SAFER STAGE 4 REPORT

APRIL 1ST, 2016 – MARCH 31ST, 2019

SAFER

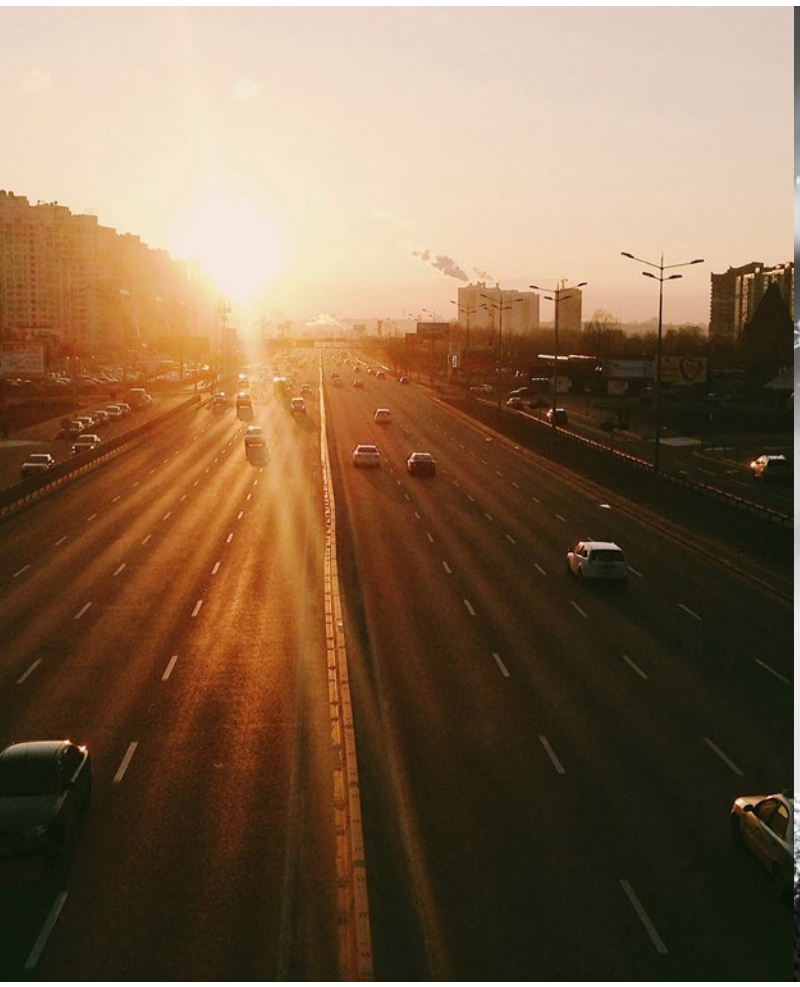
VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

SAFER Vehicle and Traffic Safety Centre at Chalmers *is a competence centre where about 35 partners from the Swedish automotive industry, academia and authorities cooperate to make a centre of excellence within the field of vehicle and traffic safety.*

Research at SAFER spans a broad base, covering several disciplines and encompassing both safe mobility and vehicle safety in real environments. The centre's activities engage the very elite in the field of safe transport solutions, and the results contribute to increasing the competitive advantages of the partner companies and organisations.

Chalmers University of Technology hosts the centre. By using the multidisciplinary scientific competence available within the centre, we make it a hub for excellent research and innovation.

SAFER conducts borderless research to save lives!



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APPENDICES

1. INTRODUCTION

THE PURPOSE OF this report is to present the effects and outcome of the three years in SAFER's stage four, extending between April 1st 2016 and March 31st 2019. There is plenty written about SAFER and our results already – yearly reports, publications, presentations and doctoral theses, all available through our website www.saferresearch.com. We hope that this report will inspire you to read more and to share our belief that curiosity, diversity and openness drive competence and research.

This phase started with a birthday party – SAFER celebrated 10 years with balloons, cake and the presentation of achievements expressed through 17 success stories. The partners had decided to sign up for a stage four, but what would the prerequisites be? Would SAFER be granted another five years of Vinnova funding? And if not – how would the new SAFER function? By then, we did not know, but soon we realized that we would not get the funding for the centre from Vinnova. But we also understood something more. We understood this change was the beginning of something new. We released new power and commitments. We found new ways of working. We experienced the true power of collaborative research.

After three year of transition, SAFER is full of energy and drive towards its vision. The partners showed a strong commitment and the region of Västra Götaland decided to support with co-funding of the core operations. SAFER Board and management have carefully assessed what creates value with SAFER and set up a corresponding strategy and an organisation to carry it out. And after three additional years of collaborative research we have the answer; SAFER is now in many aspects stronger than ever.

Sustainable transport and traffic safety are now developing at an unprecedentedly rapid rate. Technology has developed in leaps and bounds, and there is no doubt that automation and digitalization play key parts in efforts to continue reducing the number of injuries and fatalities in traffic accidents. It will require more deep knowledge, excellent research and increased collaboration with new stakeholders and new disciplines. SAFER is well prepared for this, having practiced collaborative research and innovation with a large group of diverse partners for more than thirteen years. There has been a lot of learning of what actually works and where the obstacles are. Valuable infrastructures are in place – such as the vehicle lab Revere, tools and data for large databases. Links are established with international research environments.

SAFER has developed a lot during this phase and focus has been on giving added value back to partners, for example through more efficient work processes, knowledge dissemination and better assisting in funding processes, e.g. call coordination and application quality. There are no fewer than 12, new companies, organisations and universities that have joined SAFER during the ongoing phase. We are now better equipped for rapid technology development and transition to a more sustainable transport system. Looking ahead, we also see great opportunities to better utilize the ecosystem around us, for example through collaboration with other centres and collaboration platforms.

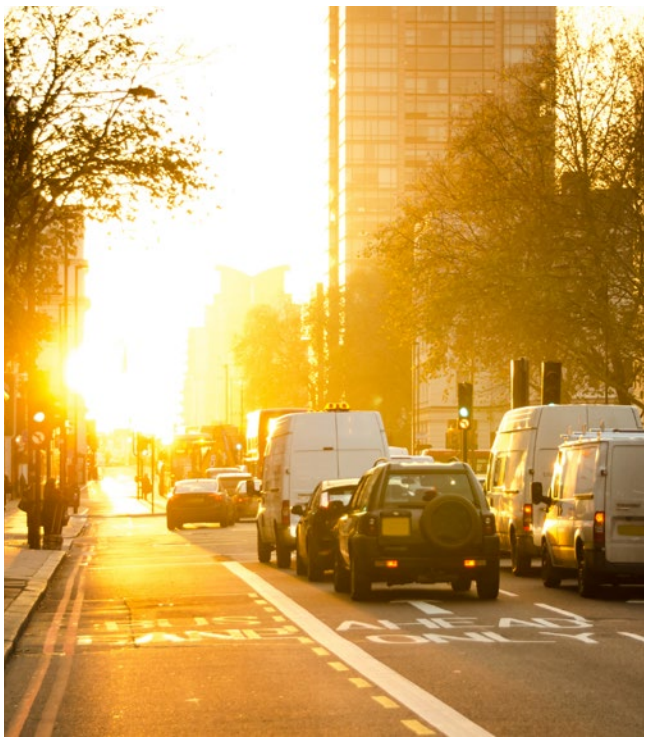
In August 2017 Magnus Granström stepped into the role as new Director of SAFER and we warmly thanked our former director, Anna Nilsson-Ehle, for her fantastic work in building up and running SAFER since its launch in 2006. Magnus' vast experience in international collaborations, EU projects and external funding in both academia and industry are key competencies that has been to good use in SAFER's operations.

The understanding of SAFER's added value and assets have become more profound as more than 350 finalised projects since SAFER started 2006 show successful results and international visibility. SAFER's partners and researchers have further strengthened the international position as the role as a spider in the global web, e.g. in collection and analysis of driving data, automation, child safety and human body models. It is also inspiring to see that the collaborative research platform has been a role model for others.

The life at SAFER has also carried on unabated with interesting seminars, project presentations, project applications, new grants, several important conferences and dissertations. It is impressive and gratifying to see all the research that is taking place within the broad community of SAFER. We are a unique organization well positioned to conduct collaborative research that is of great value for national and international stakeholders as well as its industrial partners. We have a strong commitment for a continuation of SAFER in a fifth stage and we look forward to start executing the strategic workplan and new research activities.

Being part of the development of the SAFER Vehicle and Traffic Safety Centre – Sweden's hub of traffic safety research – is incredibly inspiring. We hope you will read this report and get the same joyful feeling.

Best Regards,
SAFER Board and Management team


AHEAD
ONLY


SAFER

2. OUR VISION, MISSION, OBJECTIVES AND STRATEGY

SAFER IS CONTINUOUSLY on a bold journey towards zero fatalities and injuries in road traffic. This is achieved through open, collaborative research projects where traffic safety is key for the creation of a safe, sustainable, connected and, where suitable, automated, transport system. SAFER's holistic traffic safety approach covers people, vehicles and infrastructure. This also means that SAFER is part of a bigger societal project: the design and realisation of smart, sustainable transport systems in the cities and beyond. SAFER's role is to be a thought leader in safe mobility of people and goods, offering world-leading knowledge. SAFER creates knowledge and value beyond what a single partner can achieve on its own.

The SAFER journey started in the early 2000´s, based on decades of successful collaboration between Chalmers and several partners, for instance in the area of whiplash research. Founded as a centre in 2006, SAFER has over the years built a strong reputation, created a large number of projects with useful results, knowledge building through PhD students, arranged seminars and conferences etc. Our success stories are many and SAFER has delivered world-leading knowledge in areas like human body modelling, naturalistic driving data methods and cycling safety. Some examples of strong areas developed over SAFER's lifespan so far, our "Golden eggs", are shown in figure 1. More examples of SAFER's success stories can be found on the website www.saferresearch.com

OUR MISSION: TO ENHANCE TRAFFIC SAFETY

Create, transform and transfer knowledge
– Run collaborative research projects with excellent academic publications and high relevance to society and industry.
– Explore new research areas through pre-studies and participation in international networks.

Serve as an open innovation arena
– Enhance innovation capability.
– Provide the prerequisites for creative and productive research collaboration.
– Inspire students, researchers and product developers to be devoted to traffic safety.
– Disseminate results and knowledge to society.

Be a base for international collaborations
– Be a well renowned and attractive international traffic safety research centre of excellence.

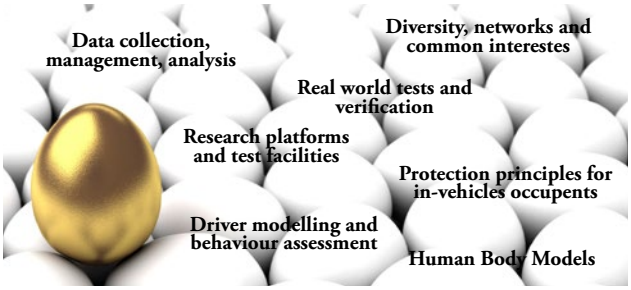


Figure 1: SAFER's "Golden eggs", our existing strengths that we will continue to build upon also in the future to create excellent, relevant, inter-disciplinary research.

WANTED POSITIONS

Since 2012 SAFER has aimed at a wanted position, consisting of five statements:
1. Visible and measurable results in practice.
2. Hub for Swedish traffic safety research.
3. Acknowledged as a world leader in traffic safety.
4. A broad set of partners and collaborations in order to ensure the strategy and explore new needs and countermeasures.
5. A balanced project portfolio and a long-term financing of the core operations.

The assessment of results and contribution to the wanted positions are integrated in this report.

OUR VISION: TOWARDS ZERO INJURIES IN TRAFFIC

SAFER provides excellent inter-disciplinary research, innovation and collaboration to secure close to zero accidents and injuries in traffic and enable Sweden to hold global leadership in the new paradigm where traffic safety is a key factor for implementing a sustainable, connected automated traffic system.

OUR OBJECTIVES

Together, we want to create new knowledge and research findings that enable people and goods to be transported safely, effectively and sustainably. Vision Zero is our guiding star and we want to make significant contribution to this bold vision and save lives and reduce traffic injuries. Our research has a human centric approach. Protecting people is our primary goal, although there are secondary positive effects of our research that also contribute to a sustainable society, for example, reducing the number of traffic accidents contributes to reduced cost for the society, less environmental impact and more cost-effective freight transport.

Our work with the Vision Zero is constantly integrated into our research. To ensure that we conduct research that is relevant to support us reaching the vision and that our results benefit society, SAFER is linked to Vision Zero academy, which has the Swedish Transport Administration's mission to coordinate research on Vision Zero. A representative is present in SAFER's management team and the exchange between the researchers is of great value to both platforms. We are also pleased that the Swedish Government has relaunched Vision Zero, an intensified initiative for increased transport safety in all modes of transport. Just like at our SAFER centre, vulnerable road users constitute a priority area for Vision Zero. It is also positive that traffic safety finally has became integrated in the global Sustainable Development Goals, which are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, peace and justice. SAFER supports the UN goals and will integrate these important perspectives in the research and strategic work. Below is a short summary of goals that are relevant for SAFER. A more in-depth work will start in the beginning of SAFER stage five.

– **Goal 3:** Good Health & Well Being: Ensuring that people can move safely in the road transport system without any risk for injuries and death is in line with SAFER's overall mission.

– **Goal 9:** Industry innovation and infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

– **Goal 11:** Sustainable cities and communities: Make cities and human settlements inclusive, safe, resilient and sustainable.

– **Goal 17:** Partnerships for the goals: Working together, shoulder by shoulder, towards the same vision to help save lives and reduce injuries in traffic is also one of our centre cornerstones.

OUR STRATEGY

To significantly contribute to the vision and mission as well as become a renowned international centre of excellence, SAFER delivers results, builds competence and creates strong networks in selected areas. Furthermore, SAFER is designed to value for the partners beyond what a single partner can achieve on its own.

SAFER consists of three different conceptual parts – SAFER Core, SAFER Research and project portfolio and SAFER Assignments and investigations, see figure 2. SAFER Core is the name for the driving function of SAFER with its secretariat including communication and support systems, research areas and their reference groups, the infrastructures, networks and the physical working environment. To realise our vision of becoming a world leader in traffic safety, our strategy is based on four interlinked corner stones that direct our actions: Act as a thought leader, Create identity and influence, Create and share knowledge and Shared infrastructures.

The four cornerstones have different but interlinked content, implying that the strategy is to keep the four parts together.

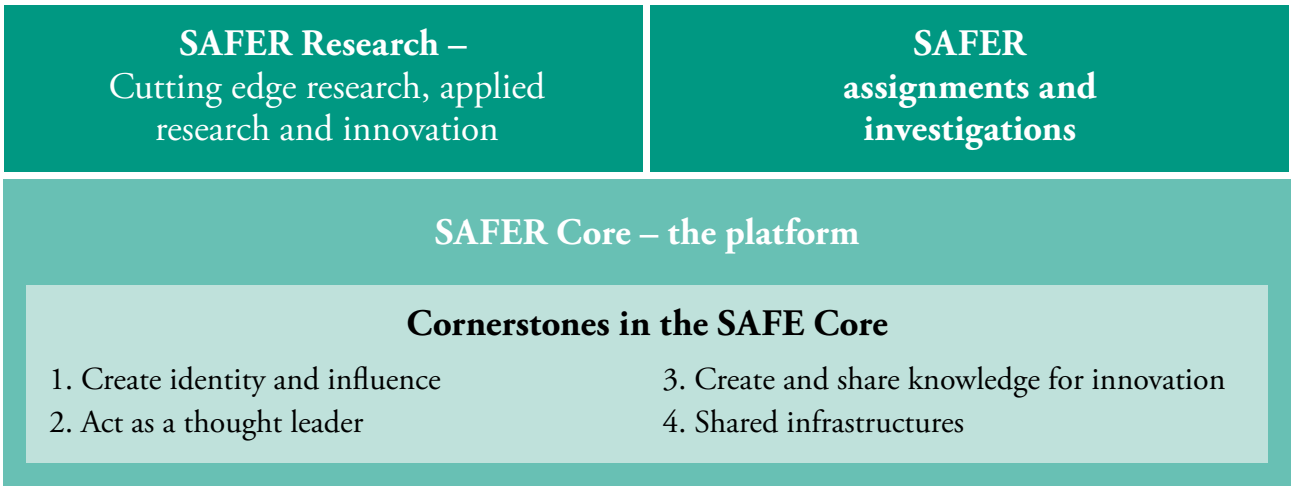


Figure 2: SAFER's three conceptual parts and four cornerstones.

1. Create identity and influence
The name SAFER should stand for excellence in traffic safety research and be of value to all partners to associate with. This identity is built, expressed and made visible through different ways – the office, website, seminars and conferences and other activities. By communicating what SAFER stands for and the achieved results we will attract international stakeholders, collaboration projects and funding.

2. Act as a thought leader
As a thought leader SAFER should define strategic research agendas based on needs and trends, create and drive SAFER's research and innovation agenda and develop road maps. The conclusions and needs of the SAFER community should be made visible and known.

3. Create and share knowledge for innovation
The basic task for the research areas and the reference groups is to transform and share knowledge and to create a strong academic base. New knowledge and relevant facts should be made available and visualized. Furthermore, networks should be created and maintained to the benefit of all partners. SAFER should be promoting project generation and coordination and act as a catalyst for joint projects. By creating strong connections to world class research environments and nurturing an international reputation for outstanding collaboration between industry, society and academy, it is possible to influence the international research agenda.

4. Shared infrastructures
Shared infrastructure is a hallmark for SAFER. Databases of real-world data including their collection, storage and analysis tools are strong assets and SAFER will further develop business models to maintain them. Revere – Resource for Vehicle Research – the full-scale laboratory is increasingly important for the safety research in the domain of automated driving and a connected transport system. The collaboration and support to AstaZero gives high value. The physical environment, SAFER's office environment, with working desks, meeting and analysis rooms, creative work spaces, instruments and bikes are another asset.

3. TOGETHER – WHAT COLLABORATIVE RESEARCH REALLY MEANS

CROSS-FUNCTIONAL, transdisciplinary, cross-border or multidisciplinary? The way we work within the SAFER research platform can be expressed in many different ways. But to make it easy, we can simply call it *together*. Because that's exactly what we do, we create life-saving road safety research together.

OUR PARTNERS

Safe mobility can only be realized when talented and dedicated people work together with a clear vision, shoulder by shoulder. The development of knowledge in vehicle and traffic safety is essential, and by applying results from collaborative research the SAFER partners create visible and measurable results in practice. The partners access – and contributes to – a unique competence and research collaboration platform. When the stage four began in 2016, 26 partners entered into the agreement. 12 additional stakeholders have joined the agreement during the three years of stage four. Together, the 38 partners have created new knowledge and research findings that enable people and goods to be transported safe, efficient and sustainable. See appendix 1 for a complete list of partners.

HOW WE ARE ORGANISED

The partners govern SAFER via the shareholders meeting and the Board, consisting of eight members. The Board meets 5-6 times a year including at least one dedicated strategy meeting. At Chalmers, SAFER is the core of the research profile Traffic Safety within the Area of Advance Transport. The daily operation is run by the director, the secretariat and the management team. These teams consist of a few persons paid by SAFER and some partner employees' in-kind. Five Research areas create the formal arena for partners to meet and identify key issues and initiate needs-driven research. Each group is led by a Research area director, who is also a member of the Management team, and is supervising the project portfolio. The Competence Areas, led by respected scientists, gather SAFER partners to share and develop new knowledge within their respective field. This ensures contact with centres and organisations with similar or complementary research, globally. See appendix 2, 3 and 4 to read more about the Board, Management team, and Competence areas. More information about the five research areas and their research result during stage four can be found in chapter 9.

SAFER focuses primarily on pre-competitive research and projects including several partners. It is a multidisciplinary and diverse meeting place where the persons involved come from academia/institutes, industry and society. This means that those working at SAFER are employed by one of the partners. During stage four, there have been about 350 researchers active in the community. In a creative and open research environment, diversity is an important aspect and a conscious concern. Other diversity aspects at organisational level include partners of different sizes, maturity in subject, etc. At individual level, diversity aspects of importance and present at SAFER include gender, multiculturalism, mixing senior and junior researchers, etc. SAFER consciously promotes a good gender balance and SAFER Management team as well as the SAFER Board are close to a 50/50 balance.

OUR VALUES AND IDENTITY

SAFER is guided by its vision, strategy and values. The essence and ultimate purpose of SAFER is to conduct world-class research to save lives and prevent injuries in traffic. SAFER develops a unique identity with clear values such as openness, respect for each other, curiosity and joy of discovery. We are passionate to make a difference, contribute to society, find new innovative solutions and we understand the benefits from interdisciplinary expertise and talents. Creativity is a hallmark and thrives on diversity in all aspects and borderless networks seeking and attracting expertise where it is to be found. SAFER, in collaboration with researchers on management of open innovation, has identified five guiding principles for success of a multidisciplinary research platform:

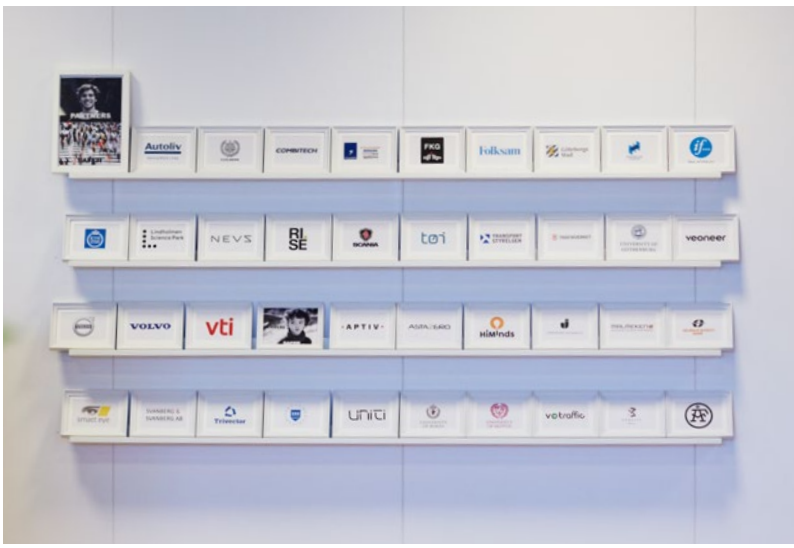
1. Presence of participants equals influence
SAFER has physical space (1250 sqm, work places, analysis and meeting rooms), individuals have a high degree of presence, and SAFER arranges several activities additional to the project work.

2. Diversity is the source of creativity
The fundament of engaging in collaborative innovation is to achieve something that each partner could not have achieved on its own. SAFER brings different perspectives together and has processes for supporting the integration of these even when the diversity causes tensions and strains in the collaboration.

3. Multiple identities create an extended action net
Individuals engaged in collaborative innovation should have at least two affiliations, i.e. one to the employer and one to the collaboration. These identities serve two purposes: the employer identity gives the rights and duties to act on behalf of my employer and share that network, the collaboration identity gives the rights and duties to act on behalf of the collaboration and to see the other partners as peers rather than competitors. Individuals at SAFER always have at least two, sometimes even three or four identities, e.g. connected to the employer, SAFER and adjunct at a university.

4. Higher purpose unites the participants
A common concern is important as it gathers actors to join forces to actually make a difference. It is stated in SAFER's vision that the common concern is to collaborate to secure close to zero accidents and injuries in traffic. Thus, the purpose of SAFER is to solve a societal challenge, which demands a collective effort.

5. The participants are the designers of the collaboration
Collaborative innovation is a form of continuous organising, constituted and constructed by the individuals working in it. The actions, the advances and the failures impact the collaboration. At SAFER the individuals have been actively involved in shaping the physical office space, the joint activities, routines, structures and regulations.



OUR CORE COMPETENCES

It is a SAFER core value to promote and achieve interaction as well as strong links between the partners. This attitude influences all activities from weekly seminars to how the organisation is manned by all partners, to the set-up of projects and the design of the office space. SAFER is accepted as a JRU (Joint Research Unit) in EU projects, which means we can act as a partner consisting of several SAFER partners. This is valuable when a SAFER partner lacks the competence or resources to be on its own, or when there is a need to limit the number of organisations per country in order to balance a consortium. Most projects and applications that have been conducted during the years include several partners and these joint partner constellations have increasingly complex setups. It is evident that the prerequisites and capability to organize strong consortia have grown and it has been possible to respond quickly to proposals from international research groups that look for Swedish partners. Competence at SAFER both needs and drives international collaboration. Vehicle and traffic safety are topics encompassing a large number of research areas and disciplines. The competence profile at SAFER is thus multidisciplinary, spanning from mechanical engineering, computer engineering, and sensor technology to biomechanics, human factors, behavioural science, and statistics. This broad basis is possible through the contribution of SAFER's different partners. As part of the overall strategy, the competence is developed and nourished in 12 partially overlapping Competence Areas which gather key persons from partners. Read more about the Research areas and their achievements in chapter 9 and about the Competence areas in appendix 4.

Mobility is one of RISE's business areas, and safety for vehicles and people in the transport system is central to our operation. The collaboration within SAFER develops our relationships with the partners, which help us to set up new collaborative projects.

Board member Jan Jacobson, RISE

4. THE RESEARCH ENVIRONMENT AND INFRASTRUCTURE

MULTIDISCIPLINARY RESEARCH does not just mean that our partners' researchers collaborate, we also aim to utilize the research infrastructure available within the network. In this way, many research projects can be carried out in a better and more effective manner while increasing the use of the resources. The goal is – as with SAFER as a whole – to create win-win. This unique infrastructure includes full-scale road traffic safety test environments, simulators and a research lab for active safety and autonomous driving. The partners have, through projects, access to several advanced testing and evaluation facilities, including driving simulators (at Chalmers, VTI, Volvo Car Corporation and Volvo Group), material and component testing (at Chalmers, RISE, KTH, Volvo Car Corporation), crashworthiness testing (at Volvo Car Corporation, Autoliv, RISE and VTI) and full-scale testing of active safety systems (AstaZero). SAFER also provides physical work areas as well as a world-class naturalistic driving data platform. Together, these resources allow borderless research with outstanding opportunities of real-world testing and validation.

REVERE RESEARCH LAB FOR ACTIVE SAFETY AND AUTONOMOUS DRIVING

An important success during this phase is that SAFER has contributed to the build-up of the Revere vehicle laboratory. Revere (Resource for Vehicle Research) is a research facility with a focus on autonomous driving, active safety and vehicle dynamics. The lab was inaugurated in November 2015 and is now fully established booked with customers from different disciplines. Many projects in SAFER's portfolio are connected to Revere. Read more about Revere in chapter 5.

SAFER NATURALISTIC DRIVING DATA PLATFORM

The SAFER Naturalistic Driving Data platform is a secure, world-class platform for handling data from naturalistic driving data collection. Providing state-of-the-art data management, several large datasets and a leading research competence regarding naturalistic driving data, this platform gives unique access to naturalistic data derived from 5 million driving kilometers. The SAFER partner researchers also have access to the in-depth crash database INTACT. During 2017 the high-profile project UDRIVE was finalised. In this project a huge amount of naturalistic driving data was collected and the storage and future use for SAFER's partners have been secured.

IGLAD (Initiativ For The Global Harmonisation Of Accident Data) was initiated in 2010 by European car manufacturers and is an initiative for harmonisation of global in-depth traffic accident data to improve road and vehicle

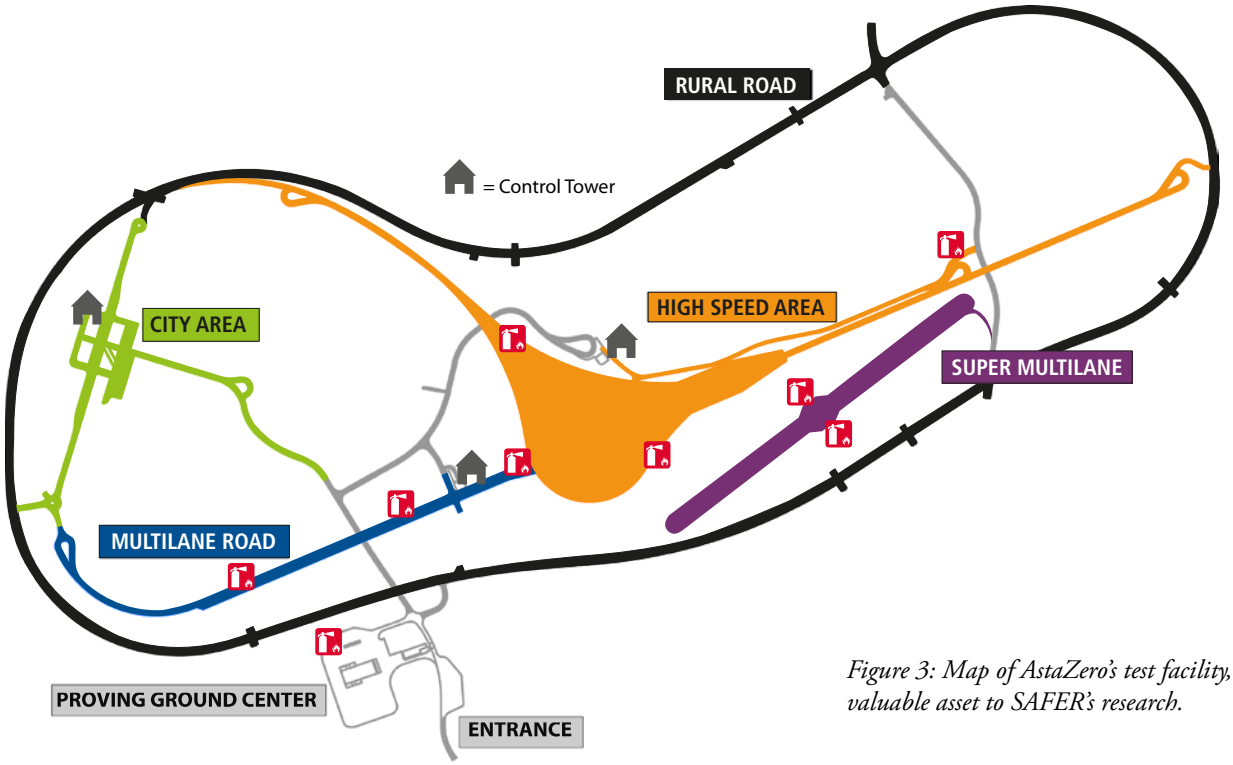


Figure 3: Map of AstaZero's test facility, a valuable asset to SAFER's research.

safety. A database containing accident data according to a standardised data scheme that enables comparison between datasets from different countries is every year extended with around 900-1000 cases. SAFER is both the administator and chair in the project. Partners in the consortium are Autoliv, Volvo Cars and Chalmers.

ASTAZERO REAL-WORLD PROVING GROUND

AstaZero (Active Safety Test Area Zero) is the world's first full-scale test environment for a safe, sustainable and connected automated road traffic future. Different traffic environments make it possible to test advanced safety systems and their functions for all kinds of traffic and traffic situations – in city environments as well as on rural, multi-lane and high-speed roads. This enables a broad range of research, development and validation. AstaZero also serves as an international testing area open for stakeholders within the industry, the society and the academia. AstaZero is owned by RISE Research Institutes of Sweden and Chalmers University of Technology. SAFER, together with AstaZero, has created a program to make the test track available for curiosity research. SAFER is responsible for the coordination of calls for open academic research that need to use the AstaZero facilities in research projects. Since the program started in May 2017, 10 calls for proposals have been available for researchers and a total of 10 projects have been granted so far where of 6 have been successfully conducted so far. One of the first successfully performed projects within the call was "HMI for autonomous vehicles in traffic" (HATric). The aim was to investigate how the driving behaviour characteristics of autonomous cars affect users' understanding, trust and acceptance of the technology in different situations. SAFER continues to coordinate open calls for curiosity research of this kind throughout stage five.

SIMULATOR SIM IV

Sim IV at the Swedish National Road and Transport Research Institute has an advanced motion platform system and permits significant linear movement along both x and y axes. It is useful when simultaneous longitudinal and lateral acceleration is important or if a wide field of vision is prioritised. Cabs, bikes and passenger compartments can be exchanged quickly. The simulator's imaging system has a camera-based calibration system, making it easy to switch between different driver positions. The simulator has been a valuable tool in many SAFER projects, e.g. PROSPECT and VICTIg I and II. In VICTIg the unique set-up used in the simulator was a car cabin without motion. The simulator study demonstrated how the simulation framework proposed in the first project (VICTIg I) can be used in a real experiment with a full-scale hardware set-up. The results from the simulator study are contributing to a currently ongoing safety analysis of situations where a platoon encounters a manually driven vehicle at an on-ramp of a highway. The simulator was a great contribution in terms of having more realistic driver interface compared to previous set-up.

SAFER OPEN RESEARCH ARENA

Fundamental to research activities and the development of competences are the facilities. Practical and easily accessible working spaces and meeting rooms have greatly increased the opportunities for frequent and deep dialogue between experts with know-how in different areas. This type of interaction is a catalyst to foster collaboration and fruitful, innovative ideas. All SAFER partners have access to our facilities at Lindholmen Science Park in Gothenburg. The SAFER office is a meeting place with a 1,250 sqm working area including about 70 workplaces, 15 small meeting rooms, conference facilities and project areas.

LINDHOLMEN SCIENCE PARK

Lindholmen Science Park is both a dynamic area and an arena for collaboration across geographical borders. It is home to several of Sweden's leading development projects, with a focus on mobility for tomorrow. Lindholmen Science Park has become the most knowledge-intensive and expansive area in Gothenburg, and an important hub for automotive and mobility research. About 375 companies have elected to locate offices in the science park, as have two universities and six secondary schools. Some 25,000 people now spend time here every day, a figure that is expected to double over the next five years. The location is full of life and energy that allows you to meet and learn about each other's ideas. We feel that the environment at Lindholmen is right for a collaboration platform like SAFER and the venue as such is a contributing factor to our successful way of researching and collaborating across borders and between different disciplines.

The atmosphere here at Lindholmen Science Park is very inspirational and dynamic. Our location, in the centre of the eco-system, is full of energy, science and entrepreneurship. SAFER, with its partners and successful collaborative research model, is an important contributor to continue to create a creative environment.

Tord Hermansson, CEO Lindholmen Science Park

5. REVERE – A CONNECTED RESEARCH INFRASTRUCTURE

IF ONE IS TO CONDUCT WORLD-CLASS research, resources and infrastructure are needed in at least as high quality. And if it is not available, well, then you have to make sure to get it. And that is exactly what SAFER did in the field of testing of automated vehicles and active safety systems. During this phase of SAFER Revere has grown up from newborn to established and fully flourished adult!

THE SUCCESS STORY OF REVERE – HOW IT ALL BEGUN

The development of active safety systems in the automotive industry has been incredibly fast in recent years. The safety systems have become very advanced and successful in a short period of time and many traffic accidents have been avoided. In connection with the launch of one of the world's most advanced test tracks for active safety, AstaZero in 2014, researchers at SAFER and Chalmers also began to consider how the academy and industry together could optimally utilize the new proving ground. The team found that there was a need to create a value-enhancing link between this new real-world test environment, academic science and advanced simulation environments. The first thought of a laboratory for advanced vehicle research was born. Then, in November 2015, Revere – Resource for Vehicle Research – a small-scale, easily accessible and efficient research laboratory with excellent research competence opened at Lindholmen Science Park, the heart of the Swedish automotive industry.

Since its inception, many research projects have been performed successfully and the lab is now fully established as an important research infrastructure closely connected to SAFER. The most important success factors have been the availability of the advanced test environment, complete research platforms, skilled researchers and of course fruitful collaboration between society, industry and academia.

THE SUPPORT TO RESEARCHERS

Revere contains a research lab with resources including technical equipment, several test vehicles, both light and heavy, and supporting personnel. The vehicles can be fitted with different types of sensors, equipment for data logging, communication technologies and other testing equipment. The Revere laboratory provides a complete research platform for development and verification of theoretical models, algorithms and technologies both in real traffic environments and in simulators. Tests in different traffic environments can be carried out in close cooperation with the test facility AstaZero and on public roads. Real vehicle tests provide more credibility for the researcher's theories and Revere's set-up helps support interaction between researchers from different disciplines. For the future, it is planned to work even more with professionalizing the testing, for instance through more well-documented routines etc. The goal is always to build on existing knowledge, so that the Revere platform constantly grows more advanced, while at the same time resting on an increasingly stable foundation.

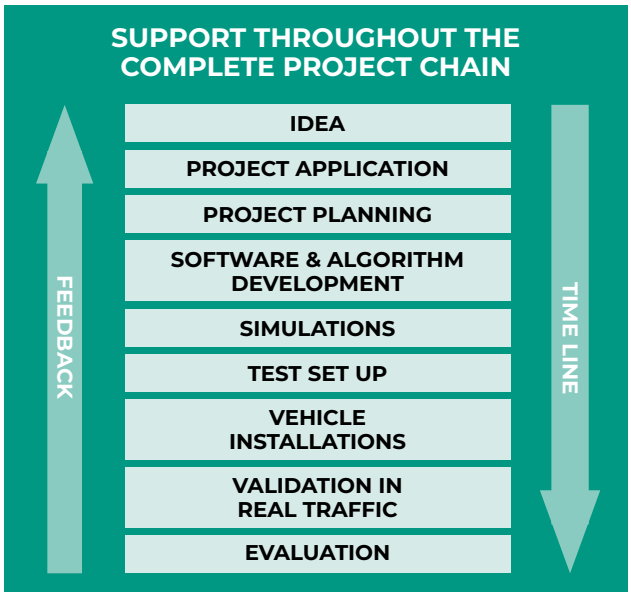


Figure 4: Revere supports the researchers throughout the complete tool chain, from idea to development of algorithms, simulation to final testing and validation in real traffic environment.

ACTIVE DOLLY

An active dolly is an unpowered vehicle used to connect with a prime mover for very long tractor-trailer combinations, up to 32 meters / 90 ton. The two axles can be steered individually, which is a unique functionality. Hence, performance of long high-capacity transports can be improved with an active dolly. The project aimed at building up a dolly and demonstrating improved performance in critical manoeuvres.

Figure 5: Revere's active dolly is now considered as a full-scale research platform for long vehicle combinations.

HIGHLIGHTS

Many of the projects in SAFER's project portfolio is connected to the research infrastructure at Revere, but here comes also some other examples of activities and projects conducted at the vehicle laboratory:

- In September 2017 Sweden's King Carl XVI Gustaf visited AstaZero to learn more about the unique test facility and to experience demonstrations of automated vehicles. The demonstrations showed how Revere's truck, operating in city traffic, could avoid a collision with the vehicle ahead. The visit to AstaZero was a gift to the King on his 70th birthday.
- Participation as first Swedish team in the Formula Student Driverless league in 2018.
- Hosting of the 2018 WASP (Wallenberg AI, Autonomous Systems and Software Program) Summer School where PhD students realised autonomous platooning in less than 72 hours on scaled cars and ported it to Revere's XC90 car "Snowfox" and within an afternoon running it successfully at AstaZero.
- Successful demonstrator of the world's smallest and most portable robotic framework OpenDLV (open-source software for driverless vehicles).
- Successful instrumentation of multiple research platforms for light & heavy vehicles under one roof.

Figure 6: Successful demonstration for the Swedish King.

COOPERATIVE PERCEPTION & PLANNING PLATFORM (COPPLAR)

Several research groups at Chalmers University are involved in a project called COPPLAR which is aimed towards automated driving. The purpose is to move towards our vision of a cooperative self-driving vehicle that can handle challenging city traffic and changing weather conditions. The focus is on using cooperation between vehicles to safely navigate complex inner-city scenarios. In this project, prototype vehicles (research platforms) have been built which are capable of handling the most prioritized scenarios and demonstrate cooperative self-driving in a controlled environment at the AstaZero test track.

Revere is involved in building the platform using its resources and in the vehicle testing phase of the project. The long-term aim is to develop a self-driving vehicle that can travel between Chalmers Univerity of Technology's two Gothenburg campuses at Johanneberg & Lindholmen.

Figure 7: The route for the self-driving vehicle between the two Chalmers' campuses.

GRAND COOPERATIVE DRIVING CHALLENGE 2016 (GCDC)

In May 2016 nine teams from different European universities participated in GCDC, a competition for autonomous vehicles in Helmond, the Netherlands. While competing against each other in different autonomous driving scenarios the teams also had to collaborate and share information to get a high score. SAFER was well represented with in total four teams; one from The Royal Institute of Technology in Stockholm, one from Halmstad University and two teams from Chalmers University of Technology. After one full working week of preparations and two hectic competition days over the weekend, on site in Netherlands, Halmstad University was proudly announced as the winner. The vehicles had been prepared in the Revere laboratory.

Figure 8: SAFER was represented in four different teams at GDCD 2016.

Research activities in close collaboration between industry and academia in the way we do within SAFER and Revere is unique and incredibly effective. It not only leads to research results and innovations, but also inspires and develops people.

Board member Johan Karlsson, Chalmers

6. GLOBAL COLLABORATIONS AND INTERNATIONALISATION

SAFER MAY BE BASED IN SWEDEN but has a truly global mindset. Our international commitment is wide, with vital partnerships with universities and traffic safety research communities all over the world. By initiating and participating in global collaborative research structures, we strongly influence the political traffic safety agenda and contribute to the development of sustainable, safe mobility – in Sweden, and elsewhere.

SAFER has a strategy for internationalisation and the basic idea of the strategy is that by creating strong connections to world class research environments and nurturing an international reputation for outstanding collaboration between industry and academia, we can further strengthen Swedish safety research, innovation ability and global competitiveness, as well as influence the international research agenda. When stage four began, a larger analysis was carried out to identify the need for additional global links and international collaboration in order to decide whether and, if so, what would be focused on. The conclusion of the study was that the already existing collaborations were well-functioning and that we should rather deepen collaborations than broadening to new ones. Collaboration and further exchange with China were, however, something that was considered to have increased priority. SAFER works with institutes and academia as well as other collaborative organisations and research programs and some select examples are described below.

ACTIVITIES IN NORTH AMERICA

SAFER has specifically fostered links with University of Michigan Transportation Research Institute (UMTRI), based on a MoU between Sweden and Michigan's Ministry of Transportation. Through earlier experiences and results from two collaborative projects (SeMiFOT 1 och 2), SAFER has further developed the methodology for Field Operational Tests (FOT) and Naturalistic Driving Studies. The latest achievement in analysis infrastructure is the CAC10 set-up between SAFER and UMTRI, where large data sets can be accessed and analysed remotely across the Atlantic.

The SAFER cluster in impact biomechanics and human body modelling (HBM) has a long tradition of exchange and collaboration with UMTRI. UMTRI has strengths in areas such as belt restraint fit, anthropometry, HBM adaptation (morphing) to varying body sizes and postures. Also tools available at UMTRI is of value for the SAFER research projects. Chalmers Area of Advance Transport is currently developing a formalized exchange program with UMTRI to increase, and to support the continuity, of the future exchange.

The SAFER cluster has also an increasing exchange with professor John Bolte and his group at Ohio State University. Bolte made a longer stay at Chalmers and we plan for a visiting PhD-student during a year. This university has extensive knowledge in, for example, validation of crash tests, cadaver testing and mechanics, and the collaboration provides a great exchange for our own research.

SAFER also has an informal, but important, collaboration with NHTSA (National Highway Traffic Safety Administration). In 2016, Chalmers graduated a doctoral student from NHTSA, Stephan Ridella. Some cooperation in child safety has also been underway during the phase.

For many years, SAFER has also collaborated with the University of British Columbia. Examples of joint research and exchange of knowledge of strategic nature have been in the modelling of muscle response. Knowledge in this area is a prerequisite for continuing our work in building human-like virtual crash models for all types of people in different sizes and shapes.

SAFER and Chalmers has recorded NASS CDS data (National Automotive Sampling System Crashworthiness Data System) to match and to be added to IGLAD, a harmonized global in-depth traffic accident database. NASS CDS was part of NHTSA's crash data collection program and has now been replaced by CISS (Crash Investigation Sampling System). CISS collects detailed crash data to help scientists and engineers analyze motor vehicle crashes and injuries.

ACTIVITIES IN ASIA

CTS – The China Sweden Research Centre for Traffic Safety (CTS), with Swedish partners Chalmers, Volvo Cars and Volvo Group, and Chinese partners Tongji University and RIOH Institute for Highway Safety has grown with four new partners – Autoliv, VTI, Tsinghua University in Beijing and Geely Automotive Research. SAFER constitutes the Swedish research platform in this collaboration. Joint projects are ongoing as well as other activities to enhance safety in China, for instance though road mapping workshops and development of joint project proposals. Examples where SAFER has been present is the ADAS conference in Shanghai June 2016 in collaboration with Tsinghua and Tongji universities, and SAE China in October 2016, 2017 and 2018 where CTS have had a specific session. Recently, two project proposals developed within CTS were awarded funding in a joint Swedish – Chinese call. A new set of call proposals are now being developed for the next part of the funding programme.

TUAT – Tokyo university of Agriculture and Technology – is a collaborative partner to SAFER since long. A Chalmers researcher, Matthias Lidberg, has been a guest researcher at TUAT during the period November 2016 – March 2017.

Tokyo Institute of Technology is active in head injury prediction research and collaborates with researchers at JARI, which have since many years intensive collaborations with SAFER. Yusuke Miyazaki, Associate Professor at the Department of Systems and Control Engineering at the Institute, visited SAFER during three months in 2018.

SAFER has since long been in close cooperation with Nagoya University in Japan and has had exchanges with professors Takeda and Mizuno. Researcher exchanges involving students and senior staff are ongoing and include both data analysis and driving simulator studies leading to joint publications.

Xiamen University of Technology has invited Rob Thomson, Johan Davidsson, and Mats Svensson as guest professors under the "High Level Expert Program" in China for the period 2016-2019. Regular visits of the Chalmers professors are used to facilitate the growing activities in safety at the XMUT and introduce the Chinese faculty and students to Swedish experience in research and education.

Chalmers and the SAFER cluster in impact biomechanics and HBM has an exchange with JARI (Japanese Automotive Research Institute) since 1993 in whiplash injury research and more recently also on brain injury. During this period of research, two JARI employees, Jacobo Antona and Fusako Sato, received their PhD degrees from Chalmers.

Generally, increased cooperation with China is important for SAFER's further development. In China, there is a large and detailed documentation of accidents available, which are valuable for our research. In addition, there is a different traffic environment than the one we are used to researching, a completely different traffic pattern with more pedestrians, cyclists and various types of two-wheelers. Reconstruction of accidents is another area where cooperation with China can be of great value. According to our strategy, cooperation with China will be further developed during phase five, for example through the already established and positive cooperation within CTS.

ACTIVITIES IN EUROPE

SAFER has over time focused on having a strong presence and become increasingly invited to different forums on the European scene. The plan has been to engage in activities related both to influencing and participating in order to promote SAFER's research agenda and thereby its scientific level and partners' success. Worth mentioning regarding influencing is, for example, the membership in the European Automotive Research Partners Association (EARPA), both in the Safety Task Force and in the extended Board, and participation in the European Road Transport Research Advisory Council's (ERTRAC) scenario work on Road Safety Research beyond 2030 as well as a road map for European road safety research from 2020 and onwards. SAFER and its partners participate actively in the European Council for Automotive R&D (EUCAR), ERTRAC and ERTICO – ITS Europe. SAFER's director is a member of the ERTRAC safety group and has with support from SAFER researchers' provided texts for topics for the 2018 – 2020 calls as well as to the Position Paper for future Road Safety. Currently, the work is focussed on the structure and content of the upcoming Horizon Europe programme, ensuring the road safety topics in the new setting.

SAFER has been – and is – involved in a number of EU projects (e.g. AdaptIVe, CARTRE, L3Pilot, VIRTUAL and MeBeSafe) and has built a reputation of high competence, good teamwork and high-quality deliveries.

The Vinnova financed platform TS-Europe has created the possibility to craft messages and provide input to several channels involved in the shaping of the H2020 work programmes. The programme has developed positively over time and we have been able to keep track of Swedish partners and activities in the different H2020 calls. Also, SAFER participation and contribution to forums such as the Swedish network of people involved in the technology platforms and Forum for Innovation in the Transport Sector (closed down by the end of 2018) has been beneficial to provide an additional channel to provide input to the programmes as well as channelling information to the SAFER partners.

ACTIVITIES IN SWEDEN

As earlier mentioned, SAFER has a core position in the different platforms for autonomous drive where the property traffic safety is both a goal and a boundary condition. SAFER is a member of Drive Sweden's programme office as safety is an important perspective for a sustainable transport system. SAFER has also been a member of the DriveMe programme office, responsible for the involvement of Chalmers' different competences. The large research program WASP (Wallenberg Autonomous Systems and Software Program) involves researchers connected to SAFER. WASP has a test infrastructure, WARA, which has established contacts with Revere to ensure synergies.

The Vinnova programme Strategic Vehicle Research and

Innovation (FFI) is one of the main sources of national funding for SAFER projects, especially the sub area Road Safety and Automated Vehicles, but also in related areas such as Efficient and Connected Transport Systems. During stage four, there has also been a specific call for Bicycles and Other Vehicles in a Safe and Smart Cooperation for a Sustainable Future where SAFER played a role as a catalyst to kickstart proposal creation for this call.

In November 2018, the international centre AI Innovations of Sweden opened at Lindholmen Science Park in Gothenburg. The aim of the center is to get Sweden up to the global stage in research within AI. SAFER, with its over ten years of knowledge building on the collection, analysis and management of very large amounts of traffic data, led one of the pre-studies to the centre, "The data factory". The collaboration platform will provide a broad spectrum of industry, academy and public administration and healthcare professionals the opportunity to establish a national arena with a data factory to accelerate AI-related research and innovation. In addition, the centre will focus on creating collaborations with strong players internationally. SAFER aims to work in close cooperation with the research centre during the next phase.

The SAFER director is a member of GNS (Gruppen för nationell samverkan) – the national group for collaboration on traffic safety led by the Swedish Traffic Administration. This group focusses on knowledge exchange and coordination of activities supporting and developing Vision Zero, hence an important platform for SAFER to align with, influence and support. SAFER has also been active in the GNS expert group on vulnerable road users. This group has together produced a "Common strategy for safe walking" (Gemensam inriktning för säker gångtrafik 1.0") where they identified and prioritised activities to reduce injuries for vulnerable road users. A second working group produced "Common strategy for safe traffic with bicycle and mopeds 2018" (Gemensam inriktning för säker trafik med cykel och moped 2018), where the approach was similar.

SDSN- The Executive Committee of the Sustainable Development Solutions Network (SDSN) has approved SAFER for membership in the Solutions Network. SDSN supports the implementation of the UN Sustainable Development Goals adopted by world leaders in September 2015. SAFER will work together with SDSN in support of sustainable development and aims to find further means of collaboration on research, solutions initiatives, and policy work.

Part of the strategy for how SAFER should be developed during stage four was to better utilize the ecosystem for research and collaboration in Sweden. An inventory and establishment of contacts has now been made and structured. The goal for the completed work to is to have this fully implemented, including the working process and exchange during the next stage of SAFER. The surrounding ecosystem is continuously changing, and new opportunities arise, so the way of working has to be adaptable. One example of the developed connection to the ecosystem is the newly established joint work together with PICTA (Pre-hospital ICT Arena) focusing on post-crash issues and activities.

Figure 9: The document has been developed in collaboration between fifteen actors and is part of the joint work Together for the Zero Vision, in which SAFER is an active part.

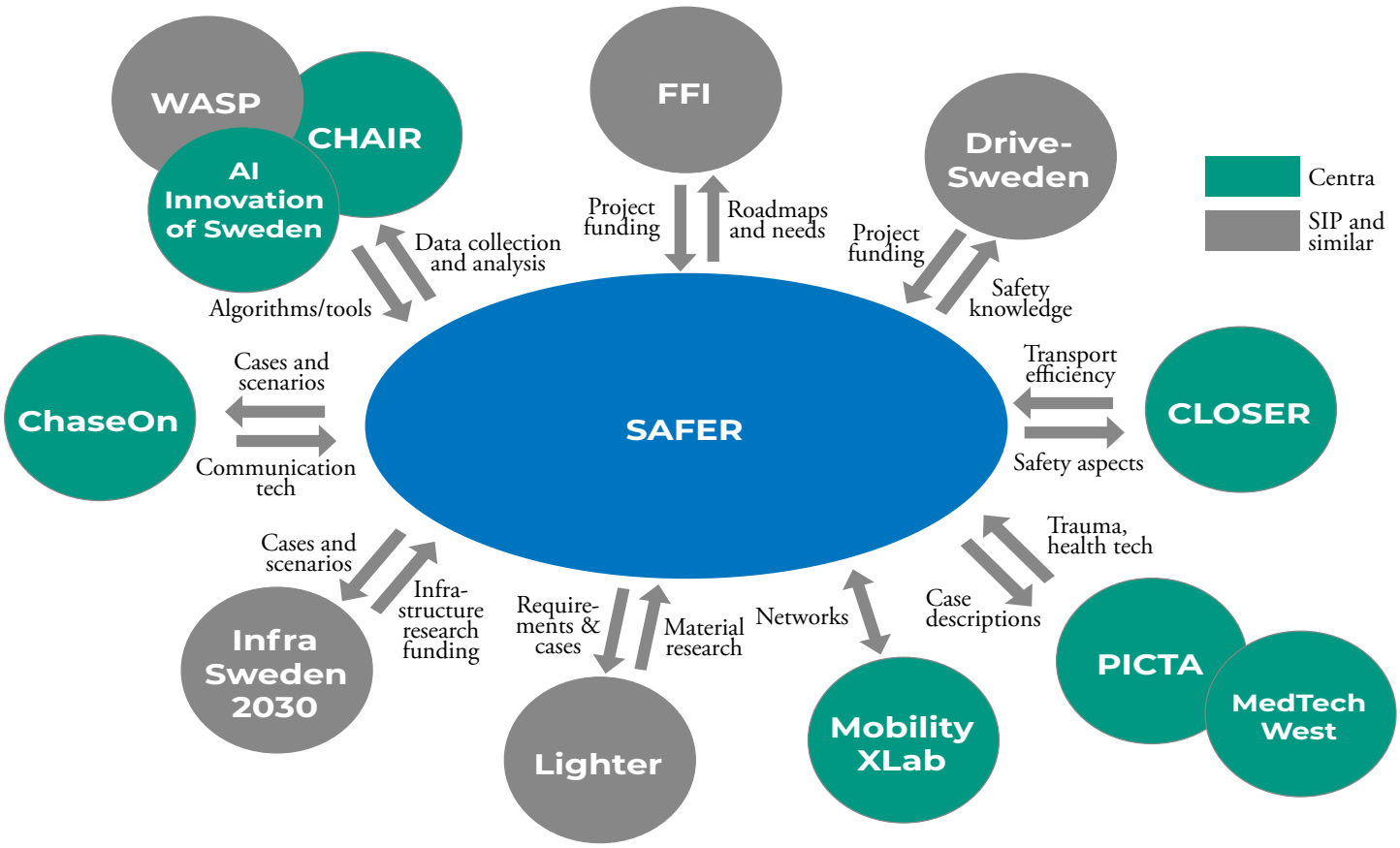


Figure 10: A picture of the immediate ecosystem in which SAFER acts in Sweden.

ACTIVITIES IN AUSTRALIA

SAFER is partner to ADVI – Australia Driverless Vehicle Initiative – that was formed to build momentum by rapidly exploring the impacts and requirements of this new technology in a truly Australian context and making recommendations on ways to safely and successfully bring self-driving vehicles to Australian roads.

Within the area of child safety and passengers in future cars, SAFER researchers collaborate with researchers at Monash University as well as NeuRA (Neuroscience Research Australia).

ACTIVITIES IN AFRICA

SaferAfrica is an EU-project that aims at establishing a dialogue platform between Africa and Europe focused on road safety and traffic management issues. It will represent a high-level body providing recommendations for the update of the African Road Safety Action Plan and the African Road Safety Charter, as well as fostering the adoption of specific initiatives, properly funded.

Successfully creating networks and exchanging knowledge with truly knowledgeable researchers all over the world is a prerequisite for us to continue to be the world-leading traffic safety research hub we strive for.

Board member Sinisa Krajnovic, Chalmers

7. FINANCING

SAFER IN STAGE FOUR has had two main types of financing, one being SAFER Core which is the base for the core activities in terms of the secretariat, the office and open research area and base funding for the seminar and dissemination activities, the other being the project financing for research and project activities.

SAFER CORE – THE CENTRE FINANCES

SAFER Core is financed from funding from Västra Götalandsregionen and partner cash contributions according to the overall partner agreement for the fourth stage of SAFER, as agreed in the beginning of 2016. The framework agreement stipulates an annual contribution of 4.5 MSEK from Chalmers, 1 MSEK from partners on level 2 and 130 KSEK from partners on level 2. The contribution from Västra Götalandregionen is 2.5 MSEK per year. This sums up to about 20 MSEK cash and about 10 MSEK in-kind for the entire period. Given the size of the project portfolio, the proactive ambitions, the number of partners and external collaborations the size of the core team, which is perceived as "SAFER dedicated staff" (director, controller, communications, project coordinator, facility manager), is competitively lean.

Partners on level 1 and 2 contributes with in-kind to SAFER Core. Partners on level 1 contributes with 500-900 ksek per year to e.g. Research area directors, Competence area leaders, other management group members and in projects. The in-kind is an important tool to ensure competence and infrastructure contributions from all partners. The total amount of in-kind contributions has been well delivered and distributed within SAFER.

The preliminary result for the SAFER Core finances is shown in the table below. The cash resources for SAFER are governed by the Board, who has continuously monitored the budget and decided on changes in expenditure when required.

The budget, and the partners' cash contribution, was set on the basis that the center would receive further funding from Vinnova. However, the expected financing of about 7 MSEK million was not received and the budget has therefore been tight during the period. The strategy set up aimed to handle the new financial situation in a lean and efficient way. We have also invested for the upcoming stage 5, for example in brand building activities, i.e. a new website and recruitment of new partners. No less than 12 new partners joined the main agreement during the ongoing phase (marked in the table as additional partners).

When we sum up the financial result for stage four, we can conclude that we managed the tight budget fairly well, but not fully.

PROJECT FINANCES

The project financing comes from a variety of sources, primarily national programmes such as the FFI programme (Strategic Vehicle Research and Innovation), different strategic innovation programmes funded through Vinnova, Stiftelsen för Strategisk Forskning (SSF) and others, but also internationally through EU's Horizon 2020 programme and similar sources. In addition to this, internal funding from all partners play an important role, whether it's academic, institute or industry partners. The project portfolio is described in the next section, and at the time of writing, the overall budget for the projects in SAFER's fourth phase in the portfolio sums up to 750 MSEK. Even though the full budget of each and every project may not be relevant to the SAFER research it clearly shows the benefit for the partners to join in the SAFER projects that generally has a high hit rate in the competitive programmes. Also, the leveraging factor of collaboration projects is clear, especially when accessing the knowledge and financing power on the European arena.

SAFER STAGE 4 (YEAR 11-13)

EXPENSES (kSEK)	
Personnel	10 509
Premises	5 666
Running costs office	808
IT costs	293
Communications	775
Knowledge sharing activities	343
Indirect cost Chalmers	1 843
Other costs, travel etc	285
Sum	**20 522**
INCOME (kSEK)	
Partner (level 1 and 2) cash contribution	11 700
Ass. partners (level 3) cash contribution	210
Additional partners and ass. partners	730
Funding from Region Västra Götaland	7 300
Sum	19 940
RESULT (KSEK)	**-582**

Figure 11: Preliminary figures for the finances in SAFER Core stage 4.

8. PROJECT PORTFOLIO

THE PORTFOLIO OF PROJECTS is the base for the SAFER collaboration, comprising of different types of project, but all focusing on one or more of the issues addressed in the roadmaps and other strategy documents, created through the multidisciplinary research. The project portfolio is created, maintained and developed through the joint efforts in the research areas and among the partners and through stage four the focus has been to secure a solid foundation of projects and related activities through various sources of funding, albeit without the previous specific funding base from Vinnova as in stage 1-3. This has meant that the research areas have had to focus even more on suitable available funding from various national and international (primarily EU) research and innovation programmes.

A research project at SAFER relates to one or several of the five research areas and they are: Systems for accident prevention and automated driving – which handles projects on accident prevention (accident avoidance and crash mitigation) and automation. Human body protection covers projects concerning injury prevention. Road user behaviour concerns how we can support people to act safer in traffic. Care and Rescue handles projects on mitigating consequences of accidents and Safety performance evaluation develops methods to process, analysis field data and develop assessment procedures. For practical reasons a specific project belongs to, and is managed via, a Reference group, even if it can relate also to others. Projects that cover multiple research areas or focus on general questions are called Competence projects. See the distribution of projects between the different areas in figure 12.

The primary forum for initiating and discussing projects at SAFER is the collection of Reference groups, which recommend project proposals to the Management team and Board for decision. The agenda covers new project ideas, project reports and final results as well as strategic issues like input from all partners on research areas and on conferences, seminars and international collaborations and calls. The Reference groups include representatives from all level 1 and 2 SAFER partners and are the base for establishing world class competitive project portfolios. Each Reference group hosts a mix of projects; pre-studies for future projects, and small and large national and international projects. Based on these factors, and others, projects are either "own" or "associated". A project present at SAFER can be initiated at SAFER and/or funded by SAFER ("own") or started by SAFER partners in another context and brought in to the SAFER environment ("associated") where it can thrive and benefit from the presence of other projects and researchers. A SAFER associated project can also be an externally funded larger projects that has had a previous succesfully performed pre-study, financed by SAFER.

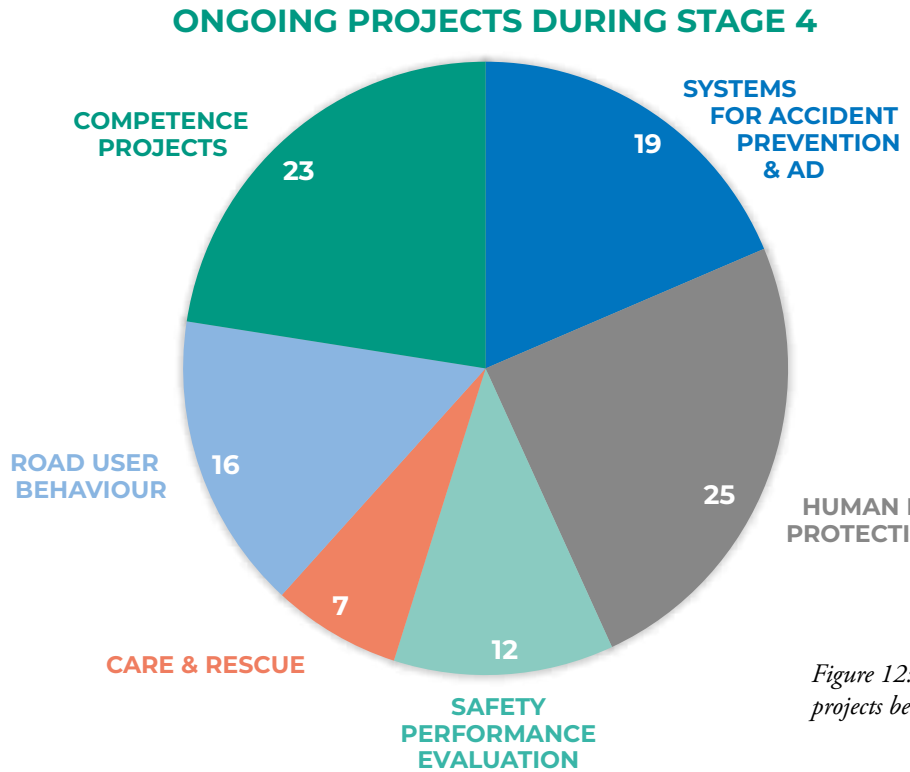


Figure 12: The distribution of projects between the research areas.

Figure 13: The number of partners in SAFER's projects.

Since interdisciplinary collaborative research is a key approach to excellence and innovation, projects should involve at least two partners preferably from different stakeholders. The majority of the projects involve 2-4 SAFER partners and some 21% involve 5 or more, see figure 13.

During SAFER stage four 57 projects with external funding have been added to the project portfolio adding up to a total of 102 projects that have been ongoing during the phase. 79 of them belonged to one of the five research areas (complete list in appendix 6) whereas 23 projects were competence projects. Many of the project have been successfully finalized during the phase and SAFER will enter its 14th operational year with about 40 ongoing projects.

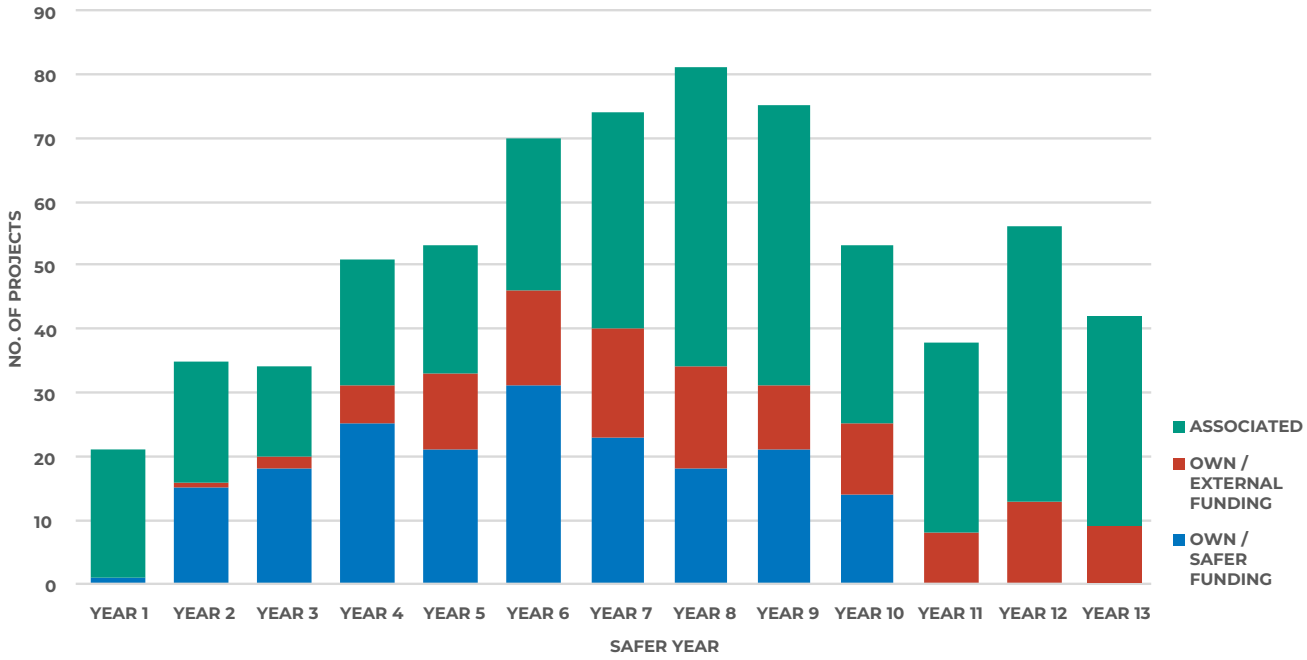


Figure 14: Number of projects in SAFER's portfolio. Note: Many own projects have both SAFER and external funding. This figure only consider main funding.

SAFER's project portfolio is strong and contributes to Sweden's development, competitiveness, and not least to the creation of a truly sustainable transport system.

Anna Nilsson-Ehle, Chairperson for Vinnova

9. RESULT FROM THE RESEARCH AREAS

ROAD USER BEHAVIOUR

A RELATIVELY NEW formed research area at SAFER is Road user behaviour. The working group was established as such in early 2017 and the activities are now in full swing. The research covers how drivers and riders of vehicles, ranging from bikes to trucks, and vulnerable road users (VRUs) actually behave in traffic, not just how they are supposed to. It also covers permanent and temporary impairment of the driver, and driver state definition, monitoring and prediction with algorithm development. The driver´s interaction with in-vehicle information systems, including nomadic devices, and interaction with advanced driver assistance systems, how the driver reacts to and accepts warnings as well as automatic interventions of active safety systems such as emergency braking, are also included.

Human factors issues are growing due to the more complex interaction with the increasing automation of vehicles, creating new challenges. In national projects and larger European projects unique knowledge, understanding and driver models of driver behaviour have been developed. This provides guidance to design new active safety and automated vehicle functions. The unique knowledge acquired has enabled explanations to driver behaviour issues that have since long been sought after.

DESIGN OF USER-FRIENDLY SYSTEMS

During SAFER stage four, one of the focus areas have been automated driving and how systems could be designed to fit human behaviour. Human factors have been investigated to design automated systems in both national projects, with for example HATric, and in European projects such as AdaptIVe. The latter – Automated Driving Applications and Technologies for Intelligent Vehicles – has received a lot of attention during the 1st European conference on Connected and Automated Driving, organised in Brussels in April 2017. Human factors was one of the key research areas in AdaptIVe. The main objectives were (i) to develop high-level use cases, (ii) to investigate the interaction between drivers and vehicle automation systems by experiments in driving simulators settings and (iii) to develop high level human factors recommendations regarding interaction between the human driver and the automated system. In sum, the human factors work resulted in a catalogue based on a 4-A structure (Agent state, Awareness, Arbitration and Action) with 26 functional human factors recommendations for the User-Centred Design of automated vehicles, comprising the interactions between the driver and the vehicle automation system(s). AdaptIVe has also been a valuable and suitable platform to interaction with other major stakeholders within the automotive industry.

Another European project within the Horizon2020 framework is PROSPECT. This project has been aiming at improving the protection of vulnerable road users (VRUs) with an emphasis on the two groups with the largest shares of fatalities: cyclists and pedestrians. The project was successfully ended in 2018 and the results helped the researchers to take important knowledge steps within this area.

Research investigating “optimal” vehicle HMIs has also been conducted in a large international project, ADAS&ME (Adaptive ADAS to support incapacitated drivers Mitigate Effectively risks through tailor made HMI under automation). The project is developing adaptive HMI to automatically hand over different levels of automation and thus ensure safer and more efficient road usage for all vehicle types. In Sweden, Scania is focusing on monitoring several driver states beyond sleepiness and distraction. Specifically, the Scania truck will also monitor for emotions and rest which represents a business case for the truck company. The challenge faced in ADAS&ME is to create a physiological definition of rest and find ways to measure this in a minimally obtrusive way. VTI focusing on bus drivers. Automated functions might be one way to work to reduce the level of stress and fatigue for city bus drivers. The hypothesis is that a system supporting drivers during entering and exiting the bus stop might be a good support, in addition it might decrease the risk of hard accelerations/decelerations with risk of passenger falling. Smart Eye and Autoliv are partners contributing respectively with eye tracking technologies and driver monitoring sensors and algorithm development.

Figure 15: AdaptIVe Final event: More than 250 experts from 20 countries all over the world joined the AdaptIVe final event in Aachen, June 2017.

MEBESAFE – A NOBEL PRIZE WINNER'S THEORY IS BEING TESTED AT SAFER

An emerging area within traffic safety has been how to apply the concept of nudging. "Nudging" comes from "nudge", i.e. touch gently, where the concept behind is to encourage people to behave correctly without direct instruction, legislation nor enforcement. The recent European project MeBeSafe (Measures for Behaving Safely in Traffic) will dig into the concept of nudging to increase traffic safety.

The Nobel Prize 2017 was awarded to Richard H. Thaler, University of Chicago, IL, USA "for his contributions to behavioural economics". And the same theory – nudging – is now being tested in the field of traffic safety at SAFER.

Figure 16: Nudging, like a sign of this kind, will be evaluated in SAFER's project MeBeSafe.

ELDERLY IN THE TRANSPORT SYSTEM

The number of older drivers in many countries is increasing, and SAFER has taken on itself to gain knowledge regarding their needs and the change in driving behaviour needed to sustain their mobility by using their cars in a safe way. The last decades, several SAFER projects have focused on studying older drivers' behaviour to understand their accidents involvement and to use this knowledge to design active safety and support systems. A lot of attention has been spent on crossing accidents and to collect data in real-life driving to understand the behaviour. This knowledge is used by industrial partners to design system to support drivers through crossings. Through on-road assessment and in-depth interview, issues regarding speed adaptation (i.e. use the speed which is appropriate in a specific scenario, might be lower than the legal speed limit) and awareness of own capability (i.e. correct calibration not over- or under- estimating the capability) have been identified. What factors influence our awareness of own capability is still a research question and a doctoral thesis is on-going to give answers and find applications such as designing training, feedback and support systems.

SAFE BIKING

Another area of success is biking. The fact that increased cycling can contribute to more sustainable cities is beyond doubt. But how to make biking safer is more complicated. Therefore, SAFER was commissioned by the FFI program to catalyse a process to kick-start research in the field. The aim of the project was to stimulate project ideas within academia, industry and society. A total of seven projects went on for review for funding and project implementation. The competence SAFER represented was also used within the national Group for Collaboration (GNS) run by the Swedish Transport Administration. The last years, an important work has been conducted to update the "Common National Alignment for safe traffic with bikes and mopeds 2018". This activity is a good example of how a multidisciplinary research arena such as SAFER can contribute to cooperation and innovation over traditional boundaries as well as supporting the Swedish Vision Zero. Another example is the project "Bike Model" using naturalistic data as from traditional and electric bike (pedelec). The aim of the project was to develop rider models to support cycling safety including infrastructure and electrical bicycle design. Results showed that individual cyclists increase speed when moving from a traditional to an electric bicycle. Electrical bicycles are not only faster than traditional bicycles they also experience lower lateral and longitudinal accelerations. Braking behaviour is also different depending on whether a cyclist ride an electric or a traditional bicycle. In particular, e-cyclists are more likely to experience unexpected situations requiring harsh braking. The main conclusion of the study is that in general, e-cyclists are faster, have harder time planning braking, and overtake other road users more often than other cyclists. As a consequence, many situations that are already challenging for cyclists, e.g. obstacles on the bike lane, poor visibility and construction work, become even harder and potentially critical for e-cyclists.

Figure 17: In collaboration with Cycleurope SAFER is conducting a project to develop a new type of safer three-wheel bike. As it has just three wheels, it becomes more stable.

Thanks to digitalization and automation trends in transport, the relevance of knowledge on human behaviour has grown the last decade. There is an increasing draw associated with effort and resources to understand and find out how we can behave safer in traffic. It is only by collaboration between different sciences we can achieve this together. Research areas such as nudging and user experience are growing. And this is exactly the knowledge needed to take the next step towards Vision Zero.

Understanding the road users' behavior becomes ever more important as vehicles are increasingly automated and connected. Through the cooperation within SAFER, VTI and the other SAFER partners are able to carry out excellent human factors research, with a large potential for utilization through the different partners.

Board member Jonas Jansson, VTI

9. RESULT FROM THE RESEARCH AREAS

SYSTEMS FOR ACCIDENT PREVENTION AND AUTOMATED DRIVING

OVER THE YEARS, different types of active safety systems have been developed and helped to advance the safety of many of the vehicles we see on the roads today. The research area Systems for accident prevention and automated driving has contributed to this and will continue to do so in the future. During the fourth phase of SAFER the automation aspect has been increasingly in focus. The automated driving and move towards driverless vehicles are indeed a complex matter, and there is strong need for applied research projects to build the required knowledge. The overall question for the area during the past three years has been: how can active systems and automation predict and prevent collisions? SAFER's approach has been, and will be, focused on the thorough understanding of the different aspects needed to ensure a maximized benefit from a safety perspective, based for instance on field data analysis and accident information.

This research area covers in brief:

- Understanding of basic principles relevant for safety performance of collision avoidance and mitigation systems.
- Principles of sensors and algorithms relevant for safety performance in more complex conflict scenarios.
- Verification and validation of active safety systems, semi-autonomous and fully autonomous vehicles and connected transport systems where infrastructure, vehicles and vulnerable road users interact to enhance safety.

Development and implementation of automated vehicles is an enormous task and the partners in SAFER are interested in working with matters that a multidisciplinary research platform can contribute with. Examples of areas are validation, verification, method development and field operational tests. Projects within automation and autonomous driving have grown in number during stage four, and in the text below some achievements within the Research area are presented. For a complete presentation of all projects related to this research area, please see our website.

HEADSTART

One of the main challenges for the implementation of self-driving vehicles is the testing and validation. Therefore, it was appropriate that SAFER as JRU was granted funds under the Horizon 2020 framework program to conduct HEADSTART (Harmonised European Solutions for Testing Automated Road Transport). The project takes on the challenge to define testing and validation procedures of functions including its key enabling technologies, i.e. communication, cyber-security, positioning, by cross-linking of all test instances such as simulation, proving ground and real-world field tests to validate safety and security performance according to the needs of key user groups, e.g. technology developers, consumer testing and type approval). SAFER is in this project the joint research unit and its partners RISE, Chalmers, AB Volvo, Veoneer and AstaZero are involved in the project. SAFER will set up the requirements for testing and perform demonstrations at AstaZero. The project starts in 2019 and will last for three years.

AUTOFREIGHT – AUTOMATED TRUCKS BETWEEN GOTHENBURG AND VIARED

The overall objective with the project is to create conditions for self-driving trucks along highway 40 between Gothenburg harbour and Viared, a distance of about 75 kilometers. The vision is that the driver will drive the truck manually from the port to highway 40 and then activate the autonomous mode. The project will also review existing legislation for high level automation. During the past year, the project has made progress and the truck can now follow a pre-programmed route and make various maneuvers, for example lane changes. Image processing is another important area in the project where a camera with the ability to classify different objects has been used.

REALSIM FOR AD

One of the main problems when developing autonomous vehicles is the availability of real-life driving data and testing of the new functions. Therefore, in SAFER's new project "RealSIM for AD", tools for simulation, based on SAFER's unique

databases with real-life driving data, will be developed. A digital environment of the City of Gothenburg will also be developed. The challenge is to make simulation tools look similar to the reality, and here are SAFER's databases, which contain more than 5 million kilometers of data, an important asset.

IDOLLY – SELF-DRIVING TRAILERS WITHOUT DRIVERS ON PUBLIC ROADS

Half an hour's drive on the highway east of Gothenburg Viared Industrial Park is located. Within soon, self-driving trailers will drive from the transshipment terminal to the various companies in the industry park. The semi-trailer will be transported without a driver by means of a so-called dolly. A dolly can be connected to the front of a trailer and hence give the trailer a front axle. In this case, the dolly is equipped with its own electric motor, steering, different types of sensors and an advanced control system. This allows the dolly-trailer combination to drive autonomously, without a human driver.

DRIVE SWEDEN TEST SITE AUTOMATED HIGHWAY III

SAFER was leading this project, that started in 2017, to accelerate the implementation of autonomous vehicles and digitized transports. The purpose was to create test beds for the development, evaluation and demonstration of autonomous and digitalized transports, focusing on rural roads and highways. The project also helped improve visibility and coordination between actors and between projects that demonstrate and test autonomous regional and long-distance transport of goods and people. The project was completed in 2018 and the result was a number of joint project applications for further research and collaboration.

AUTO PILOT SITE TO PLANT

The purpose of the project is to build a safe and efficient fully automated transport system that is capable of operating in narrow spaces, such as a mine, and on public roads. The material from the mine will thus be transported without a driver in the vehicle all the way from the mining area to the enrichment plant. The system should be able to work both with and without support from various infrastructure systems, such as GPS, WiFi and 4G. It is essential for SAFER to engage in confined area automation since it is in this environment that research and technology development will take place before it evolves into the public road domain.

SWEDEN4PLATOONING

The objective of the project is to demonstrate feasibility of CACC (Cooperative Adaptive Cruise Control) on public roads, with trucks from Scania and Volvo at the haulage company Schenker. Further will platooning (lateral and longitudinal control of trucks) be demonstrated at suitable test sites. The goal is to make V2V communication viable for commercial vehicles and thereby connective safety. This is the first project for cross brand communication (V2V) and applications among SAFER partners; an important enabler for connected safety. It is a three-year project ending in 2019. Partners are Scania, Volvo, Royal Institute of Technology, SICS Swedish, ICT, Schenker AB, and Trafikverket.

DRIVE ME

Drive Me is one of the world's first full-scale pilot projects with autonomous cars, real customers and testing on public roads. SAFER is represented in the Drive Me project management and as the academic partner. This will strengthen

the project's scientific dimension, which includes independent research and programmes for educating new experts. In December 2017, the first two families, the Hains and the Simonovskis, received their Drive Me cars.

ESPLANADE

The ESPLANADE project targets the complex question of showing that an autonomous road vehicle is safe.
One of the key issues investigated in the project is how the communication between the car and the driver will be set up, for example, by clarifying who is responsible for conveying the vehicle in different situations. The ESPLANDE project aims at providing a methodology that can be applied to increasingly complex tasks in order to ensure a safe introduction of more and more advanced self-driving vehicles.

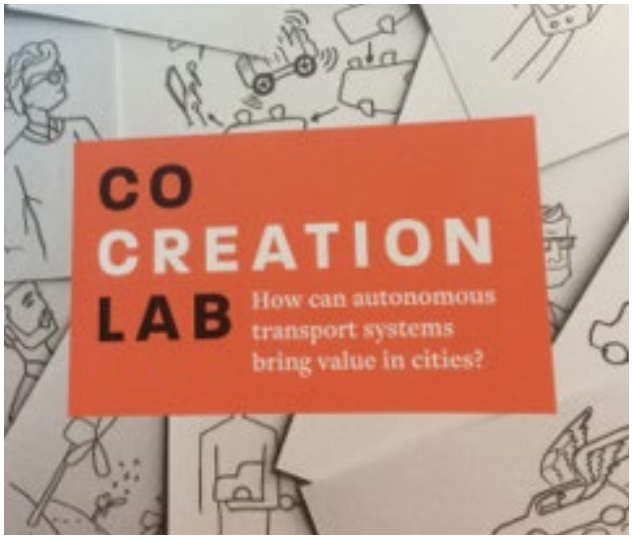
VICTIg I AND II

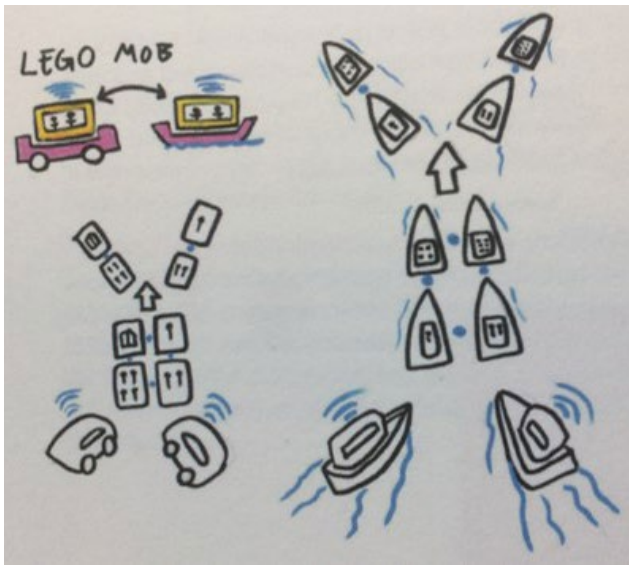
The successful SAFER project VICTIg I – Vehicle ICT Innovation Methodology – has now been finalised after five years of research. The project has been aiming to find methods for efficient development and test of the software intense ICT functions that enable active safety functions for automated and assisted vehicles. Three conference papers, one journal paper, one licentiate thesis as well as one doctorate thesis have been published in the project. The project was so successful that it now continues in a VICTIg II. The method developed in the first stage of VICTIg vill now be used in the next stage, VICTIg II. The project will look into safety evaluation of highway platooning under a cut-in situation, using simulation.

CO-CREATION LAB

How can autonomous transport systems bring value in cities? So far, discussions and projects concerning autonomous vehicles have mainly been related to technology, technical systems, internet services and legislation. There is very little material on how autonomous vehicles affect the city's infrastructure, traffic, environment, city life and people's everyday lives. Stakeholders from various professions and backgrounds gathered in these co-creation workshops, where they through creative exercises developed new ideas and concepts related to autonomous transport systems in specific urban contexts. The purpose was not to create ideas for implementation, but to explore hidden values and identify the competence gaps to free them.

During SAFER stage five, we will continue to strengthen the expertise in the area of Systems for accient prevention and automated driving, meeting the challenges ahead of us regarding safety aspects of vehicles, road users and infrastructure when we are moving towards higher degrees of automation, but in most cases in a mixed environment. Also, the scientific base for verification and validation is of utmost importance in order to ascertain that correct methods are used in an area that is much more complex than previously. This base is also required to create a foundation for future standardization of test methodologies.





Through research and collaboration between academia, institute and Swedish automotive industry in this research area, we develop a cutting edge knowledge base together with our peers. Based on the research projects and networking, the Volvo Group is supported to keep a leading position in ADAS and vehicle automation for a better, safer and more efficient transport system for goods and people.

Board member Magnus Rilbe, Volvo Group

9. RESULT FROM THE RESEARCH AREAS

HUMAN BODY PROTECTION

THE RESEARCH AREA Human Body Protection encompasses research needed to understand and develop countermeasures to prevent injuries in accidents. Focus is on emerging challenges in transportation, creating a knowledge base as well as a tool box for human body protection evaluations and enablers.

Human body protection covers biomechanical injury mechanisms, responses and consequences, the principles for protection, including safety system usage and pre-sensing input, as well as mechanical and mathematical occupant and unprotected road user models for complete crash sequences. In addition, it includes research to develop new simulation models and methods needed for the development and assessment of novel crashworthy structures. In particular focus are new material models, efficient numerical crash simulation methods and system design optimization tools targeting lightweight vehicles, including compatibility aspects.

SAFER partners have a world leading position in the area of applied biomechanics research and application; exemplified by child safety and whiplash injury research, development of crash test dummies and human body models. SAFER enables the continuity of this position. Important parts of current research comprise human kinematics and behaviour together with other influencing factors in pre-crash events, and how to model these. SAFER has pioneered this research area for car occupants and aims to continue this journey. Additionally, within the area of traffic safety related composite research, SAFER and its partners are currently one of the world-leading groups focusing on developing modelling and simulation tools for composite structures in crashes. Many aspects are still unresolved and will require significant research efforts for years to come.

Future challenges include vehicles with higher degree of automation, likely leading to less accidents, but each of those accidents being more unique. This requires not only more detailed methods for evaluation, which are based on more refined biomechanics research. It also adds the complexity to the methods and tools, by including vehicle pre-crash dynamics by the automated systems; eventually also being self-driving, making all occupants to passengers and likely increasing the span of activities of those passengers within the car. The growing focus on sustainability emphasizes the importance of low-weight material, and the challenges simulating those in crashes.

During SAFER stage four, examples of prioritised research questions were:

- How to model and measure injury consequences for humans in a crash, including preceding events?
- How do pre-crash factors and individual differences influence injury outcome?
- How to proactively develop principles and prerequisites for crashworthiness of novel vehicles?

This has been addressed through focused activities and projects, see a selection of examples is presented below.

WORLD LEADING HUMAN BODY MODEL FUNCTIONALITY

Within human body modelling (HBM), SAFER provides a competence platform for SAFER partners as well as a natural contact point for external cooperation. The growing activity in human body modelling has already placed SAFER among the more well-known organisations within Europe, and the interest shown by other universities proves its high academic relevance.

SAFER's HBM vision encompasses a scalable, tuneable, human body model with omni-directional injury prediction capabilities, including high-g and low-g events. This means a virtual human substitute that can be used for predicting injury outcome in any impact situation/direction, able to replicate a large population of people (standing as well as sitting) with humanlike kinematics in impacts as well as maneuver events. The human body models, including the knowledge obtained in the pre-competitive joint research, are used by the industry in safety developments. Today, it is used by Volvo Cars and Autoliv for collision mitigation system development, in addition to occupant restraint systems. The SAFER strategic investment ten years ago, together with funding mainly from the FFI programme, has helped to significantly speed up the process of industrial implementation, providing the SAFER partners with a state-of-the art human body model.

When starting stage four, research projects on injury prediction as well as muscle activation and modelling

Figure 18 SAFER's A-HBM model.

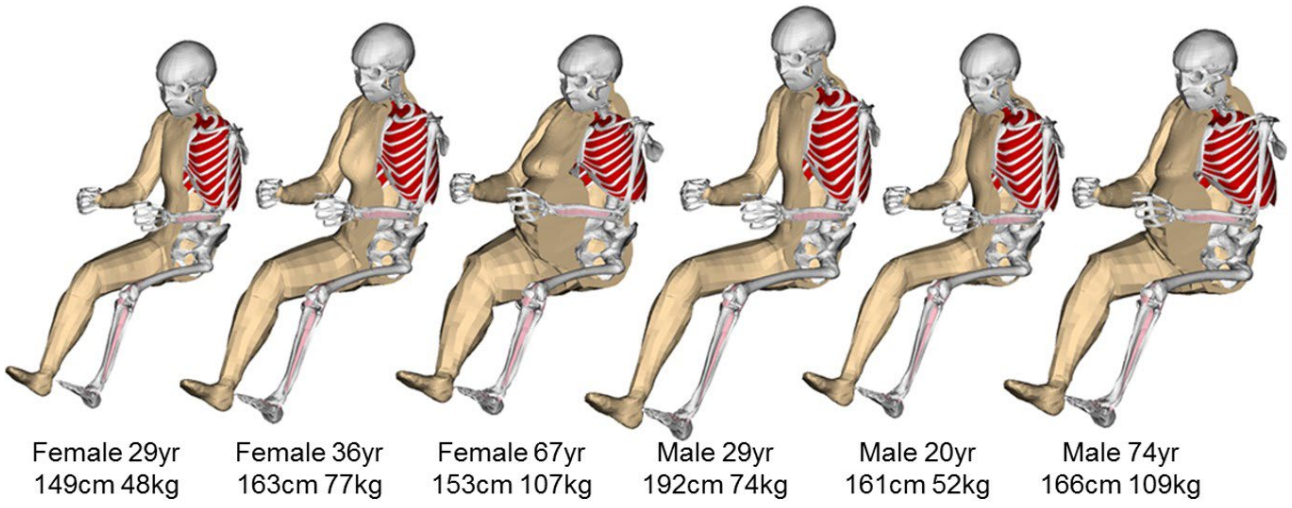


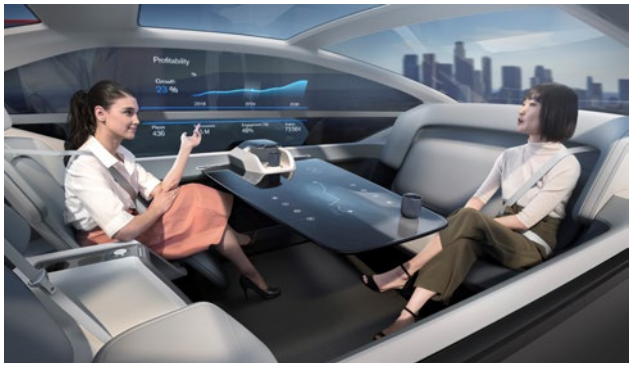
Figure 19: Self-driving cars will contribute to new seating postures. Therefore, improved models and tools need to be developed.

strategies were ongoing. The SAFER Active human body model (A-HBM) was capable of recreating braking scenarios. Research projects on injury prediction capabilities were ongoing, mainly focusing refinement of chest and head. During 2016, an extensive test series with volunteers in evasive steering events was performed and the data was used to further develop the SAFER A-HBM for developments of active safety technologies including also lateral movements. More recently, research on vertical motions are included as well, continuing into stage five. Several projects have been started focusing injury prediction capabilities, refining the head and chest injury prediction further, as well as initial research on upper extremities. In addition to the work on the SAFER HBM model, projects (ViVA I and II) on open-source models funded by Vinnova has taking the tools into a new dimension of sharing. A first version of an open-source model of a mid-size female, targeting whiplash injuries in rear end impacts is available online. This has also led into a one of the two EU projects started in 2018, taking open-source models into a higher level (VIRTUAL).

During 2017 the 9th version of SAFER's Human Body Model was launched and well received. The project partners now have a competitive advantage of a unique tool to evaluate occupant protection in a crash. The human model combines research results from several of SAFER's HBM projects and is world-leading in its functionality. As far as we know, this is the only model, even the only tool or crash test dummy, that manages to recreate the movement during a turn or brake manoeuvre with a subsequent collision, in the same sequence. This area has resulted in numerous publications and several PhD students.

During stage four, the SAFER core group of activities and involved researchers in the area of human body modelling has increased. The national research projects, within FFI as main funders, have continued and added functionality to the SAFER HBM. A project, Assessment of Passenger Safety in Future Cars, adds a dimension of combining understanding on challenges in future protection, and methodology developments enabling creation of a large population of occupants, called morphing. The project focuses on the challenges of evaluating the protection of the heterogeneous population of passengers. The newly started EU-project OSCCAR, works with a similar goal, but in a larger European context. Recently, a project application was approved addressing the challenges of simulating different degree of reclined sitting postures, focusing the modelling of the pelvis and surrounding body parts. Moving towards a higher degree of automation, the tools for protection systems

Figure 20: Self-driving cars will contribute to new seating postures. Therefore, improved models and tools need to be developed.



The fact that researchers at SAFER already in 2006 understood the need for new tools to analyse human protection will be a game changer for tomorrow's automating driving customer offers. The research that led to the A-HBM is key to understand how to protect you when doing something else than driving in an automated vehicle.

Board member Malin Ekholm, Volvo Cars

Figure 21: Simulator tests in the SAFER project Småfolk, a project contributing to setting the global child safety agenda.

capable of recreating biofidelic sitting postures and tissue modelling are essential.

An important milestone in SAFER's work on human body models was reached this fall. Now the first morphed models have been used in simulations; reconstructions of real accidents within the Injury-HMB project. These morphed models are models that have been scaled from the mid-sized male SAFER THUMS human model into the sizes of the real occupants in the accidents. This development makes it possible to make more realistic reconstructions, i.e. create human models as the person involved in the accident was in size, age and gender, and to start creating a family of individuals for vehicle developments.

The strategic investment made 13 years ago has paid out well. Several projects build the foundation of the activities in the area with the goal to develop HBMs with omnidirectional injury risk prediction, including scaling and tuning and variety of acceleration levels. SAFER's aim is to continue to stay leading in this area.

SAFETY FOR THE LITTLE ONES

Following the long heritage of child safety, involved SAFER partners joined efforts in SAFER's cluster of "Child safety and protection of rear seat occupants" and together driven international activities having impact on the global agenda. Several joint projects have been conducted over the years. Between 2016 and 2019, the SAFER child safety cluster has been active in e.g. joint publications, workshops as well as organizing a well-attended international Child Safety Seminar in Gothenburg with about 60 guests. As a result of the cooperation between the researchers from different disciplines, a well-received paper with a focus on the user experience in the context of changing mobility modes and aligning user expectation and user experience with optimized safety was presented on the Protection of Children in Cars Conference in Munich in December 2017.

Within the area of child safety, the third SAFER PhD student defended her thesis successfully 2016 and more than a hand full of papers were produced and presented around the world by the project partners, including research carried out in cooperation with Children's Hospital of Philadelphia, USA and Monash University, Australia. The child safety area is an example of where SAFER research is setting the global agenda. The research results on children's sitting postures, behavior and pre-crash dynamics have raised the communities' awareness of the challenges in real world protection for children. The project partners have a constant dialogue with and influence on

standards, regulatory and consumer organisations contributing to drive real world safety globally. One of the main challenges for future research and focus is the fact that real children do not behave like crash test dummies and we need to accomodate this rather than prevent their behaviour.

STRUCTURES AND MATERIALS

A future sustainable transport system will most likely contain several different completely new types of vehicles, made of different materials. How these materials can ensure continued traffic safety is of crucial importance for the transport system to actually become sustainable in practice. This is therefore an important research area within SAFER. Examples of materials are different types of plastics, hybrid-material and composites, also of natural materials. This includes addressing challenges with respect to joining and methods for optimal material selection. Crashworthy hybrid-material solutions where a mix of materials are used for optimal safety.

During stage four, the focus has been on continuing to create simulation models for different materials in order to be able to evaluate their crash properties. Success has been achieved and SAFER and its partners are currently one of the world-leading groups focusing on developing modelling and simulation tools for composite structures in crashes.

As a result of the collaborative research, significant steps have been taken to develop accurate and efficient CAE tools for crashworthiness assessment of composites. In the end of 2016, a three year FFI-funded project involving 10 Swedish partners (7 SAFER partners) was ended. This project has been the core and common ground for the partner activities in this research area. Significant advances in terms of new material models and numerical methods have been developed as a basis towards the end goal of having a robust, accurate and industrially applicable simulation methodology for composites in crash by 2020. This project has resulted in three journal publications, where one was specially highlighted by the editors of the renowned Journal Composites Science and Technology, publications and presentations at several international conferences, and the delivery of two licentiate theses on crash modelling of composites. It also led to the formation of four new projects on the same topic (~30 MSEK for three years).

Complementing the activities on composites, research activities have also been performed on developing material models and numerical methods for simulating laminated safety glass in crashes. SAFER partners together with European partners from Germany (e.g. Fraunhofer EMI and Saint Gobain) and the United Kingdom (Jaguar-Landrover) finalized in 2017 a collaborative research project (CompMethGlass) developing a Finite Element model for the simulation of the response of windshields of laminated glass in crash situations. This model is now being implemented at the two automobile manufacturers in the project consortium: Volvo Cars and Jaguar-Landrover. The collaboration was successful in terms of both building a strong network of researchers and development engineers in academia, institutes and industry, but also on characterizing the materials involved and in developing models for the mechanical behaviour.

In 2017 three new major projects started; CompMethGlass II, FFI – Crash2 and Ductile Composite. Within these projects, several PhD students have been employed, who add great knowledge in composite and crash. Thomas Bru took his doctor degree on November 30, 2018 with the doctoral thesis ”Material characterisation for crash modelling of composites” and two additional PhD students are taking their doctor degrees in 2019. In order to further strengthen the international network, a major workshop on this topic was held in Gothenburg, September 2018. Research results have been presented and received great international attention at the 21st International Conference on Composite Materials in Xian, China and at ECCOMAS Composites. The Volvo-owned Polestar brand announced in October 2017 that they will present a car built in composite in 2019. This will be a strong driving force for further research within this area.

9. RESULT FROM THE RESEARCH AREAS

CARE AND RESCUE

ACCORDING TO World Health Organization (WHO), EU and others, post-crash actions play a significant role in order to reduce overall mortality and injury severity in all road traffic accidents and among all road users. As an example, research carried out in the US shows that up to 30% of traffic accident victims could be saved if proper care and rescue was implemented in the post-crash phase, i.e. if each victim got optimal care. Improvements in this area will therefore significantly reduce mortality, human suffering and society costs related to traffic accidents. The Research area Care and Rescue started in 2014 as a successor to Post-crash, but with a wider scope. It focuses on the post-crash phase and all care and rescue activities related to this from an incident is detected until all victims are handled and traffic is re-established. Several projects have been running under this umbrella. The stakeholders include SAFER's existing partners but also additional actors representing areas like rescue services, healthcare, Information and Communication Technology (ICT) and MedTech industry.

The short-term focus has been to continue to establish a relevant project portfolio and to involve further SAFER partners and other stakeholders in the activities. In the long-term the objective is to become a significant international player at the forefront within research and development of methods and solutions aiming at traffic accident related care and rescue. Specific assets supporting this ambition is a close relation and established networks with healthcare and actors in the rescue chain, as well as research within ICT, bio-medical engineering, medicine and pre-hospital care. The open arena Pre-hospital ICT Arena (PICTA) established at Lindholmen Science Park in 2014 is a unique asset with respect to this. This arena is a true triple-helix collaboration platform with more than 30 national partners participating. It addresses the complete pre-hospital process from incident detection through transport to delivery at the correct hospital and ward. PICTA has developed very well during the final year of stage four. Therefore, it is natural, and more efficient, to move our mostly ICT oriented Care and Rescue research portfolio there instead to the next stage of SAFER. This is a concrete example of how SAFER improves its use of its surrounding ecosystem. In this way, the projects can be run more efficiently while SAFER's partners still can be involved and collaborate within this field.

Care and Rescue addresses challenges within three defined areas:
- Incident detection, prioritizing and dispatch
- On-scene support
- Reducing secondary effects of an accident

Within Incident detection, prioritizing & Dispatch, the objectives are quicker and more accurate detection and notification of incidents, e.g. improved eCall functionality, and improved incident assessment and prioritization including injury severity prediction.

Within On-scene support, the objectives are to improve care and prioritization of causalities on-scene and in transport. This includes detection of occult traumatic injuries like TBI (Traumatic Brain Injury), improved triage and clinical decision support, and improved extrication methods. Post-crash fires are also within the scope.

Within Reducing secondary effects of traffic accidents, the objectives are to look into methods and actions to eliminate additional accidents and reduce effects on traffic system as a consequence of a traffic accidents.

One objective for Care and Rescue is to become a valued international player. Apart from taking part in and contributing to international conferences like AAAM (Association for the Advancement of Automotive Medicine), continued focus has been given to the development of SAFER´s multi-stakeholder cross disciplinary collaboration environment and platform for real-life development and evaluation (living lab). Today this is used as a national resource but stepwise it will become a unique selling point for participation also in international projects.

During SAFER's fourth stage, a lot of attention was given to the project Via Appia – including concept development, further partner involvement, and applications for funding. Via Appia is a concept aiming at efficient handling of road user alarms, using smartphones and ICT to improve road safety at a broader scale, and facilitating the packaging of new ICT offerings containing alert notifications of various types. It has a wide partner group and addresses ICT as a tool to improve road safety. The aims are to reduce fatalities and injuries, as well as societal costs resulting from road traffic accidents, by enabling smarter handling of various eCall like solutions, collecting incident related information and providing notifications in open format on "acute" traffic incidents. Apart from cars, road users like bicycles, motorbikes, all-terrain vehicles and horse riders are included. A special

focus was given to public transport – particularly buses. Incidents with buses are cumbersome to analyze and prioritize as quickly as desired. Several examples in media during the last years clearly illustrated this. Unfortunately, funding applications to Vinnova failed twice, but the project group all strongly believe in Via Appia and is therefore seeking other routes to make it happen through their new host, PICTA.

New areas explored during the period for research interest are for instance extrication, post-crash fires, safety for rescue personnel at scene and long-time effects of injuries. All these are good examples of areas that can contribute significantly to reduce mortality and injuries in the phase following a traffic accident. As part of the "expanding the research portfolio" strategy dialogue with insurance companies and potential new partners, including start-up and innovation intense smaller companies, have been carried out. To date this hasn't resulted in any new projects – there is a documented need, but no SAFER partner is prepared to take the lead in establishing projects. Unfortunately, these areas don't fall within the scope of PICTA and therefore they will stay unexplored for the time being.

VALUABLE PUBLICITY IN PRESTIGIOUS JOURNALS

Several pre-studies earlier carried out at SAFER have taken off to the next phase and developed into successful projects and products. Publications from the SAFER environment have attracted great international attention and received awards, e.g. SAFER researchers Rubén Buendia, Stefan Candefjord and Bengt Arne Sjöqvist was published in the prestigious scientific journal Physiological Measurement. The title of the paper is Bioimpedance technology for detection of thoracic injury and gives in depth scientific information on how prehospital care can save lives, e.g. after a traffic accident. The article was selected into PMEA´s Highlights of 2017 Edition as one of the very best research articles which featured some of the most cutting-edge areas of biomedical engineering.

JALP!

The smartphone-based invention Jalp! developed to save lives of cyclists and All-terrain vehicle-drivers, and originated from SAFER, has been further developed for MC at Chalmers Ventures Entrepreneurship School. A company is now established under the name Detecht and an app is available for both IOS and Android. The smartphone prototype app developed within SAFER – Jalp! can shorten the time it takes until the injured person can be given care and thus save lives and reduce injuries. Jalp! uses built-in sensors to collect data on how the bike is moving. If an accident occurs, the sensors will detect this and start to vibrate and send out an audible signal. SOS alarm can also be contacted. The entrepreneurs from Detecht won the regional Venture Cup 2018 and other competitions.

MICROWAVE HELMET CAN HELP SUPPORT RESCUE STAFF

A project initiated from SAFER has stimulated groundbreaking research on how a microwave "helmet", including AI-algorithms, can yield fast and safe evaluation of head injuries (intra-cranial bleedings). The project has passed its first clinical study and the second is now running. The project has also gained significant attention in various media.

The same technology is also in its initial evaluation for detecting pneumo- and haemo-thorax injuries on-scene. Traumatic injuries cause about six million deaths per year worldwide, and many survivors suffer life-long disabilities. Traffic accidents are a common cause. Thoracic (related to chest) account for over a quarter of fatal and severe injuries. Two common thoracic severe injuries are presence of air and blood in the pleural space (between the membranes surrounding the lungs). These conditions can be life threatening and a diagnostic tool in the prehospital setting, i.e. in road and air ambulances can save lives. In the project "Prehospital Diagnostics for Traumatic Thoracic Injuries" the intent has been to evaluate the use of microwave technology combined with electrical bioimpedance to diagnose and monitor presence of air and blood in the pleural space. Initial tests with promising results have been carried out in animals together with among others the University of Stavanger, Norway.

Associated projects, including Master thesis projects, have also been carried out within areas addressing injury severity prediction (ISP), clinical decision support and triaging at scene and dispatch. Various technologies and methodologies are being explored, including "Big data" and machine learning.

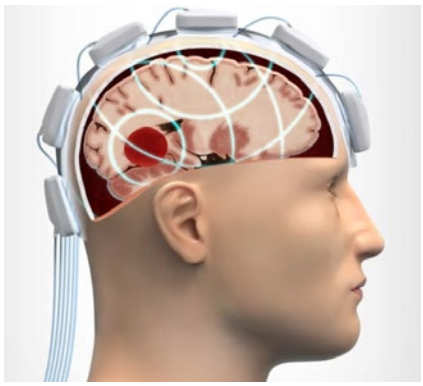
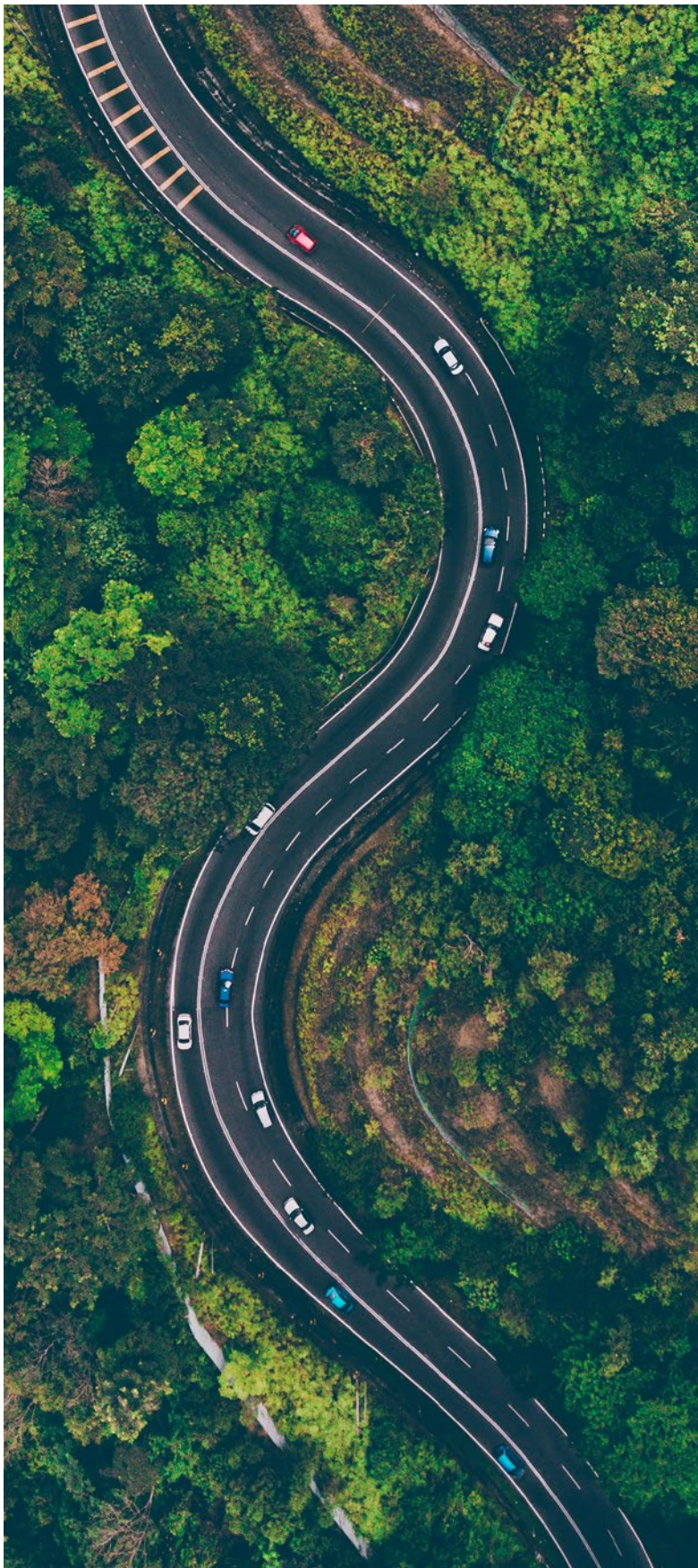


Figure 22, Helmet for occult injury detection.



9. RESULT FROM THE RESEARCH AREAS

SAFETY PERFORMANCE EVALUATION

THIS RESEARCH AREA IS CRITICAL to all the other research activities at SAFER and is a cornerstone of future safety research, i.e. SAFER uses the research area to orient future research activities. It is considered the strongest collaborative area at SAFER by the partners and is an important knowledge resource for all regarding road accident prevention. The fundamental studies determine road safety priorities and examine safety benefits through statistical analyses of road traffic data, including accident, incident, and near-miss data. Development and standardisation of methods regarding all aspects of road traffic data analysis, also recording and sharing of data, are other important tasks. It can thus be considered complementary to all SAFER research areas and is in fact integrated in many different SAFER research projects on new safety strategies. Results of the safety performance evaluation studies are critical for securing the utility of new safety systems and providing confidence in their market introduction.

The safety performance evaluation area gives SAFER a strong identity and a position in the global research community. For instance, SAFER's world leading cluster of researchers connected to naturalistic data activities has an internationally acknowledged reputation to a large extent due to conscious strategic choices and activities throughout all years from the start of SAFER. Databases with field data have a long history at SAFER and have continuously evolved together with the kind of data collected and the analysis to be performed. These activities have made it possible for SAFER partners to take leading roles in international research projects on data activities and SAFER has become a data node for in-depth naturalistic driving data. The main projects are described in the following part of this chapter.

RESEARCH EXCHANGE

SAFER has worked with other stakeholders and research platforms in international projects over the years. Besides many partners in Europe, SAFER has links to University of Michigan Transportation Research Institute (UMTRI) and Virginia Tech in USA, Nagoya University and Tokyo University of Agriculture and Technology in Japan, and UNSW in Australia. The international aspect is manifested not least by visiting researchers at SAFER. The area of safety performance evaluation had the privilege to have Carol Flannagan, research associate professor at UMTRI, from mid-2017 through mid-2018 at SAFER. Carol had a focus on challenges for road safety analysis regarding self-driving vehicles during her visit at SAFER. Besides visiting scholars, SAFER directly supports both undergraduate and postgraduate projects at SAFER to grow students.

In December 2016, Jonas Bärgman defended his PhD thesis on methods for analysis of Naturalistic Driving Data (NDD). The thesis includes research on both quantitative and qualitative analysis methods of NDD, in particular the method Counterfactual Simulation, which can be used to understand the crash and injury risks related to the glance patterns associated with different driver behaviours (e.g. radio tuning and text messaging). It can for example be used when evaluating driver vehicle interface designs with respect to crash risk. The research also demonstrates that the choice of driver models when using simulations to estimate safety benefits of ADAS has a very large effect on the benefit estimations – up to a factor of three.

In October 2018, Ulrich Sander defended his PhD thesis with the title "Predicting Safety Benefits of Automated Emergency Braking at Intersections – Virtual simulations based on real-world accident data". The objective of the thesis was to evaluate the effectiveness of a generic Intersection AEB system in avoiding accidents and mitigating injuries. The analysis indicated that about two thirds of left-turn across path accidents with oncoming traffic and about 80 percent of straight crossing path accidents could be avoided by an idealized Intersection AEB. Moderate to fatal injuries could be avoided to an even higher extent. Key parameters impacting effectiveness were found to be vehicle speed and limiting or predicting path choices.

Figure 23: Carol Flannagan has been a visiting professor at SAFER during stage four, contributing with knowledge to the community within road safety analysis of self-driving vehicles.

ACCESS TO AND UNDERSTANDING OF DATA

The introduction of advanced driver assistance systems in large amounts during the fourth stage of SAFER has increased the need to understand how they are used and how they perform in real world traffic, and eventually understand how these systems should be improved further. The need to understand technologies for accident prevention goes together with the need to understand the underlying complex system of factors behind crashes, which has made the interest for FOT and NDS studies even stronger – an area in which SAFER is deeply committed and will continue to develop spearhead competence and leadership. These activities bring new research collaborations, which in turn is an effective mechanism for SAFER to expand its access to larger amounts of data, providing opportunities for new research insights for the partners. Data collection is expensive and is typically limited to specific regions. Hence, international collaboration makes research for instance on socio-geographical differences possible.

The EFrame project aimed to develop a structured framework for traffic safety evaluation in an industrial (commercial vehicle manufacturer) context. The resulting framework facilitates more efficient development of crash/injury countermeasures by (1) identifying and focusing on the most important safety problems, (2) estimating the potential and actual safety benefits of safety systems and services and (3) identifying the data sources needed to perform these analyses. The framework has the potential to reduce the number of killed and injured in traffic by focusing industrial development and academic research on the most effective safety systems and services. The project has also, thanks to its broad scope, fostered increased collaboration between different sub-fields of traffic safety analysis (e.g., passive safety, active safety and road user behavior analysis) and thus contributed to the development of a critical mass of competence at SAFER in this area.

SAFER researchers have participated in the ITS World Congress 2016 in Melbourne and arranged the yearly FOT-Net international workshop. Two papers from European projects where presented at the ITS conference; data sharing content in project agreements are crucial, detailed from the Data Sharing Framework in FOT-Net Data and the Data Protection Concept in UDRIVE – both developed by SAFER. Additionally, SAFER researchers have presented how the data sharing framework can be adjusted to automation at the special session “Automated vehicle pilots: challenges for data collection and sharing”. The Data Sharing Framework from FOT-Net Data was presented at the Transport Research Arena in Warsaw 2016. At the ITS World Congress in Copenhagen in 2018 SAFER arranged a workshop on Strategies for data sharing and knowledge. The topics addressed in the workshop was policy and funding to promote data provision, automation impact – what data is needed to find the answers and sharing of knowledge base.

Figure 24: L3Pilot partners presented nine cars equipped with automated driving technologies during the annual EUCAR Reception & Conference in 2018.

KEY HIGHLIGHTS FROM PROJECTS

Chalmers University completed the Swedish in-depth database INTACT, which is a holistic road traffic accident database, including information about all phases of road crashes. The collected data has been released to SAFER researchers during the fourth stage and has enabled analyses of crash causation factors along with long-term consequences of road crashes. The on-going project "Initiative for the Global Harmonization of Accident Data" (IGLAD) is dealing with harmonized in-depth accident data from several countries on four continents, including eight EU countries. SAFER has been the administrator for the database for six years. IGLAD is acknowledged as the most relevant source of comparable in-depth crash data globally. The data has been analysed and used in various projects, including the EU project PROSPECT.

L3 PILOT: 11 COUNTRIES, 100 VEHICLES AND 1000 DRIVERS

SAFER's increasingly strong position regarding NDS data analysis is demonstrated in the European project L3Pilot (Piloting Automated Driving on European Roads), which started in September 2017 and which is the largest FOT supported by EU. The project is a common European undertaking to evaluate the potential of more than 20 different self-driving features, as well as to investigate attitudes of the drivers, and drivers in surrounding vehicles, towards self-driving cars. The project aims to demonstrate how the self-driving cars operate in a realistic environment, to identify remaining technology gaps, to shape relevant policies and to raise awareness about the true potential of the self-driving technologies. The result, and the processes developed, will help guiding the introduction of self-driving vehicles. SAFER has taken the responsibility for the data management tools and procedures, and is leading the analysis of naturalistic driving data, which is one of the key tasks in this exciting project.

During the past years, the data infrastructure at SAFER has been further enhanced and the FOT-Net Data Sharing Framework, directed and developed to a large extent by SAFER, was completed. It consists of seven topics with detailed guidelines about what to address. The framework formed the base for the data management in the project UDRIVE, and has been much appreciated by the NHTSA, Virginia Tech and UMTRI in USA, Nagoya in Japan and UNSW in Australia, among others. Documents can be found on the FOT-Net.eu.

SAFETYCUBE – Safety CaUsation, Benefits and Efficiency- was a Horizon 2020 project centered around state-of-the-art evaluations of accident risk factors and safety measures based on analyses of accident data statistics and on in-depth understanding of pre-crash phases of road accidents. The project has developed a Decision Support System (SafetyCube DSS) which has the aim to guide road safety stakeholders to identify the most cost-effective measures that will address the most urgent road safety problems on the European level.

UDRIVE is a SAFER project that has been running during the third and fourth SAFER phase. This is the largest naturalistic driving study on cars, trucks and powered-two wheelers in Europe to date. It was an EU FP7 project with 19 partners throughout Europe, where SAFER played a key role in data management. The SAFER partner Chalmers is sub-project leader for the UDRIVE analysis. The four-and-a-half-year project ended in June 2017, having collected car data in Great Britain, Germany, France, Poland, and the Netherlands, truck data in the Netherlands, and powered two-wheeler (scooter) data in Spain. Research topics ranged from risk assessment methods and studies of secondary task behaviour through better understanding of the interactions between drivers and vulnerable road users as well as eco driving. In the last year, the Data Protection Concept (DPC) was finalized. The DPC consists of data protection requirements on each step of a FOT and has been applied to UDRIVE through-out the project. Also, the remote access IT infrastructure was put to the test during a condensed period of intensive analysis and did prove to work. This infrastructure allows for remote access to other secure enclaves, which was earlier tested in a project with UMTRI, who holds several important datasets being a hub for automation in USA.

ARCADE succeeded CARTRE (Coordination of Automated Road Transport Deployment for Europe) in 2018. CARTRE started in October 2016 and finished in 2018. The project continues under the new name ARCADE. SAFER is participating as a Joint Research Unit (JRU) including the partners Volvo Cars, Chalmers, and Lindholmen Science Park. AB Volvo does participate individually. One mission is to support the development of a platform for data, information, and experience exchange, including an annual conference. The first European Conference on Connected Automated Driving took place in April 2017 in Brussels, which derived from CARTRE and the second conference will be held in April 2019, courtesy of ARCADE. The SAFER partners contribute to most tasks, N.B. AB Volvo being the WP leader for Deployment Support and Roadmap Dissemination and SAFER being the task leader for the Data Exchange Platform.

PROSPECT (Proactive Safety for Pedestrian and Cyclists), is an EU research project, that finished in the end of 2018. The project contained five key objectives: 1) a better understanding of relevant VRU scenarios, 2) an improved VRU sensing and situational analysis, 3) advanced HMI and vehicle control strategies, 4) four vehicle demonstrators, a mobile driving simulator and a realistic bicycle dummy demonstrator, and finally 5) testing in realistic traffic scenarios and user acceptance study. The consortium included the majority of European OEM's, including Volvo Cars. The accident research was performed by Chalmers and VTI among other SAFER partners.

QUADRAE (Quantitative Driver Behaviour Modelling for Active Safety Assessment Expansion) is an on-going VINNOVA-FFI project with the aim to develop driver models for simulations and benefit analyses of new active safety systems. Accident data will in particular be used in the development and validation of the virtual driver models.

E-FRAME was finished in 2016. The objective of this FFI project was to develop a structured framework for traffic safety evaluation in an industrial (commercial vehicle manufacturer) context. The resulting framework facilitates more efficient development of crash/injury countermeasures by identifying and focusing on the most important safety (crash) problems, providing a toolset for analyzing crashes and estimating the potential and actual effectiveness of safety systems and services and, finally, identifying the data sources needed to perform these analyses.The framework did target not only severe accidents (injuries/fatalities) but also road accidents with property damage only as well as parking collisions. The developed safety evaluation framework will now be used to perform a cost-benefit analysis to understand the effectiveness of a system/service before its introduction in the market.

NEXT STEPS

The general development the last three years of our safety performance evaluation research area has to a large extent been about a changed mindset among the partners, which most likely will become more visible during the next phase of SAFER. Significant projects have finished during stage four and a large classic FOT, the L3Pilot, has started. New projects, yet to be planned in detail, will be promoted during stage five. These projects will have to deal with further automation and complexity of car driving, in the same time as regular road traffic as of today will continue. The road traffic is unique in the way that indeed many people are involved in operating the system. We do all drive, walk, and cycle without being hired and monitored professionals. We even transport goods and other people without being on duty, but as individual persons. For this reason, road accident prevention differs from aviation, hospitals, and process industries although accident models and theories are similar. Increased automation and digitalization of road transport will not reduce the number of road users, but rather increase complexity for all, at least in the short and medium term. SAFER is well positioned with multidisciplinary research to take on board new challenges regarding accident prevention, based on a profound know-how regarding all kinds of road traffic data analysis.

Large amounts of accurate data are crucial for safety benefit analyses as well as development for future vehicle safety systems. These data are definitely best collected and maintained in collaboration. At Autoliv, as well within SAFER, we use road traffic safety data not only to study and address current road safety priorities, but also to predict future needs for crash prevention and injury mitigation.

Board member Cecilia Sunnevång, Autoliv

10. KNOWLEDGE PRODUCTION, VISIBILITY AND COMMUNICATIONS

NEXT TO THE KNOWLEDGE PRODUCED through the research, projects and collaborations for the purpose of cross-fertilisation and exchange of knowledge and ideas, SAFER has throughout the years been organizing a vast number of internal and external seminars, project days and conferences.

SAFER is acknowledged as a meeting place and the various seminars are appreciated by the partners as efficient means to share knowledge and create visibility among SAFER researchers on current topics, as well as offering great opportunities for networking. SAFER has built its strong brand through visibility and through actively participating in debates, panels and seminars at various events. Within many traffic safety areas, SAFER is now renowned to the extent that organisations frequently approach SAFER for collaboration, expert opinions, or giving talks at conferences and seminars. Research results are being disseminated through the website as well as through press releases and news articles, with good media coverage. For instance, several SAFER projects have got media publicity, e.g. the female crash test dummy was broadcasted in Swedish television and the iDolly project was picked up by several influential national media outlets.

SAFER has arranged and participated in a wide range of events over the years – primarily to present results and findings of the research and knowledge production activities. The examples below are exactly that, examples, that give an impression of that it is all about; from podcast to international conferences, from political dialogues in EU to knowledge exchange in the SAFER offices. A complete list of engagement to share knowledge and research findings are listed in appendix 7.

HOST OF INTERNATIONAL CONFERENCES

The capability to host high quality, well-attended scientific conferences is yet another sign of a well-respected community with high impact in this field. As a token of credibility, SAFER was trusted with hosting both the 5th and 6th International Conference on Driver Distraction and Inattention in Paris, March 20-22, 2017 and in Gothenburg, October 15-17, 2018. The meeting in Gothenburg was covered by national radio and television.

In June 2016 SAFER arranged and co-hosted the highly appreciated IEEE Intelligent Vehicles Symposium 2016 (IV'16). Almost 600 participants from 42 countries attended. 206 papers (28 oral presentations and 178 posters) were included in the program with 742 authors from 29 different countries. SAFER has also been engaged in the International Cycling Safety Conference, in Bologna, November 2016, 2017 and 2018.

SAFER SEMINARS AND INSPIRATIONAL WORKSHOPS

During the years SAFER has continued to arrange seminars regularly to bring research results both to SAFER partners, to the researcher community and to the public. Workshops for the stakeholders to gather around a certain topic, share knowledge and get inspiration as a base for new common projects have also been conducted regularly. All in all, about 75 SAFER seminars and workshops have been arranged during stage four.

LUNCH SEMINARS

SAFER has arranged Thursday seminars almost every week during February to May and September to December, primarily for internal cross-fertilization and exchange of knowledge and ideas. The SAFER Competence area leaders, Infrastructure leaders and Research area directors have been responsible for the content. During stage four about 75 lunch seminars have been conducted.

PODCAST

"Liv och trafik" is a knowledge pod about traffic safety where SAFER researchers are interviewed in short episodes. So far 38 episodes have been released, Topics varies and covers automated vehicles, cycling, child safety, visibility in traffic, motorbikes, traffic history, heavy vehicles and much more, see *http://www.livochtrafikpodden.se/*

EVENTS ON THE NATIONAL ARENA

On the national arena, SAFER has organised or participated in sessions yearly at Transportforum in Linköping, and presented at the Tylösand conference several times. In addition to disseminating research results to partners and the researcher community, SAFER has done so also to the public. For example, SAFER has taken an active role in organising seminars at the yearly Gothenburg Science Festival and several times per year together with the National Society for Road Safety (NTF Väst), which is the non-profit Swedish organisation for enhancement of traffic safety. Activities like these are appreciated both by the public and by the researchers who reach other target groups with their research.

EVENTS ON THE INTERNATIONAL ARENA

On the international arena, SAFER has been present on many international conferences all over the world. To mention a few examples, ESV in Detroit in June 2017 and the annual IRCOBI conferences. Within the FOT-net data project several well-attended workshops have been organised, e.g. on Data anonymization and feature extraction workshop in August 2016. Another event that gave the SAFER researchers an opportunity to show their broad competence and to build new international networks was the International Cycling safety Conference in Bologna in November 2016. Safer was the main sponsor of a workshop about "Naturalistic cycling analysis". Furthermore, SAFER participated in a parliamentary debate on self-driving vehicles, as well as in several important conferences including a key note speech at the Automated driving conference Road Safety & the Human Factor in Vienna, March 2017. In Asia, SAFER has been present on e.g the 3rd ADAS China Forum conference in Shanghai, June 2016.

In January 2018 an important round table discussion about cycling safety was conducted in Paris and SAFER's researcher and cycling expert, Marco Dozza, participated in the dialogue. The Round table brought together a broad range of international stakeholders and experts. They shared their experience on cycling safety questions and discussed the policy options for reducing traffic injuries whilst promoting active travel.

STUDY TOURS

Knowing which expertise is available under the SAFER umbrella and knowing which research issues the partners want to gather around is of course an important prerequisite for joint and successful projects. Visiting our partners on study tours to create the right conditions for dialogue, inspiration and discussions are important elements in our collaboration model. The tours have been going to the AstaZero proving ground, Cycleurope in Varberg, Halmstad University and The Institute of Transport Economics (Transportøkonomisk institutt, TØI) in Norway. All of our partners have been invited to participate.

THE KNOWLEDE LIBRARY AND WEBSITE

On SAFER's new website, we present our research findings, projects and publications. In our Knowledge library you can find the results of our researchers' work and you can also read our news and keep up-to-date with our seminars and other activities and events in our calendar. Our partners and research areas, infrastructures and competence areas are presented and our unique collaborative working method is explained. We also hope that the website will inspire more partners to join SAFER. The more knowledge we can get in how to develop a safe and sustainable transport environment, the more lives we can save.

THE SAFER PUBLICATION LIBRARY

SOCIAL MEDIA ENGAGEMENT

SAFER's presence in social media has increased during stage 4 and LinkedIn is a new, important communication channel as well as Mynewsdesk, Sweden's leading PR tool, aiming to get in touch with media interested in traffic safety, sustainable innovations and research. SAFER is active on the following social media platforms:

- Facebook: safercentre
- LinkedIn: https://www.linkedin.com/company/11284446
- Twitter: @safercentre
- You Tube: Saferresearch

NEW BRAND PLATFORM, GRAPHIC IDENTITY AND COMMUNICATION STRATEGY

During the stage, a new brand platform has been developed to modernize and make clearer what the brand SAFER is and stands for. A new communication strategy has also been developed to create focus on the communication activities that give the most value to our partners in our joint work to save lives and prevent injuries in traffic. The new graphical profile helps keep the communication collected, stylish and easily accessible. A new website has also been developed and launched: www.saferresearch.com

PUBLICATION VOLUME

SAFER's research projects have produced more than 240 publications during stage four, including peer reviewed journal articles (36%), conference papers and posters 37%, reports (6%), master theses (10%) and doctoral and licentiate theses (10%). Publications which are still listed as "in preparation/in press" will be made available in the near future (e.g. accepted papers of conferences that have not yet been held) are not included. In addition, these numbers also exclude publications from research conducted within SAFER but not belonging to a specific project (e.g. some PhD and post-doc research). A certain degree of underreporting should also be considered. All publications are made available in SAFER's Knowledge Library (https://www.saferresearch.com/library).

SAFER DOCTORS

During SAFER stage four, 22 PhD students working in the SAFER environment have written their doctoral thesis, licentiate thesis, or both. 16 doctoral thesis dissertations and 8 licentiate seminars. have been conducted. See the complete list with SAFER doctors and licentiates in appendix 8.

Figure 25: PhD students that have been working in the SAFER environment are honoured with a golden SAFER doctor hat. Minjuan Wang defended her doctorial thesis "Same, Same but Different: On the Design of Cross-Regional Advisory Traffic Information Systems" successfully in May 2017.

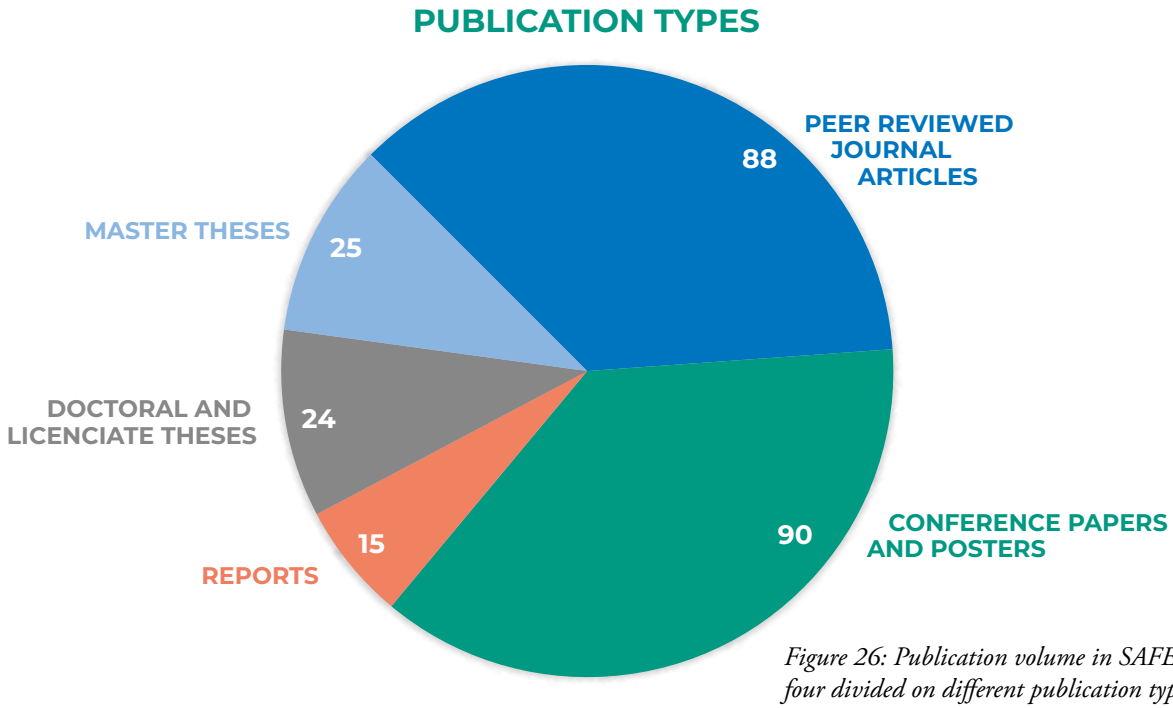


Figure 26: Publication volume in SAFER stage four divided on different publication types.

Figure 27: Anna Nilsson-Ehle was awarded Chalmers' honorary medal for exceptional meritorious efforts in 2017.

Figure 28: A new Golden Diesel Ring bearer – SAFER's Lotta Jakobsson.

Figure 29: The NHTSA Award winners in 2017, Magdalena Lindman and Per Lenhoff.

Figure 30: Venture cup winners 2018; Detecht. The invention, originated from SAFER, can shorten the time it takes until the injured person can be given care and thus save lives and reduce injuries.

OTHER AWARDS AND HONOR APPOINTMENTS

SAFER's director Anna Nilsson-Ehle was awarded Chalmers' honorary medal for exceptional meritorious efforts in 2017. The fact that Chalmers acknowledged SAFER's importance by giving the director the honorary medal is a clear evidence that the competence centre's activities are particularly significant for the university. At the ESV conference in Detroit June 2017, Magdalena Lindman (Volvo Cars) was awarded the US Government's award for Safety Engineering Excellence and Per Lenhoff (Volvo Cars) received the NHTSA's Special Award of Appreciation. Also, Ola Boström (Veoneer, previously Autoliv) was awarded (not on site at the award ceremony).

The Association of Motor Journalists (VdM) in Germany honoured SAFER's Research area director Lotta Jakobsson with the prestigious Golden Diesel Ring for her extraordinary commitment to child safety and vehicle safety research. The Golden Diesel Ring, which incorporates a fragment of Rudolf Diesel's first experimental engine from 1893. Detecht, the start-up company developing a smart app to help motorcycle drivers after an accident – an invention that can save lives, won the Venture Cup 2018. The idea originated from SAFER.

The development pace is higher than ever and it is impossible for a single actor to completely cover and create necessary changes in a sustainable transport system. There is a need for collaboration between many partners. Therefore, the mix of representatives from industry, academy and authorities is one of the key strengths of SAFER.

Board member Maria Krafft, Trafikverket

APPENDICES

APPENDIX 1: SAFER PARTNERS

PARTNER LEVEL 1 AND 2

The following partners and members have been engaged during stage four:

- Autoliv Development
- Chalmers University of Technology
- City of Gothenburg
- Combitech
- Cycleurope
- Folksam
- Halmstad University
- If Insurance
- Institute of Transport Economics (TØI)
- KTH Royal Institute of Technology
- Lindholmen Science Park AB
- NEVS (as of April 2018)
- RISE (including former partners Acreo Swedish ICT, AstaZero, Viktoria Swedish ICT, Swerea IVF, SP Technical Research Institute of Sweden, Swerea Sicomp AB)
- Scandinavian Automotive Suppliers (FKG)
- Scania (as of April 2018)
- Swedish National Road and Transport Research Institute (VTI)
- Swedish Transport Administration
- Swedish Transport Agency
- University of Gothenburg
- Volvo Car Corporation
- Volvo Group
- Veoneer (as of April 2018)

MEMBERS (ASSOCIATED PARTNERS)

- Aptiv (as of April 2018)
- AstaZero (as of December 2018)
- HiMinds (as of April 2018)
- Malmeken AB
- Mälardalen University
- Smart Eye (as of April 2018)
- Svanberg & Svanberg AB (as of June 2018)
- Trivector
- Uniti (as of April 2017)
- University of Borås
- University of Jönköping (as of April 2018)
- University of Skövde
- University of Umeå
- V-Traffic (MediaMobile) (as of April 2017)
- Zenuity (as of April 2017)
- ÅF

APPENDIX 2: SAFER BOARD

The following members have been part of SAFER Board during stage four:

- Autoliv: Ola Boström in 2016, Cecilia Sunnevång as of January 2017
- Chalmers: Sinisa Krajnovic and Johan Karlsson (who also represents University of Gothenburg as of April 2018. Per Lövsund was the representative until March 2017)
- RISE: Jan Jacobson
- Swedish Transport Administration: Maria Krafft
- University of Gothenburg: Jan Smith, until March 2017
- Volvo Car Corporation: Malin Ekholm
- Volvo Group: Magnus Rilbe
- VTI: Jan Andersson in 2016, Jonas Jansson as of January 2017
- Independent chairperson: Karin Svensson
- Hans Fogelberg (Region Västra Götaland) and Eric Wallgren (Vinnova) join the Board as observers

APPENDIX 3: SAFER MANAGEMENT TEAM

The following members have been part of SAFER's management team during stage four:

- Directors: Anna Nilsson-Ehle (until March 31 2017), Anders Marby, Acting director (April 1-August 13, 2017), Magnus Granström as of August 14, 2017
- Bengt Arne Sjöqvist, Research area director Care and Rescue until March 2018
- Christian Grante, Research area director Systems for accident prevention and automated driving until September 2018
- Fredrik Sandblom, Research area director Systems for accident prevention and automated driving as of Jan 1, 2019
- Fredrik Von Corswant, Infrastructure leader Revere
- John-Fredrik Grönvall, Infrastructure leader Naturalistic driving data, as of September 2018
- Mats Petersson, Acting Research area director Systems for accident prevention and automated driving, September – December 2018
- Helena Gellerman, Infrastructure leader Naturalistic driving data until September 2018
- Ines Heinig, Project coordinator
- Ingrid Skogsmo, Senior project leader, September-December 2018
- Johan Strandroth, Vison Zero academy, until May 2017

- Kristina Lindblom, Controller
- Lotta Jakobsson, Research area director Human body protection
- Malin Levin (fd Persson), Communications and partnerships, Deputy director, as of October 2016
- Mats Svensson, Chalmers profile director traffic safety
- Matteo Rizzo, Vision Zero Academy, as of November, 2017)
- Tania Dukic Willstrand, Research area director Road user behaviour
- Torbjörn Andersson, Research area director Safety performance evaluation

APPENDIX 4: COMPETENCE AREAS

BEHAVIOUR IN ACCIDENT CAUSATION

By applying an interdisciplinary approach, the scope of this competence area is to quantify the role that human behaviour plays in causing accidents and derive safety priorities from this knowledge.
Competence area leader: Trent Victor

BIOMECHANICS & PROTECTIVE SYSTEMS

This competence area spans the entire injury prevention field including fundamental biomechanics of for instance brain, neck and thorax, as well as human body modelling, child safety and unprotected road users' safety.
Competence area leader: Mats Svensson

DRIVING SIMULATOR APPLICATIONS

Driving simulator applications concern the use and development of these research tools. Simulators offer several benefits, such as the possibility to study concepts and prototypes in the early phases of development and risk free testing of systems for accident prevention.
Competence area leader: Lena Nilsson (until December 2017), Alexander Eriksson

FIELD DATA

Field data includes the competences involved in the whole chain from collection of data, analyses (case analyses and aggregated), data storage and management to effect analyses.
Competence area leader: Vacant

FUNCTIONAL SAFETY

Functional safety is the absence of unreasonable risk due to hazards caused by malfunctioning behaviour of electrical or electronic systems. The challenges are high for the systems used in active safety and automated driving. Also, security issues will influence the functional safety of connected road vehicles.
Competence area leader: Jan Jacobson

HUMAN FACTORS DESIGN

Human factors design is about the interplay between humans and technical systems in different contexts; how technical systems should be designed to achieve efficient and safe interaction with the users.
Competence area leader: MariAnne Karlsson

HUMAN MONITORING

Human monitoring focuses on methods to measure, record and analyse human vital signs and physiological information in all areas such as Care and Rescue situations and field or simulator studies on human behaviour.
Competence area leader: Bengt Arne Sjöqvist (until August 1, 2017)

ROAD INFRASTRUCTURE

Road infrastructure covers the competences needed for the design of roads and road way structures including infrastructure for communication.
Competence area leader: Nicole Kringos

SENSORS & COMMUNICATION

Sensors and communication enable technologies for a plethora of safety systems. The scope of this group is to create and share research ideas around vehicular communications, sensors systems, and signal processing.
Competence area leader: Erik Ström

STRUCTURES & MATERIALS

The purpose of this competence area is to gather researchers concerned with vehicle architectures and lightweight materials suitable for future efficient vehicles with new powertrains.
Competence area leader: Martin Fagerström (until December 31, 2017)

TRAFFIC SYSTEMS

Traffic systems comprise the research competences in accident avoidance by acting on the system level above the vehicles, including system and service design within cooperative ITS.
Competence area leader: Cristofer Englund

VEHICLE DYNAMICS

Vehicle dynamics is creating a collaborative arena connecting vehicle dynamics research carried out in academia/institutes and the corresponding advanced engineering activities in the automotive industry.
Competence area leader: Bengt Jacobson

APPENDIX 5: GLOBAL COLLABORATIONS

INSTITUTES AND ACADEMY

- Children's hospital of Philadelphia
- Japanese Automotive Research Institute Nagoya University
- Tokyo university of Agriculture and Technology
- University of IOWA
- University of Michigan Transportation Research Institute (UMTRI)
- Xiamen University of Technology

COLLABORATIVE ORGANISATIONS AND RESEARCH PROGRAMMES

- Australia Driverless Vehicle Initiative (ADVI)
- CLEPA European Association of Automotive Suppliers
- CTS (China Sweden Traffic Safety Centre)
- European Automotive Research Partners Association (EARPA)
- European Council for Automotive R&D (EUCAR)
- European Road Transport Research Advisory Council (ERTRAC)
- HUMANIST
- Movéo
- Neuroscience Research Australia
- The Association for the Advancement of Automotive Medicine (AAAM)
- The Group for national cooperation
- SDNS Northern Europe (Sustainable Development Solutions Network)
- WARA-CAT (Collaborative and Autonomous Transport)
- WASP (Wallenberg Autonomous Systems and Software Program)

APPENDIX 6: PROJECT PORTFOLIO

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
SYSTEMS FOR ACCIDENT PREVENTION AND AUTOMATED DRIVING					
A63 ReVeRe Lab Build up 2	Fredrik von Corswant	01-04-2016	31-12-2017	VGR	Chalmers, Volvo Cars, AB Volvo, VGR
A64/A65 AutoFreight	Fredrik von Corswant	01-04-2017	31-12-2019	VINNOVA	AB Volvo, Combitech, City of Borås (incl. companies at Viared industrial area), Chalmers
A66 DriveSweden TestSite Automated Highway III	Fredrik von Corswant	01-11-2017	31-10-2018	VINNOVA	Ericsson, AB Volvo, Scania, Autoliv, PostNord, Telia*, Telenor*, Chalmers, CIT
A67 RealSIM	Monica Ringvik	01-11-2017	31-12-2019	VINNOVA	AstaZero, Chalmers, Data Intelligence, Wiretronic, Volvo Technology
A6x HEADSTART	Jonas Sjöberg	01-01-2019	31-12-2021	EU H2020	SAFER, RISE, Chalmers, AB Volvo, Veoneer
Active Converter Dolly testing	Manjurul Islam	01-01-2016	30-06-2018	FFI	Chalmers, Volvo GTT, Parator
AntWAy	Johan Tofeldt	01-05-2014	31-05-2017	FFI	AB Volvo, Kollmorgen AB, Chalmers, Halmstad University
Automated Safe and Efficient Transport System	Johan Tofeldt	14-01-2015	30-09-2018	FFI	AB Volvo, Chalmers, Boliden Mineral AB, Combitech AB och Renova Miljö AB
C2VC	Leo Laine	01-03-2017	31-07-2019	VINNOVA	AB Volvo (coordinator), Chalmers TM (plus S2 and Computer Science)
Chronos	Niklas Lundin	01-09-2016	31-03-2018	FFI	AstaZero, VCC, AB Volvo, Autoliv, Ericsson, Sentient+, Berge, Fengco, Vinga Lab, HiQ, Chalmers, SP
COPPLAR	Christian Berger	01-01-2016	31-12-2018	FFI, SAFER	Chalmers, GU, VCC, Autoliv, AstaZero
Esplanade	Fredrik Warg	01-01-2017	31-12-2019	VINNOVA/ FFI	Autoliv, Comentor, Delphi, KTH, RISE, Semcon, Systemite, VCC, AB Volvo, Qamcom, Zenuity
iDolly	Per Larsson	26-10-2017	31-08-2020	FFI	Volvo Technology AB, Chalmers, VBG Group Truck Equipment AB
DriveSweden TS AutomatedHighway I+II	Fredrik von Corswant	01-11-2016	31-10-2017	VINNOVA	Chalmers, Ericsson, AB Volvo, Scania, Autoliv, PostNord
SEBRA	David Lindström	01-06-2018	31-12-2019	VINNOVA and OpenResearch @AZ	RISE ICT Viktoria, Aptiv, LIRI AB

SERET (Safe Road Trains for Efficient transport)	Stefan Bergquist	01-12-2012	31-12-2017	FFI	Scania, Volvo, Royal Institute of Technology, SICS Swedish ICT, Schenker AB, and Trafikverket
Sweden4Platooning	Stefan Bergquist	01-01-2017	31-12-2019	FFI	Scania, Volvo, Royal Institute of Technology, SICS Swedish ICT, Schenker AB, and Trafikverket
VICTIg Part 2	Maytheewat Aramrattana	01-05-2018	31-12-2018	FFI/ VINNOVA, VTI, Högskola Halmstad	VTI and Högskolan i Halmstad

ROAD USER BEHAVIOUR					
AdaptIVe – Automated Driving Applications and Tech	Martin Sanfridson	01-01-2014	30-06-2017	EU	AB Volvo, VCC, Chalmers, Uni Lund, plus European project partners
ADAS&ME	Tania Dukic	01-09-2016	31-03-2020	EU H2020	VTI, Autoliv, Smart Eye, Total: 30 partners
AIMMIT	Annie Rydström	01-01-2014	31-03-2017	FFI	VCC, Viktoria Swedish ICT, Chalmers PPU, Semcon Caran AB
Automatisering för ökad tillgänglighet		01-08-2016	30-04-2017	Drive Sweden (Vinnova, Energimyndigheten, Formas)	Norconsult Astando AB, Norconsult AB, Viktoria ICT, Västra Götalandsregion,Västtrafik, Volvo Cars
AUX (Automotive User Experience)	Annie Rydström	01-01-2013	30-06-2018	FFI	VCC, InUse Experience AB, Viktoria Swedish ICT, Chalmers PPU+ITIT, HiQ
BikeModel	Marco Dozza	01-06-2015	31-03-2017	TV	Chalmers
DRAMA	Cristofer Englund	01-03-2018	29-02-2020	FFI Vinnova	Smart Eye, RISE
F1 FFI Cykel	Tania Dukic	01-03-2017	31-12-2017	FFI	Chalmers, IF, Autoliv, AB Volvo, VCC, VTI, CYCLEUROPE AB, Statens väg- och transportforskningsinstitut
F2 MeBeSafe	MariAnne Karlsson	01-05-2017	31-10-2020	EU H2020	SAFER JRU (Chalmers, Trafikverket), VCC, other EU Partner
HARMONISE	Emma Johansson	01-01-2017	31-12-2019	FFI	AB Volvo, VCC, RISE Viktoria
HATric (HMI for autonomous vehicles in Traffic)	Annie Rydström	01-08-2014	30-06-2017	FFI	VCC, VTI, Chalmers PPU
HF Auto	Jan Andersson	01-12-2013	31-12-2017	Marie Curie ITN	VTI, Chalmers, AB Volvo
PROSPECT	Jordanka Kovaceva	01-05-2015	31-10-2018	EU	Chalmers, VTI, VCC
QUADRAE – Quantitative Driver Behaviour Modelling	Mats Petersson	01-01-2016	31-12-2020	FFI	VCC, AB Volvo, Autoliv, VTI, Chalmers
SÄMO	Helena Selander	01-03-2019	30-09-2019	Skyltfonden	Chalmers, Cycleurope, VTI, TriVector, NTF Väst, NTF
TRUST-ME	Jonas Nilsson	01-05-2014	31-12-2017	FFI	Volvo Car Corporation, Chalmers

HUMAN BODY PROTECTION					
Adipose Tissue	Håkan Johansson	01-01-2014	31-12-2019	VR	Chalmers
A-HBM, step 3	Lotta Jakobsson	01-10-2014	31-12-2017	FFI	Volvo Cars, Autoliv, Chalmers
A-HBM, step 4	Linus Wågström	01-04-2018	31-03-2021	FFI – Trafiksäkerhet och automatiserade fordon	Volvo Cars, Chalmers, Autoliv, Dynamore Nordic
B29_B30 Fluid structure interaction in HBM	Håkan Nilsson	01-01-2013	31-12-2017	SAFER (AoA)	Chalmers
Child Safety in Cars – 2011 ARC Lincage Project	Mats Svensson	01-01-2012	31-12-2016	Australian Research Council	Chalmers, Autoliv (inkl. parter i Australien, USA och Canada)
Compcrash 2	Robin Olsson	01-05-2016	31-08-2019	Energimyndigheten (+ inkind från Gestamp)	Swerea SICOMP, Gestamp, Volvo Cars, Volvo Trucks, Chalmers TM
CompMethGlass II	Kjell Mattiasson	01-11-2017	28-02-2019	FFI	Chalmers, Volvo Cars, Dynamore Nordic
Composite Crash Behavior, FFI Crash 1	Ragnar Larsson	01-01-2013	31-12-2016	FFI	Chalmers, Autoliv, AB Volvo, VCC, ÅF, Semcon, Escenda, Altair, DYNAMore Nordic, Sicomp
Ductile composite	Martin Fagerström	06-12-2016	31-12-2019	Energimyndigheten	Chalmers, KTH och Biteam + Volvo Cars (som del i referensgrupp)
Female whiplash injury mechanisms, FusakoSato/JARI	Mats Svensson	01-01-2016	31-12-2019		JARI, Chalmers
FFI- Crash2	Martin Fagerström	01-01-2017	31-03-2020	FFI	Chalmers, SICOMP, Gestamp, Volvo Cars, AB Volvo, ÅF, Escenda, FS Dynamics, NEVS, DynaMore och MSC Software
FFI Pedestrian – head and neck, part 2	Christer Lundgren	01-01-2014	31-12-2016	FFI	Autoliv, VCC, KTH
ICONIC	Robin Olsson	01-10-2016	30-09-2020	EU Horizon2020	Swerea SICOMP + non-Swedish full partners (8) and partner organisations (5)
Injury HBM, step 3	Bengt Pipkorn	01-02-2016	31-03-2019	FFI	Autoliv, VCC, Chalmers; Umeå Univ, SU
Injury HBM, step 4	Bengt Pipkorn	01-04-2019	31-03-2022	FFI	Autoliv, Volvo Cars, Chalmers, SU
Kvinnors whiplash-skydd, forsknings-samverkan Chalme	Mats Svensson	01-01-2016	31-12-2016	Vinnova	Chalmers, Folksam
Long Term Consequences	Bengt Pipkorn	09-10-2017	02-10-2020	FFI	Autoliv, Volvo Cars, KTH, POC, MIPS
OSCCAR	Johan Davidsson	01-06-2018	31-05-2021	EU H2020	Chalmers, VCC, Autoliv
Passenger Safety	Lotta Jakobsson	15-06-2017	31-08-2020	FFI	Volvo Cars, Autoliv & Chalmers
SENIORS	Bengt Pipkorn	01-06-2015	31-05-2018	EU	Autoliv (+ BAST, Fiat, Ford, Humanetics, IDIADA, TRL, LMU)
Skadekriterier Whiplash	Johan Davidsson	01-01-2016	31-12-2017	Folksam Forskningsstiftelse	Chalmers, Folksam
Småfolk Part 2	Lotta Jakobsson	01-01-2013	30-09-2017	FFI	VCC, Chalmers, Autoliv
Whiplash diagnos med blodserum-analys – experimente	Mats Svensson	01-01-2016	31-12-2016	Folksam Forskningsstiftelse	Chalmers GU, KI
VIRTUAL	Astrid Linder	01-06-2018	31-05-2022	EU H2020	VTI, VCC, Chalmers, TÖI
ViVA II	Astrid Linder	01-04-2017	31-03-2020	VINNOVA	VTI, Chalmers, Folksam och Volvo Cars

SAFETY PERFORMANCE EVALUATION					
C29 UDRIVE	Jonas Bärgman	01-10-2012	30-06-2017	EU	SAFER JRU (Chalmers, Epsilon, VTI, TÖI, VCC), AB Volvo
C34 FOTNet Data	Helena Gellerman	01-01-2014	31-12-2016		
C39 SafetyCube	Robert Thomson	01-05-2015	30-04-2018	EU Horizon 2020	SAFER JRU (Chalmers, VTI), TÖI
C43 CARTRE	Helena Gellerman	01-10-2016	30-09-2018	EU Horizon 2020	SAFER JRU (Chalmers/LSP, VCC), AB Volvo
C44 L3Pilot	John-Fredrik Grönvall	01-09-2017	31-08-2021	EU Horizon 2020	SAFER JRU (Chalmers, ?), VCC, Autoliv, other EU Partner
C46 ARCADE (CARTRE2)	John-Fredrik Grönvall	01-10-2018	30-09-2021	EU H2020	SAFER, Chalmers, AB Volvo, (LSP via third party)
DCBIN – Driver Comfort Boundaries in Intersection	Mats Petersson	01-04-2012	30-09-2016	FFI	VCC, Chalmers, Autoliv
EFRAME – Analysis Framework for Safety Systems and	Claudia Wege	01-05-2013	31-05-2016	FFI	AB Volvo, Chalmers
Handbook of Road Safety Measures	Alena Hoye	01-01-2013		Vegdirektoratet, Samferdsels-departementet (Norge)	TÖI
K46 CRASHED	Giulio Bianchi Piccinini	01-12-2015	31-03-2018	VINNOVA	Chalmers, VCC, AB Volvo, LYTX
SHRP2-Workzone	Robert Thomson	01-11-2015	30-11-2016	Federal Highway Association	Chalmers, UMTRI

OPENRESEARCH@ASTAZERO					
Method development for studies at test tracks of long-term behavioral adaptation in automated vehicles	Azra Habibovic	01-08-2017	30-06-2018	Open Research Program	RISE, VCC
DSLD Vehicle Stability Enhancement and Demonstration	Jonas Alfredson	01-09-2017	31-10-2018	Open Research Program	DsenseD, Chalmers
HMI for autonomous vehicles in traffic (Hatric)	MariAnne Karlsson	01-06-2014	30-10-2017	Open Research Program	Chalmers, VCC
Gaze-steering coordination with pilot assist systems: A test track experiment on AstaZero	Esko Lehtonen	01-04-2018	31-03-2019	Open Research Program	Chalmers, Autoliv
Emergency care during ambulance transport: Naturalistic data from simulated type situations during driving at a test track	Björn Lidestam	01-04-2018	30-06-2018	Open Research Program	VTI, Center for Teaching and Research in Disaster Medicine and
SmArt seLf-driving vehIcle (SALI)	Edith Zavala	01-05-2018	30-06-2018	Open Research Program	GU, Universitat Politècnica de Catalunya (UPC)
Validation of optimal motion planning for automated urban driving	Matthijs Klomp	01-02-2019	20-08-2019	Open Research Program	VCC, Virtual Vehicle Research Center (Graz)
Active safety for bicycles using radar to prevent and reduce the impact in car-and-bicycle collisions	Jonas Andersson	01-02-2019	30-06-2019	Open Research Program	RISE, Aptiv
Truck drivers braking and glance behaviour during interaction with VRUs (TRUBADUR)	Giulio Bianchi Piccinini	15-01-2019	30-06-2019	Open Research program	Chalmers

APPENDIX 7: SEMINARS & CONFERENCES

CONDUCTED EXTERNAL SAFER SEMINARS, CONFERENCES AND OTHER EVENTS DURING YEAR 11-13 INCLUDE:

- On every Thursday to September to May SAFER's lunch seminars hosted by our Research areas, Competence areas and infrastructures.
- SAFER 10 years' anniversary event with presentations of the key research achievements during this first decade, April 5, 2016.
- Seminar "Unique in traffic" at the Science festival in Gothenburg, April 15, 2016.
- Seminar "How does pedestrians and cyclists understand each other?", together with NTF Väst, April 26, 2016.
- AstaZero Researchers Day "Emerging Trends in Active Safety for Road Vehicles", May 10, 2016.
- Adjunct Associate Professor Lecture: Matthijs Klomp, Applied Mechanics, Chalmers, May 18, 2016.
- SAFER Seminar: Invited Researcher Seminar with Dr. Francisco López-Valdés, University of Zaragoza, June 2, 2016.
- SAFER Seminar Protecting two-wheeler riders in car crashes Rikard Fredriksson, Department of Applied Mechanics, Chalmers University of Technology, June 13, 2016.
- IEEE Intelligent Vehicles Symposium 2016 (IV'16). SAFER & Chalmers host the conference on June 19-22, 2016, at Lindholmen.
- 3rd ADAS China Forum conference in Shanghai June 2016 in collaboration with Tsinghua and Tongji universities.
- SAFER Seminar: "Intelligent Vehicles Meeting Intelligent Humans" by Prof. Klaus Bengler, Technical University of Munich, June 21, 2016.
- FOT Data Anonymization and feature extraction workshop, August 31-September 1, 2016.
- FOT-NET Data Hands-on Workshop on Data Re-use, September 14, 2016.
- SAFER seminar: Matt Reed: "People Are Not Dummies: Modelling Human Variability for Vehicle Restraint System", October 6, 2016.
- SAFER Seminar: Kristy Arbogast: "Oblique child restraint testing, active safety research and other related topics", October 11, 2016.
- AstaZero Researchers Day, "Building trust in automated driving", October 18, 2016.
- Area of Advance Transport SOT Initiative seminar – Autonomus Transport System – "The good, the bad and the unknown", October 27, 2016.
- ICSC International Cycling safety Conference, Nov 2-5 2016, in Bologna.
- SAE China October 27, CTS session on traffic safety.
- "Autonomous drive, how will it really work"? A seminar together with NTF Väst November 11, 2016.
- Transportforum in January 11, 2017. SAFER led a session on Autonomous driving with five speakers.
- Dissemination seminar Eframe – Analysis Framework for Safety Systems and Services, January 25, 2017.
- Children, Life and Traffic, A one day seminar March 7, 2017 together with NTF Väst.
- Automated Driving: Road Safety & the Human Factor in Vienna, SAFER key note speaker, March 8-9, 2017.
- 5th International Conference on Driver Distraction and Inattention, March 20-22, 2017, Paris, France. Theme: Meeting the Challenges of New Technology and Automation. Co-hosted by SAFER, IFSTTAR & ARRB.
- SAFER seminar with Carol Flannagan, UMTRI, "From Model T to Waymo: Cars have gotten better – has transportation data science?", March 30, 2017.
- SAFER Project Day with project presentations, April 25, 2017.
- SAFER Seminar: "A Chinese outlook on future transportation and traffic safety" with CTS China-Sweden Research Centre for Traffic Safety, April 11, 2017.
- SAFER Seminar: "Protecting Occupants of all Ages, Shapes and Sizes" with Dr. John Bolte, The Ohio State University College of Medicine, May 3, 2017.
- SAFER Seminar: "Safety for automated vehicles" with Pete Thomas and Stephan Ridella, May 17, 2017.
- SAFER Seminar: "Automotive Human Machine Interaction Design" with MariAnne Karlsson, Fang Chen, Jacques Terken and Andrew L. Kun, May 23, 2017.
- SAFER participated in Enhanced safety for Vehicles (ESV), Detroit, June 5-8, 2017.
- Child safety seminar: "Child Occupant Protection – Latest knowledge and future opportunities", September 20, 2017.
- SAFER seminar: "Feasibility study of Chinese crash test dummy and human modelling development" with experts from CATARC, October 21, 2017.
- SAFER Seminar: "What does vehicle automation mean for infrastructure, road user behaviour and safety?" with Dr. Hanaeen Farah, Assistant Professor at TU Delft, Transport & Planning Department, November 2, 2017.
- SAFER Day: study tour to Halmstad University and Cycleurope in Varberg, December 7, 2017.
- SAFER Seminar: "Skilled Visuomotor Control in a Real-world Task – Explorations in the Cognitive Science of Driving" with Otto Lappi from University of Helsinki, December 14, 2017.
- Transportforum: SAFER held a session "Hur kan liv räddas och trafikskadorna reduceras genom att utveckla och förbättra vård och räddningsinsatser?", January 10, 2018.
- SAFER seminar: "Security and privacy issues in future connected vehicles" with Tomas Olovsson, January 23, 2018.
- SAFER Workshop on Driver modelling (within QUADRE with Dream4Cars EU-project members), January 26, 2018.
- Seminar "Säkrare tung trafik", co-host with NTF, March 7, 2018.
- SAFER and Revere at the Science Festival in Gothenburg – exhibition and information about self-driving cars, April 10, 2018.
- SAFER Research day – information to partners and other interested about our research and latest findings, April 19, 2018.
- SAFER Research area day, meeting with all partners about the project portfolio, May 2, 2018.
- Competence area Vehicle Dynamics year's seminar, theme is Model Fidelity for Vehicle Motion Predictions, May 24, 2018.

- Installation lecture: Professor Marco Dozza, Chalmers ”Safe road-user interactions: Can automated driving be safe and acceptable for everyone?”, June 8, 2018.
- Master thesis day, June 13, 2018
- Seminar: Artificial intelligence at Chalmers: present and future, June 20, 2018.
- Sustainable transports discussed in Almedalen – SAFER's infrastructure Revere participates with expertise in political seminar about automated vehicles, July 3, 2018.
- SAFER workshop on “Crash behaviour of composite”, Competence area Structures and Materials, September 13, 2018.
- SAFER part of the arrangement of the FOT-Net International Workshop: Strategies for sharing data and knowledge, in conjunction with the International ITS world congress, Copenhagen, September 17, 2018.
- SAFER Research area day, meeting with all partners about the project portfolio, September 18, 2018.
- Docent Lecture by Nils Lübbe, Autoliv: ”Predicting benefits and limitations of active safety systems for passenger cars”, September 21, 2018.
- SAFER seminar: “Are urbanism and mobility finally merging?” by Lars Marcus, Professor in Urban Design, Department of Architecture and Civil Engineering, Chalmers, October 3, 2018.
- SAFER arranges the 6th International Conference on Driver Distraction and Inattention in Gothenburg October 15-17, 2018.
- Doctor dissertation with Ulrich Sander, industrial doctorate at Veoneer and Department of Mechanics and Maritime Sciences, Chalmers University of Technology: ”Predicting Safety Benefits of Automated Emergency Braking at Intersections – Virtual simulations based on real-world accident data”, October 15, 2018.
- SAFER seminar with Prof. Clay Gabler from Virgina Tech: ”What can Event Data Recorders tell us about how Drivers Attempt to Evade Crashes?”, October 16, 2018.
- SAFER part of the arrangement of a workshop about Open Source Human Body Model Development, Berlin, October 17, 2018.
- Study tour to AstaZero proving ground, October 17, 2018.
- SAFER Research area day, meeting with all partners about the project portfolio, November 6, 2018.
- Safer heavy transports – follow up seminar with workshop, November 8, 2018.
- SAFER Seminar: “Safe HMI for future vehicles: an interaction design approach” with Prof. Roberto Montanari, Professor of Interaction Design at the University Suor Orsola Benincasa of Naples, November 13, 2018.
- SAFER Inspiration day – Road user Behaviour – November 23, 2018.
- SAFER seminar “Overview of the research at the Injury Biomechanics Research Center at Ohio State University” by Associate Professor John Bolte, November 27, 2018.
- SAFER Seminar with Carol Flannagan, UMTRI: “ Statistical Methods Matter? Exploring the Consequences of Methodological Choices on How We Understand Distracted Driving”, December 7, 2018.
- SAFER seminar and open discussion workshop about Real world data with Jacobo Antona-Makoshi (PhD), Japan Automobile Research Institute (JARI), December 11, 2018.
- SAFER Seminar: “Car-to-cyclist crashes: drive recorder analysis, AEB performance estimation and crash simulations” with Daisuke Ito, Nagoya, University, January 10, 2019.
- SAFER Study tour to Institute of Transport Economics (TØI) in Oslo, January 16, 2019.
- SAFER seminar with NTF: ”Bilförare genom livet – Utmaningar och möjligheter för säker mobilitet, January 23, 2019”.
- SAFER Research area day, meeting with all partners about the project portfolio, February 6, 2019.
- SAFER Seminar with Professor Duane Cronin, University of Waterloo, Canada. And Director of the Impact Mechanics and Material Characterization (IMMC) lab, presenting his ongoing research, February 21, 2019.
- Conference” Barn, Liv och Trafik 2019” together with NFT and City of Gothenburg, March 7, 2019.
- SAFER seminar with John D. Lee, Emerson Electric Professor at Department of Industrial and Systems Engineering, University of Wisconsin–Madison, Madison, WI: Automated vehicle communication and cooperation with pedestrians and other road users”, March 20, 2019.

APPENDIX 8: DISSERTATIONS AND LICENTIATE SEMINARS

The following PhD students working in the SAFER environment have written their doctoral thesis during stage 4:

Towards a Safe System Approach to Prevent Health Losses among Motorcyclists – The Importance of Motorcycle Stability as a Condition for Integrated Safety
Matteo Rizzi, Machine and Vehicle Systems, Department of Applied Mechanics, Chalmers University of Technology and Folksam, March 7th, 2016
http://publications.lib.chalmers.se/publication/235886-towards-a-safe-system-approach-to-prevent-health-loss-among-motorcyclists

Traumatic Brain Injuries: Animal Experiments and Numerical Simulations to Support the Development of a Brain Injury Criterion
Jacobo Antona, Division of Vehicle Safety, Department of Applied Mechanics, Chalmers University of Technology, May 12th, 2016
http://publications.lib.chalmers.se/publication/235126-traumatic-brain-injuries-animal-experiments-and-numerical-simulations-to-support-the-development-of%20från%20kalendariehändelsen%20i%20CPS3

Safety for Children in Cars – Focus on Three Point Seatbelts in Emergency Events
Isabelle Stockman, Division of Vehicle Safety, Department of Applied Mechanics, Chalmers University of Technology, October 7th, 2016
http://publications.lib.chalmers.se/publication/241824-safety-for-children-in-cars-focus-on-three-point-seatbelts-in-emergency-events

Characteristics of near-side car crashes – an integrated approach to side impact safety
Cecilia Sunnevång, Umeå University, Faculty of Medicine, Department of Surgical and Perioperative Sciences, Surgery, November 11th, 2016
http://umu.diva-portal.org/smash/record.jsf?pid=diva2%3A1039698&dswid=-5812

Methods for Analysis of Naturalistic Driving Data in Driver Behavior Research
Jonas Bärgman, Division of Vehicle Safety, Department of Applied Mechanics, Chalmers University of Technology, December 2nd, 2016
http://publications.lib.chalmers.se/publication/244575

The contribution of vehicle, occupant and crash factors to the risk of injury as a result of vehicle rollover – new approaches to data and modeling
Stephen Ridella, industry PhD-student from NHTSA, USA, Department of Mechanics and Maritime Sciences Chalmers University of Technology, May 17, 2017
https://chalmersuniversity.app.box.com/s/ijyzu316e5gy7m393d4gbx2ub2gnatey/file/164290352775

Same, Same but Different: On the Design of Cross-Regional Advisory Traffic Information Systems
Minjuan Wang, Interaction Design, Chalmers University of Technology, May 24, 2017
https://research.chalmers.se/publication/249202

Muscle responses in dynamic events – volunteer experiments and numerical modeling for the advancement of human body models for vehicle safety assessment
Jóna Márin Ólafsdottir, Applied Mechanics, Vehicle Safety, Injury Prevention, Chalmers University of Technology, June 13, 2017
https://research.chalmers.se/publication/249498

Traffic Situation Management for Driving Automation of Articulated Heavy Road Transports -From driver behaviour towards highway autopilot
Peter Nilsson, Mechanics and Maritime Sciences, Vehicle Engineering and Autonomous Systems, Chalmers University of Technology and Volvo Group, October 10, 2017
http://publications.lib.chalmers.se/records/fulltext/251872/251872.pdf

Understanding Boundary Conditions for Brain Injury Prediction –FE Analysis of Vulnerable Road Users
Victor Strömbäck Alvarez, Royal school of Technology, November 6, 2017
The research was a s part of the associated FFI financed project "FFI Pedestrian – head and neck, part 2", finalized in December 2016.
http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1148842&dswid=1092

Eliciting User Experience Information in Early Design Phases. The CARE Approach to In-Vehicle UX
Ingrid Pettersson, Chalmers University of Technology, Design & Human Factors, Department of Industrial and Materials Science and Volvo Cars, October 5, 2018
https://research.chalmers.se/publication/504907

Predicting Safety Benefits of Automated Emergency Braking at Intersections – Virtual simulations based on real-world accident data
Ulrich Sander, Veoneer and Department of Mechanics and Maritime Sciences, Chalmers University of Technology, October 15, 2018
https://research.chalmers.se/publication/504728

Material characterisation for crash modelling of composites
Thomas Bru, RISE Research Institutes of Sweden – Division Materials and Production – RISE SICOMP and Chalmers, Industrial and Materials Science, Material and Computational Mechanics, November 30, 2018
https://research.chalmers.se/en/publication/505312

A Simulation-Based Safety Analysis of CACC-Enabled Highway Platooning
Maytheewat Aramrattana, VTI and Halmstad University, December 12, 2018.
http://hh.diva-portal.org/smash/record.jsf?pid=diva2%3A1264677&dswid=-1022

Does Spinal Alignment Influence the Car Occupant Response? – The influence of variation in the whole spinal alignment patterns on vertebral kinematics under rear impact conditions
Fusako Sato, Department of Mechanics and Maritime Sciences, Chalmers University of Technology, Gothenburg, Sweden, February 22, 2019.
https://research.chalmers.se/publication/508597/file/508597_Fulltext.pdf

Drivers' response to attentional demand in automated driving
Alberto Morando, Chalmers, Department of Mechanics and Maritime Sciences, Vehicle Safety, Chalmers University of Technology, Gothenburg, Sweden, March 21, 2019
https://research.chalmers.se/publication/508802/file/508802_Fulltext.pdf

The following PhD students working in the SAFER environment have written their licentiate thesis during Stage 4):

Older car drivers – Needs of vehicle support for safe individual mobility
Thomas Broberg, Division of Vehicle Safety within SAFER, Chalmers University of Technology and Volvo Cars, April 20, 2017
https://research.chalmers.se/publication/248730

Visual response to attentional demand in increasing levels of automation
Alberto Morando, Department of Mechanics and Maritime Sciences, Chalmers University of Technology, June 8, 2017
http://publications.lib.chalmers.se/records/fulltext/249269/249269.pdf

Female and male whole spinal alignment and cervical kinematic responses in rear impacts
Fusako Sato, Applied Mechanics, Vehicle Safety, Injury Prevention, Chalmers University of Technology, June 19, 2017
https://research.chalmers.se/en/publication/249576

Driver interaction with vulnerable road users: Understanding and modelling driver behaviour for the design and evaluation of intelligent safety systems
Christian-Nils Boda, Applied Mechanics, Accident Prevention in the Traffic Safety Division at Chalmers University of Technology, August 25, 2017
http://publications.lib.chalmers.se/records/fulltext/250519/250519.pdf

Calibration and Modelling of Adipose Tissue Under Impact Loading
Hosein Nasari, Department of Mechanics and Maritime Sciences, Chalmers University of Technology, November 23, 2017. His research is part of the ongoing associated project "Adipose Tissues".
http://publications.lib.chalmers.se/records/fulltext/252887/252887.pdf

Modelling driver behaviour in run-off-road crashes: Applications in safety system development and safety benefit estimation
Daniel Nilsson, Department of Mechanics and Maritime Sciences, Chalmers University of Technology, December 15, 2017
http://publications.lib.chalmers.se/records/fulltext/253279/253279.pdf

Mind off Driving: Effect of cognitive load on driver glance behaviour
Emma Nilsson, Department of Mechanics and Maritime Sciences, Chalmers University of Technology and Volvo Cars, March 26, 2018
https://research.chalmers.se/en/publication/501276

Volunteer Kinematics and Muscle Activity in Dynamic Events Representative of Pre-crash Scenarios (licentiate)
Ghazaleh Ghaffari, Department of Applied Mechanics, Chalmers University of Technology, October 26, 2018
https://research.chalmers.se/publication/505297

SAFER

VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS