a reduction in the number of road fatalities, the severity of injuries, and the number of inured persons. VIF is also coordinating and contributing to **HADRIAN (**www.hadrianproject.eu**)** and **InSecTT (**www.insectt.eu**)**. HADRIAN implements a novel approach to creating automated driving systems that integrate human drivers, vehicles, and road infrastructure. InSecTT aims to create trust in AI-based intelligent systems and solutions as a major part of the AIoT (Artificial Intelligence of Things). In addition, VIF was also involved in **HEADSTART (**www.headstart-project.eu**)**, which concluded in December 2021 and defined the testing and validation procedures of Connected and Automated Driving (CAD) functions, including key technologies like communications, cyber-security, and positioning.

www.v2c2.at/

Virtual Vehicle Research GmbH

@VIRTUAL_VEHICLE

MEET THE SAFE-UP PARTNERS

IKA

Institute for Automotive Engineering (ika), RWTH Aachen University

Julian Becker

Daniel Zeuss

Julia Pelzer

Fabian Russ

Nicolas Wagener

Dr.-Ing. Dinesh Thirunavukkarasu

Dr. phil. Stefan Ladwig

Timo Woopen

Who belongs to your SAFE-UP team?

ika is involved in SAFE-UP with researchers from three of our six departments. In WP2 (Future safety-critical scenarios) Fabian Russ, Nicolas Wagener, and Timo Woopen (Manager of Vehicle Intelligence and Automated Driving) are focusing on the **integration of VRU behavioural models into traffic simulation**. Julia Pelzer and Dr. phil. Stefan Ladwig (Manager of Traffic Psychology and Acceptance) are setting the basis for the model development with **user studies from a psychological point of view**. In WP4 (Passive safety systems) and WP5 (Safety assessment methodologies) Daniel Zeuss, Julian Becker, and Dr.-Ing. Dinesh Thirunavukkarasu (Manager of Vehicle Structures) focus on the investigation and assessment of restraint systems in the context of AD-enabled seating positions. They lead the related task 4.3 and contribute to the project with their **expertise in Finite Element occupant simulation, human body model application, and restraint system modelling.**

What does IKA bring to the project?

ika's contribution to the SAFE-UP project is separated into two fields. First, within WP2, we are building upon an existing **Vulnerable Road User simulator** at ika and developing a **new bicycle simulator.** The task includes conducting VR user studies, developing behavioural models, integrating them into the software environment, and analysing critical scenarios. In the second field (within WP4 and WP5), we are building upon our knowledge and experience from previous EU projects to define, simulate, and evaluate relevant occupant safety use cases as a major contribution to the passive safety demonstrator. In doing so, we can refer to our simulation cluster, **many years of experience in full vehicle simulation** and the application of latest human body models.

Why did you want to take part in SAFE-UP?

As part of RWTH Aachen University, located in Aachen, in the centre of Europe, the Institute for Automotive Engineering strives to contribute to international and European research initiatives and **promote cross-border scientific cooperation in the areas of safety, driving experience, and sustainability.** ika researches the vehicle as a whole and the interaction of all individual components. Vehicle automation in the context of safety and comfort/driving experience forms a core topic of our research. The formulated objective of SAFE-UP, which is to investigate proactive safety systems and tools for an upgrading road environment, aligns well with the research fields at ika. Our ambition within the project is to **investigate and demonstrate the potential of integrated safety functions.** We see the use and further development of virtual methods and tools as an important enabler in this context.

Which other related initiatives are you involved in?

As well as SAFE-UP, ika was and is currently involved in several related initiatives at both the EU and federal levels. We are participating in the ongoing projects **HI-DRIVE (**www.hi-drive.eu**)** and **HADRIAN (**www.hadrianproject.eu**),** which address the challenges of introducing higher levels of vehicle automation and holistic approaches for driver role integration and automation allocation. In addition, ika was involved in **OSCCAR (**www.osccarproject.eu**)**, which ended in November 2021 and dealt with future occupant safety in AD vehicles. Another AD-related ongoing project at the federal level is the **UNICARagil (**www.unicaragil.de**)** project, in which four disruptive modular automated vehicle concepts are built. In addition, ika is involved in various projects to create suitable test environments for evaluating and testing new automated driving functions, such as **ACCorD (**www.accord-testfeld.de**)**, **KoMoDnext (**www.komodnext.org**)**, and **HDV-Mess.**

www.ika.rwth-aachen.de/en

Institute for Automotive Engineering (ika)

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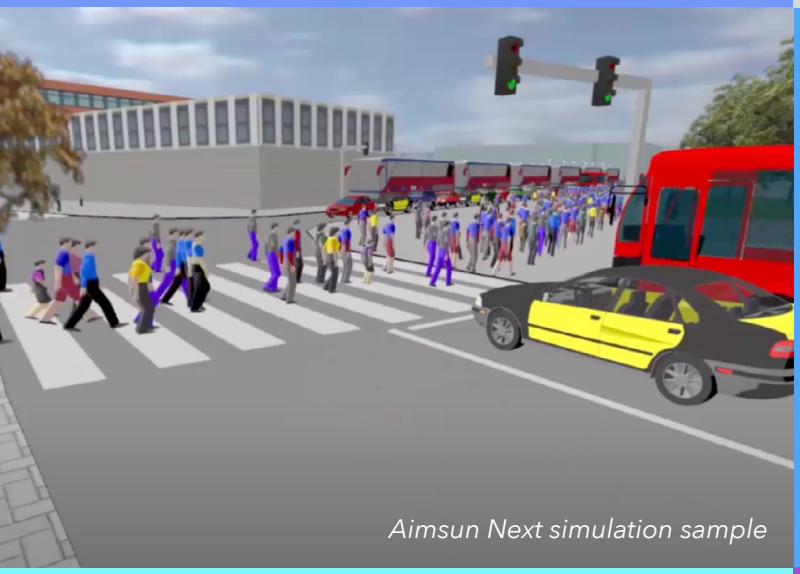
UPCOMING PROJECT ACTIVITIES

What to expect from the SAFE-UP project over the next six months...

Active and passive safety systems testing

Summer and autumn will see the four SAFE-UP demonstrators carry out their testing activities to ensure the reliability of the systems, as well as to analyse their safety. The testing will be done mostly at IDIADA's facilities, except for Demo 2, which will be performed at THI's test hall - a unique place to recreate adverse weather conditions in a controlled environment.



Aimsun Next simulation sample

Road safety simulated effects of AVs

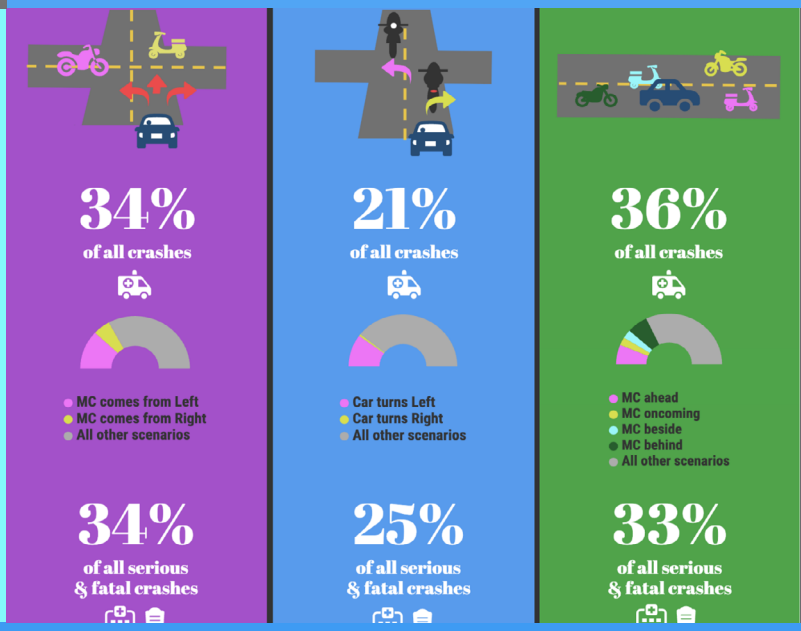
After the intense development of the behavioural simulation models (AV, human-driven vehicle, pedestrian, cyclist, PTW rider), they have now been integrated into the Aimsun Next platform. In the following months, we'll be able to observe the simulated effects of AVs on the future of road safety. Details on the methodology and results will be available shortly in deliverable 2.8.

New training materials

Considering the results from the traffic scenarios, accidentology, simulation, and demonstrators, the WP6 team will produce new training material for drivers and VRUs.

Updated impact assessment framework

After the initial version of the impact assessment methodology (D5.2), new learnings will be fed into the updated version coming out in D5.8. This will be used to evaluate the results of the demonstrators.



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If you would like to get in touch with a member of the SAFE-UP team send an email to: **contact@safe-up.eu**

The SAFE-UP project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement 861570.