SAFER ANNUAL REPORT

2022

YEAR 4/5 IN STAGE 5
JAN 1 – DEC 31 2022
OPERATIONAL YEAR 17

SAFER
VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

CONTENT

SAFER Vehicle and Traffic Safety Centre at Chalmers is a research and competence centre where close to 50 partners from the Swedish automotive industry, academia and authorities cooperate to create a centre of excellence within the field of safe and sustainable mobility.

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 knowledge dissemination, with the vision to contribute to a safe and sustainable transport system for *all*.

SAFER conducts borderless research to save lives!

INTRO-DUCTION

Welcome to our annual report! The purpose of this report is to present the effects and outcome of the fourth operational year in SAFER's fifth stage, extending between January 1st and December 31st 2022.

WHAT AN INCREDIBLY positive year of collaboration in traffic safety research we have had! First, we can finally meet again after the pandemic, and the added value in physical meetings becomes so obvious; the increased creativity and the opportunity to add perspectives and get to know each other even more, are just a few of them. Having said that, we also clearly acknowledge the value in the digital formats, allowing for a wide engagement that has grown immensely during the pandemic.

We are now in the last year of our current stage – and the formation of SAFER's future is in full swing! We are very pleased with the great commitment to creating our joint research agenda for SAFER's next stage, which starts in January 2024. We have identified common challenges as well as how SAFER could become even more attractive as a collaboration platform. We are looking forward to setting a solid and challenging strategic research agenda for SAFER Stage 6 with the right partners, relevant topics and continue to create a strong commitment for the next stage.

Our annual report contains lots of information about the development of our collaboration, our project results and our activities. We are particularly proud of how well we have succeeded in positioning SAFER within the Horizon Europe research and innovation programme. In the first two sets of calls no less than four large projects, initiated by activities within SAFER, have been funded. The projects are now engaging many of our partners and their researchers.

> " We are now in the last year of our current stage – and the formation of SAFER's future is in full swing!

The fact that traffic safety is increasingly becoming established as a part of the global sustainability agenda is also encouraging to see. Agenda 2030 and the recommendations from the UN conference in Stockholm in 2020 are now being used in society and many of our partners are sharing their strategies on how to become sustainable. An exciting example on how SAFER takes on the recommendations is our workshop series for co-creation of a sustainable, future urban environment that we have carried out together with the industry, academy, research institutes and societal actors, using the framework of Gothenburg Green City Zone (see page 47–49). The results of the research will contribute to build valuable knowledge to strengthen the regional actors' competitiveness and at the same time contribute to a more sustainable future.

Our pre-study program continues to pleasantly surprise us; we have received numerous creative ideas from our partners and the results are generally very good as these, albeit small, projects create valuable knowledge and often subsequent larger projects. Since the program started in

> " Some of our key achievements in 2022 include the launch of SAFER's data catalogue as well as our work to enable a wider use of our world-leading SAFER human body model.

2020, 41 project ideas have been submitted and 26 pre-studies have been funded. Read more about the program and the projects that have been conducted in 2022 on page 26–29.

During 2022, we have also continued with thought-provoking seminars, project presentations, project applications, new grants and dissertations. It is impressive and gratifying to see all the research that is taking place within the broad community of SAFER, and this year we likely set a new a record in the number of completed activities, more than 80 events were arranged. Another all-time-high is the number of ongoing projects; never before has our project portfolio hosted so many projects; 86 research projects have been connected to the SAFER partnership during 2022.

Some other highlights you must not miss are the launch of our new asset – the SAFER Data catalogue, that will help our researchers to get access to high-quality data and that our world leading SAFER Human Body Model's research results are moving towards providing an open-available model globally, to enable a wider use of the tool. Welcome to learn more about these initiatives and much more in this report!

We would like to thank you all for your great commitment and engagement during 2022 and we are looking forward to yet another inspiring year to co-create knowledge about developing a safe and sustainable transport system for *all*.

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Kindest regards,
SAFER Board and Management Team

THE MANIFESTO

The Manifesto presents our human-centric vision, mission and what SAFER's partners want to achieve together.

SAFER IS CONTINUOUSLY on a bold journey towards zero fatalities and injuries in road traffic. This is achieved through collaborative research projects and knowledge exchange 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 larger societal project: the design and realisation of smart, adaptable, sustainable and resilient transport systems in our 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.

VALUES AND IDENTITY

SAFER has a unique identity with clear values such as openness, mutual respect, curiosity and joy of discovery. We are passionate to make a difference, contribute to society, build relevant knowledge and we understand the benefits from interdisciplinary expertise and talents. Collaboration is a hallmark and thrives on diversity in all aspects and borderless networks seeking and attracting expertise where it is to be found.

OVERALL 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 contributions 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 lower environmental impact and more cost-effective freight transport. During SAFER Stage 5 we aim to fulfil our defined research targets, as well as work according to the four cornerstones in our strategy.

Of course, it is also a matter for SAFER to contribute with research results and knowledge striving to contribute to the global Sustainable Development Goals (SDG:s). The SDG:s 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. The work of integrating the sustainability goals in our work has been a continued focus area during 2022. The global UN-conference on road safety that was held in Sweden in February 2020 and its outcome in the form of the Stockholm Declaration and the recommendations in the book "Saving Lives Beyond 2020 – the Next Steps", have continued to create engagement and inspire us in our research.

SAFER'S VISION

All road users travel safely in the road transport system.
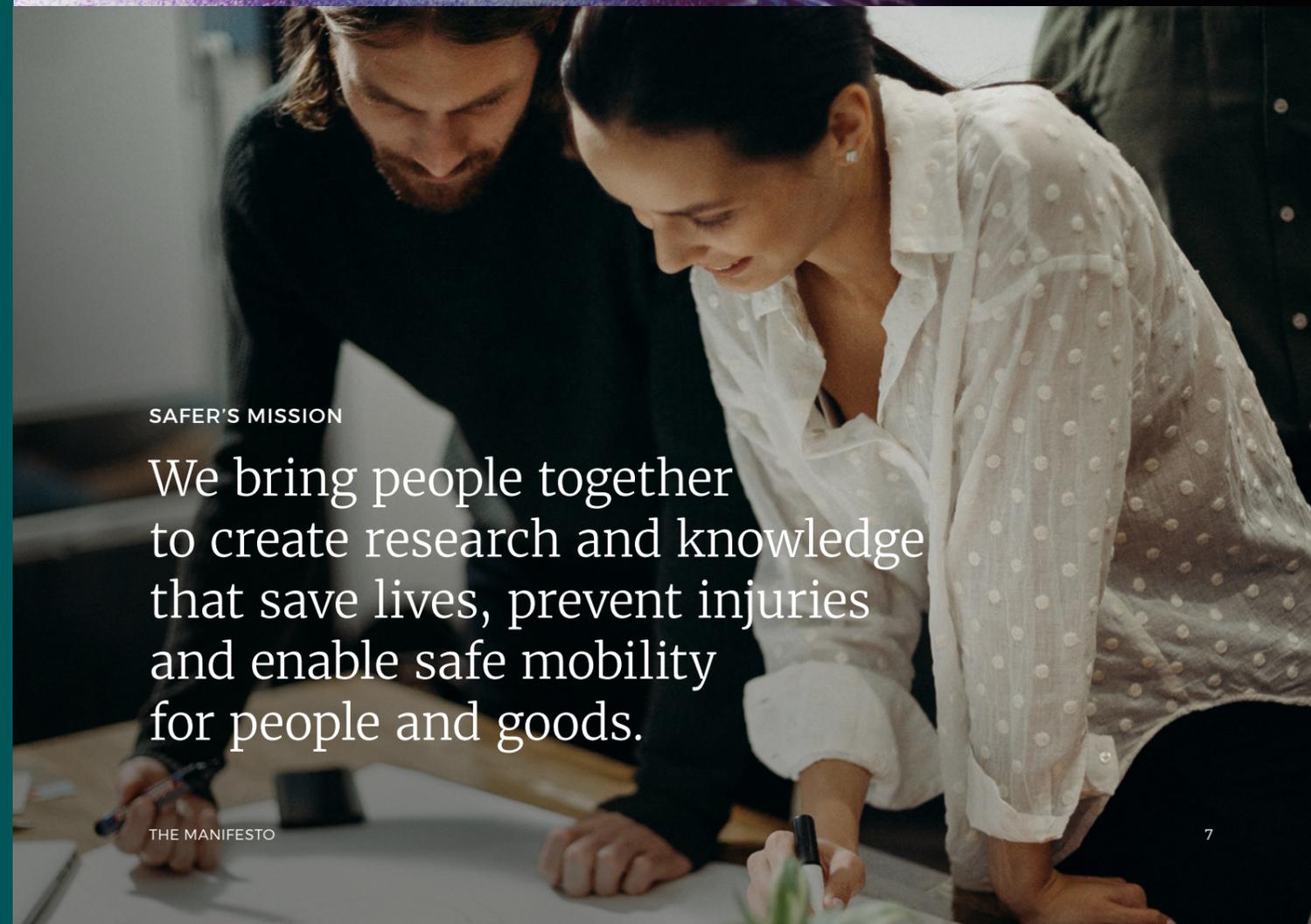
SAFER'S MISSION

We bring people together to create research and knowledge that save lives, prevent injuries and enable safe mobility for people and goods.

STRATEGY

TO SIGNIFICANTLY CONTRIBUTE to the vision and mission as well as being a well renowned international centre of research excellence, SAFER will deliver results, build competence and create strong networks in selected areas. Furthermore, SAFER shall create value for the partners beyond what a single partner can achieve on its own.

SAFER's strategy consists of three different conceptual parts – SAFER Core, the SAFER Research and project portfolio and SAFER Assignments and investigations, see figure 1. SAFER Core is the name of the driving function of SAFER with its operational team including communication and support systems, research areas and their reference groups, the connected research resources, networks and the physical working and networking environment.

To realise our vision, our strategy is based on four inter-linked cornerstones that direct our actions: *Create and share knowledge, Express identity and influence as a thought leader, Utilize the multidisciplinary research platform, Connected research resources.*

1. CREATE AND SHARE KNOWLEDGE

The basic task for SAFER is to create and share knowledge and to further develop the 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. The research results should help facilitate innovation at our partners.

2. EXPRESS IDENTITY AND INFLUENCE AS A THOUGHT LEADER

The name SAFER should mean excellence in vehicle and traffic safety research and be of value to all partners to be associated with. This identity is built, expressed and made visible in different ways – seminars, conferences, website, the office and other activities. By communicating what SAFER represent and the achieved results we will attract international stakeholders, collaboration projects and funding. As a thought leader, SAFER should define strategic research agendas based on needs and trends, create and drive SAFER's research projects and develop road maps. The conclusions and needs of the SAFER community should be made visible and known.

FIGURE 1: OUR STRATEGY

SAFER RESEARCH Cutting edge applied research	SAFER Assignments and Investigations

SAFER CORE – THE PLATFORM
Cornerstones in SAFER Core
1. Create and share knowledge
2. Express identity and influence as a thought leader
3. Utilize the multidisciplinary research platform
4. Connected research resources

3. UTILIZE THE MULTIDISCIPLINARY RESEARCH PLATFORM

A cornerstone in the strategy is to have a multidisciplinary research environment that serves as a physical meeting place, open to all partners. The networks and meeting places we create together will provide added value to partners. The community will generate new knowledge and project ideas as well as develop the people involved, both on a professional and personal level.

4. CONNECTED RESEARCH RESOURCES

The concept of connected research resources is a hallmark for SAFER and we facilitate the access and utilization of different assets available within the network. These comprise the following: the collaboration setup with the *physical environment* providing workspaces, meeting and analysis rooms, support for seminars etc; *field data*, with 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 vehicle laboratory at Chalmers, which is increasingly important for active safety research, automated driving and a connected, sustainable transport system; the *AstaZero* test environment, owned by RISE, providing a world class facility where SAFER supports research activities; *simulators* of different kinds exist in the network, most notably at the Swedish National Road and Transport Research Institute (VTI). *SAFER's Human Body Model* encompasses a scalable, tuneable, human body models that can be used for predicting injury outcome in any impact situation. SAFER provides a competence platform for SAFER partners as well as a natural contact point for external cooperation. SAFER's partner, the road safety organisation NTF Väst, gives our researchers the possibility to use a very closely located traffic training site, *Stora Holm*, offering various test tracks and a skid pad for tests and events.

MONITORING PROGRESS AND KPI:S

A number of criteria will help prioritise our research efforts and how we should work to reach SAFER's objectives. The overall objectives and criteria are regularly monitored and evaluated. Also, the key performance indexes and measures help the partners to evaluate the strategic and operational workplan.

01. IMPACT: The added value for the SAFER partners as well as the society as a whole is a key to our continued success and is an integral part of the strategic plan. This is primarily created through collaborative work where different partners contribute according to their needs and competence, the result is that we conduct excellent and relevant research with real-life applications and impact.

An example is SAFER's project portfolio, to which 32 new projects have been added during this operational year. Also, we have been active in creating future safety assurance standards for automated vehicles as well as developing a SAFER data catalogue to support our researchers to get access to high-quality datasets. By sharing knowledge on these we will help ensuring that SAFER continues to be attractive to other research groups in the world.

02. CONTINUOUS RELEVANCE: In the ever-changing landscape of road transport systems, new types of vehicles and ownerships etc, it is of utmost importance that SAFER understands the needs and the context in which we work in order to put the focus on the right topics and issues. SAFER is continuously requested to contribute both on a national and an international level.

SAFER has continued to be a strong speaking partner in the processes shaping the upcoming research programmes in Sweden and the EU during 2022. For instance, in the formation of the CCAM (Cooperative, Connected Automated Mobility) partnership in Europe, several SAFER partners have been instrumental in safeguarding the road safety aspects in the strategic research and innovation agenda. As a result of this work, SAFER partners are now contributing, and in some cases leading, several large EU-projects within the current framework programme. The capability to host high quality,

well-attended workshops, is yet another sign of a well-respected community with high impact. As a token of credibility, SAFER was trusted with hosting a workshop about medium-term trends and needs for future R&I at the Transport Research Arena in Lisboa in November. Also, we have several new projects contributing to our collective understanding on how to design safe micromobility as well as safe automation.

03. COHERENCE WITH THEMATICALLY RELATED INITIATIVES: The global research environment in which we operate is changing continuously and new initiatives are created to which we need to relate to and make sure to benefit from and provide input to when applicable. By doing so, we are perceived as a major player in sustainable and safe transport, we consider safety as one of the main prerequisites. We are well-connected to, and cooperate with, other relevant organisations.

During 2022, we have been working in close collaboration with Drive Sweden and AI Sweden to build knowledge and generate projects in which AI can be used as a tool for improved traffic safety. SAFER has been leading a working group under the AI Enhanced Mobility program, read more on page 46. Within Drive Sweden, we have further increased our presence, among other things through participation in the thematic area of public engagement and participation in a major application about Impact Innovation within the Horizon Europe framework program. Drive Sweden is an arena where we get closer contact with cities and regions, which are important recipients of our research and helps us to understand needs and challenges.

04. EFFICIENCY: Our operation needs to be efficient in order to use our limited resources as efficiently and effectively as possible; we need to be experts in streamlined working processes and our multidisciplinary research platform enhances research, networking and make work easier for our partners.

SAFER has developed a lot during the pandemic and we have learned how to create engagement together with our partners, using digital tools. But now we also see a very positive post-Covid effect within SAFER with many physical meetings, engaging networking, creative project creation and knowledge exchange!

KEY PERFORMANCE INDICATORS

|	THE FIRST YEAR IN SAFER STAGE 5 (APRIL 1ST – DEC 31ST 2019)	THE SECOND YEAR IN SAFER STAGE 5 (JAN 1ST – DEC 31ST 2020)	THE THIRD YEAR IN SAFER STAGE 5 (JAN 1ST – DEC 31ST 2021)	THE FOURTH YEAR IN SAFER STAGE 5 (JAN 1ST – DEC 31ST 2022)
ACTIVITY	2019	2020	2021	2022
Total number of projects ongoing	52	70	81	86[1]
New projects	12	38	24	32
Finalised projects	21	20	30	36
Publication volume	59	78	87	103
Number of seminars and other knowledge sharing activities	49	74	79	82[2]
Number of visits by external stakeholders	7	N/A	5	3[3]
Invitations to international projects	10	4	7	4[4]
Visability/references in conferences	18	15	33	21[5]
Connections to other research centres and collaborative organisations	25	25	27	27[6]
Partners on Level 1	7	7	7	7
Partners on Level 2	18	18	18	19
Partners on Level 3	12	12	19	21
Gender balance in SAFER Board and management team (women/men)	11/12	11/12	10/12	13/10
Number of SAFER partners per project, see figure 5 on page 31	No.	No.	No.	No.
Partner satisfaction index	—	4,45	4,75	4,75[7]

2022

1. Read more about our project portfolio on page 30 and all the projects are listed in appendix 6.
2. See complete list of activities in appendix 7.
3. ARAI Automotive Research of India, US Government accountability office putting together a report about injury prevention and wanted to learn from our experiences, Craig Hoey, Australia, investigating policy-making process in relation to road safety in Europe.
4. Two projects within EU Mission cities, several ongoing discussions regarding proposals within the recently published Horizon Europe 2023 calls and to a micro mobility network through Drive Sweden
5. See complete list in appendix 8.
6. See complete list of SAFER's ecosystem in appendix 5.
7. A survey was performed among level 1 and 2 partners to answer the question "The overall benefit of the partnership?". The scale was 1–6, 6 was very good.

> 2022 was a very positive year for us; all-time high in the number of projects in SAFER's portfolio, concluded knowledge building activities and academic publications.

AGENDA 2030
THE GLOBAL SUSTAINABLE DEVELOPMENT GOALS AND TRAFFIC SAFETY RESEARCH

AGENDA 2030 IS THE MOST ambitious set of sustainability goals ever adopted by the UN member states, and road safety is included both directly and indirectly in several of the goals. The goals are absolute and indivisible, which means that the work with different goals such as road safety, gender equality, poverty and climate change must take place in parallel. SAFER wants to continue to be proactive and contribute to Agenda 2030 through its research. We believe that broad collaborations and knowledge transfer are keys to success. The goals are inseparable and therefore several actors need to target the challenges provided by the goals, at the same time.

For us to succeed in our research, there must be funding opportunities for this new approach and we need to learn from inspiring examples of how to do this in practice. The long-term perspective is also still important, as is evaluating results; what works and what is less useful. Transport connects societies, individuals, services and goods and has a great opportunity to contribute to a sustainable transformation of the society at the same time as the transport systems also must undertake considerable changes to be more sustainable. We indirectly contribute positively to many goals since safe transport often is a prerequisite for successful goal fulfillment, e.g. enable access to health care and food distribution. There is also a specific sub-goal for road safety; 3.6. "Reduce road injuries and deaths".

Below we present an overall summary of the assessment of our traffic safety research and how we aim to approach the global SDGs.

KEY AREAS AND SUCCESS FACTORS FOR SAFER'S FUTURE RESEARCH

Sweden hosted the third global ministerial conference on road safety in Stockholm in February 2020 and this major event resulted in "The Stockholm declaration", a strategic agenda and recommendations to achieve the global sustainable development goals and halve the number of fatalities in traffic between 2020 and 2030. The Stockholm declaration was adopted into a UN resolution in August 2020. In conjunction to the conference, the book "Saving lives beyond 2020 – the next steps", developed by the conference's Academic Expert Group, led by Prof. Claes Tingvall, was also launched. The book presents a new way of thinking on how road safety can be addressed in a much broader perspective. That, in turn, can open up great opportunities to even better utilize SAFER's road safety research, find new partners and start taking big steps towards a more sustainable transport system. The book will continue and inspire us in our research activities ahead.

We have identified many new, also several cross-cutting, topics and research questions, in which we in the traffic safety research community will be able to contribute. For example, support the understanding of which technologies for increased road safety that will be most effective in the future, also taking into account future scenarios, as well as other societal needs, such as the environment and health. Becoming even better at technology transfer has a large traffic safety potential, such as even deeper look into how protection systems and preventive safety systems that are currently found in cars, can be used for two-wheelers. Knowledge transfer and reliable data are other important issues.

Many people who lose their life in traffic is a victim of someone's value chain. This way of thinking can provide entirely new ways of looking at responsibility. If each company, or organisation, starts to regularly report its footprints for traffic casualties in the same way as for example climate impact, there will be an increased focus for improvement, for example with regards to requirements for procurement, actions and follow-up. Reporting and systematic follow-up is hence another important area that has huge impact on global road safety.

The global sustainable development goals are indivisible, which opens up completely new opportunities for road safety and SAFER's research.

3. GOOD HEALTH AND WELL-BEING
Goal 3 is about ensuring healthy lives and promoting well-being for everyone. Good health is a fundamental prerequisite for people's ability to reach their full potential and to contribute to the development of society. Human health is affected by economic, ecological and social factors and goal 3 includes all dimensions and people of all ages.

SAFER'S CONTRIBUTION
SAFER's vision is that all road users should travel safely in the transport system. Our project portfolio support this bold vision with a wide range of projects that will lead to more knowledge on how to design a safe and sustainable transport system, for *all*.

5. GENDER EQUALITY
Gender bias is undermining our social fabric and devalues all of us and it is a tremendous waste of the world's human potential. By denying women equal rights, we deny half the population a chance to live life at its fullest. Political, economic and social equality for women will benefit all the world's citizens.

SAFER'S CONTRIBUTION
SAFER has a strong focus on developing traffic safety solutions that are equal for all people. We work with injury protection for all, while the vehicle safety assessments of today are mainly based on men. Our human body models represent the entire population, men and women, young and old, in all sizes.

9. INDUSTRY, INNOVATION AND INFRASTRUCTURE
A functioning and resilient infrastructure is the foundation of every successful community. To meet future challenges, our industries and infrastructure must be upgraded and we need to promote innovative sustainable technologies.

SAFER'S CONTRIBUTION
Knowledge building and collaborative activities to support access to safe, affordable and sustainable transport systems for all, are the foundation of SAFER's research. We also work on development of various forms of collaboration and connect to other actors to put traffic safety in a broader context.

11. SUSTAINABLE CITIES AND COMMUNITIES
Goal 11 is about making cities and settlements inclusive, safe, resilient and sustainable. This in turn requires new technology and cooperation between several sectors.

SAFER'S CONTRIBUTION
An important component of a sustainable society is safe transport. This is also the basis of our research; to contribute with knowledge and facts to build a sustainable road transport system. We cooperate together with other actors to plan for future mobility and produce knowledge that can form the basis for new products and services that contribute positively to fulfillment of this goal.

THE FRAME-WORK

The framework is the context in which we work; the partners' agreement, the operational plan, financing, working processes, the operational team, partnerships and the connected research resources.

ORGANISATION AND MANAGEMENT OF THE CENTRE

SAFER'S VEHICLE and traffic safety research is completely based on partnership. 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 Transport Area of Advance. 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. Four 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 and a Co-director who are supervising the project portfolio and overall development of the area. The Research area directors are also members of the management team. The Competence networks, 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, both nationally and globally. See appendix 2, 3 and 4 to read more about the Board, management team and Competence networks. More information about the four Research areas and their research result during the fourth year of SAFER Stage 5 can be found on page 32–50.

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 this year, there have been about 575 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 organizational 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.

PARTNERS

Safe mobility of people and goods in a sustainable system 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 contribute to – a unique competence and research collaboration platform. In SAFER's Stage 5, 35 partners joined the collaborative research agreement and during this year three new organisations have joined the partnership.

During the spring we welcomed **Chalmers Industriteknik**, which is a research institute that offers academic excellence in several areas strongly connected to, or enabling, SAFER's research areas; e.g. innovation, protection systems, machine learning, AI-methodologies and application areas, digitalization, data science, research infrastructures, materials science as well as expertise in leading complex collaboration environments and large EU projects. Another important area for collaboration will also be the global sustainable development goals. Connecting traffic safety to other research disciplines to gain momentum will be a key contributor to tackle our global sustainability challenges and create a truly sustainable transport system.

We also see that Chalmers Industriteknik further can strengthen our international applications. The research institute undertakes several different types of research tasks and investigations connected to road safety, including for example crash safety, materials science and different types of gender equality issues in transport.

Pionate is a small start-up company with strong competence in traffic and vehicle safety, focused on data collection and data analysis. Pionate has extensive experience from both academical research and product development in the automotive domain. Research includes, for example, autonomous vehicles, Advanced Driver Assistance Systems (ADAS), driver behavior, vehicle data logging and creation of data sets, computer vision, biomimics, and also the development of related systems architectures and software. Areas of interest are subjects relating to data logging and Advanced Driver Assistance Systems, but also Artificial Intelligence and Machine Learning, Human Machine Interface, driver interaction and attention, sensors and sensor fusion and much more.

The company aims to contribute to SAFER's activities with input and ideas for ongoing and new research as well as creation of new research projects. Pionate would like to work closely with other SAFER partners with logging vehicle data supporting their research interests. Pionate will also, when possible, provide a data logging platform and share vehicle data. Pionate is entering the SAFER partnership on level 3.

We have also welcomed our new associated partner, **Bookman**, a company that creates inspiring visibility products with a minimalist design for cyclists, runners, pedestrians and others who need to see and be seen in traffic. The company is aiming to be at the forefront of innovation and research around road user behaviour and innovative product design that reduce accidents in traffic. A key research question of interest is looking into changing behaviour and how to increase usage of visibility products. It will be valuable to find project opportunities and learn about the significance of, for example, the design of reflective products and how we can use a scientific approach to increased usage of these items, which are so important for visibility in traffic.

The new partner has experience in product design as well as access to a relevant customer base that could bring valuable insights to SAFER's research about vulnerable road users.

Together, they all contribute to create new knowledge and research findings that enable people and goods to be transported safe, efficient and sustainable. See the complete list of the 47 partners that have been active in the partnership in 2022 in appendix 1.

CONNECTED RESEARCH RESOURCES

STRONG ASSETS FOR REAL-WORLD TRAFFIC SAFETY RESEARCH

As a SAFER partner you get access to SAFER's open research arena and, through relevant projects, research resources available within the network. Also, expertise to use these research resources is available in the community. The overall idea – and one of our strategic cornerstones – is that research should be easier, better and more efficient through collaborative partnerships. This unique set of platforms includes full-scale road traffic safety test environments, simulators and a research lab for active safety and autonomous driving. 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.

LINDHOLMEN SCIENCE PARK – THE SWEDISH HUB FOR FUTURE MOBILITY

Lindholmen Science Park, in which SAFER is located, 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. More than 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 definitely 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.

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 about 6.5 million kilometres of driving in real traffic.

SAFER is located at Lindholmen Science Park in Gothenburg, the Swedish hub for future mobility.

SAFER was granted research funding for a major investment in developing the FOT databases in 2019 by adding e.g. an improved eye tracking and body position features, to even better understand human behaviour in vehicles. The development has been conducted with the help of machine learning - powerful computers will track different driver states and behavior, instead of a real person doing the work. The upgrade is soon to be completed, and the database will be able to support more research questions than before, e.g.to validate safety systems in future vehicles that keeps track of the driver's attention and drowsiness.

SAFER's research infrastructure has been expanded with a new asset for efficient traffic safety research; a data catalogue containing information about available quality assured datasets for research and description on how these can be accessed. With an ever-increasing focus on data in the community, we have established a SAFER data portfolio to support projects and partners. Knowledge of the different datasets available in SAFER's network is important for efficient work within projects, providing new perspectives on past and present research, and being able to create completely new projects through data-driven research. By sharing knowledge on these datasets in a SAFER data catalogue, we will help ensure that SAFER continues to be attractive to other research groups in the world. Read more about the SAFER data catalogue on page 45.

IGLAD is an Initiative for the harmonization of Global in-depth traffic Accident Data to improve road and vehicle safety. More than 10 years after its initiation, the IGLAD project database has firmly established itself as an in-depth data source for accident research and vehicle safety applications. Almost 10,000 accidents from five continents have now found their way into the database. They all share a uniform coding, harmonized between the data providers,

The simulator at VTI is a connected research resource at SAFER and often used in various research projects as a valuable tool.

as well as a quality standard. With the current data, it is already possible to perform descriptive analyses of accidents and injuries in various countries.

In 2022, the first-ever IGLAD- Pre Crash Metrics (PCM) was released providing 200 pre-crash simulations from real accidents coming from seven countries on three continents. A group of consortium members will report on the implementation of the IGLAD-PCM, selected analyzes and application examples at the ESV conference in Yokohama in April 2023.

More information about IGLAD can be found at iglad.net

SIMULATORS

The driving simulator Sim IV at the Swedish National Road and Transport Research Institute (VTI) has an advanced motion platform system and permits significant linear movement along both x and y axes in combination with a hexapod. Sim IV is useful when motion feedback is important or if a wide field of view is prioritised. The SIM IV can facilitate cabins for a car, a truck and a bicycle. The simulator's visual system is now also complemented by introducing a VR head set that are used for bicycle applications. In 2022 a new mini simulator setup has been available at VTI's facilities at Lindholmen.

The simulator is used regularly by SAFER's partners, for example in MICA II, CO$_2$ – Effects on driver state and
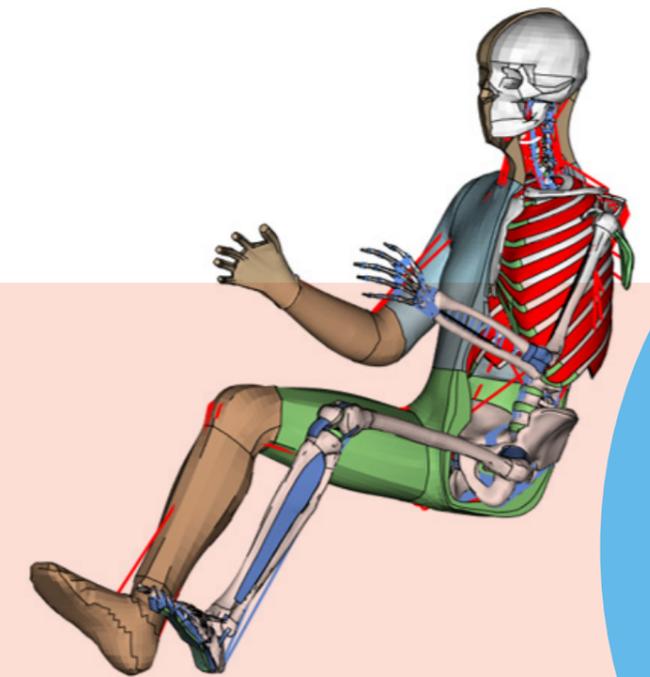
SAFER's HBM is one of the most advanced human body models in the world, and we are now working towards providing an open-available model globally, to enable wider use of the tool.

driving performance, External Interaction Principles for Creating Trust in Heavy Automated Vehicles (EHMI) and the CTS-project Heterogeneous Traffic Groups Cooperative Driving Behaviours Research under Mixed Traffic Condition as well as in Fit2Drive. Furthermore, the fixed-base simulators in Linköping have been used for a data collection in the PANACEA EU-project.

SAFER HUMAN BODY MODEL

Within human body modelling (HBM), SAFER provides a competence platform for our partners as well as a natural contact point for external cooperation. SAFER's HBM vision encompasses a scalable, tuneable, human body model with omni-directional injury prediction capabilities, suitable for use in high-g and low-g events and as any road user, occupant or vulnerable group. This means a virtual human substitute that can be used for predicting injury outcome in any impact situation and direction of loading, able to be morphed to replicate a large proportion of the population, standing or sitting, with humanlike kinematics in crash events as well as pre-crash manoeuvres. The SAFER HBM research combines several projects, all developing the existing model towards the overall goal of performance. The research results are moving towards providing an open-available model globally, to enable wider use of the tool. On page 42 you can read more about the SAFER HBM and its development during 2022.

At Stora Holm, a connected research resource at SAFER, various test tracks and a skid pad are available for tests and events.

AstaZero dry zone, the world's longest indoor test track, was inaugurated in 2021.

Revere (Resource for Vehicle Research) is a research laboratory facility, providing support to projects and related to e.g. autonomous driving, active safety, electromobility and vehicle dynamics.

STORA HOLM –
A CLOSELY LOCATED TEST TRACK

SAFER's partner, the road safety organisation NTF Väst, offers our researchers to use a very closely located traffic training site. Here you can drive on different surfaces such as gravel, asphalt, slippery surface and in hilly terrain. The facility's off-road course is located in a naturally area at the facility. There are also possibilities to practice driving in transverse upward and downward slopes as well as in a water-filled ditch. Also, the test track is very useful as a venue for open air events and demonstration activities.

ASTAZERO REAL-WORLD PROVING GROUND

AstaZero (Active Safety Test Area Zero) is one of the most advance full-scale test environments in the world 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 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 industry, society and academia. AstaZero is from September 2022 owned by RISE Research Institutes of Sweden.

During 2022 AstaZero has continued strengthen its position as the world leading testbed for the automated and connected transportation system. Not only the physical track which is under constant purpose-built evolvement for supporting traditional active safety and assisted driving functional testing. As a complement to this, which making the proving ground unique, is i.e., the perfectly positioned virtual twin together with a controllable 5G network and so is the related research as well.

In December there was a grand opening of the brand new re-designed City Area, now called FLX Zone. FLX Zone is today a more adaptable, as indicated with the name which was difficult with the permanent City Area. Three main areas within FLX Zone are targeted: logistics/logistic centers, parking/parking houses, and city environments, with all the infrastructure to realize optimal testing for such environments. This includes connectivity with canyoning possibilities, charging optimization, docking and un-docking scenario studies as examples.

Continuing with the connectivity, the private 5G network provides a world unique opportunity for experimental testing for requirement settings of components, modules and systems, which is something unique for AstaZero. Therefore, not only traditional automotive and transport providers seek to the proving ground, but also the ones transporting in the air and infrastructure owners as cities, harbors, and logistic centers. AstaZero also runs cyber-security projects together with OEMs and network providers to test resilience. Test bed as a digital twin, enabling researchers and engineers to simulate different scenarios and then also being able to verify the simulation models physically, are also available at the facility. As a step towards robust automated driving the facility now also can offer a method, developed in the SAFER associated project **SEVVOS**, where water spray can be reproduced in a controlled way for i.e., sensor development testing.

AstaZero also run several bigger research projects, not only related to vehicles but also for the complete system enabling automated transportations.

AstaZero is today a leader in the work of defining today's and tomorrow's test methods in various research and customer projects. AstaZero is also an important partner in several global collaborations and participates in working groups, e.g. in EuroNCAP, to develop and define test methods.

REVERE – RESOURCE FOR VEHICLE RESEARCH

The Chalmers Revere laboratory provides a complete research platform for development testing and verification of theoretical models, algorithms and technologies both in real traffic environments and in simulators. 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.

Revere is also active in several research projects about motion and energy control of heavy vehicles. Revere is one of the few academic labs, globally, which can do experiments on full scale long heavy combinations. This is especially important now, since EMS2 (up to around 35 meters) is planned to be introduced in Sweden during 2023, for better transport efficiency in general and reducing CO_2 footprint in particular. Also, electrically propelled trailing units is a novel emerging technology which requires research now and the nearest years.

Furthermore, Revere is project partner in the recently approved, FFI-funded research project **EVIDENT** along with University of Gothenburg, VTI, RISE, AstaZero, Aptiv, CEVT, and Einride. The goal of this research project is to systematically explore in a use-case-driven research setup modeling properties and measurement criteria to better describe and evaluate the fidelity gap between testing in virtual environments such as simulations and testing on a proving ground. Revere joins by providing its years-long technical expertise with sensor platforms as well as providing access to its flexible vehicle platforms powered by the open source software stack OpenDLV that was pioneered at the lab and is finding growing interest in more and more research groups in Sweden, Europe, and across the globe. Another example of an important project in which Revere is contributing with expertise is in the EU- funded project **SUNRISE**, read more on page 39.

As part of phase 3, funded by Västra Götalandsregionen (VGR), Revere has actively invested in maritime research and instrumented platforms, with an expansion of the existing autonomous **Seacat** platform and the new boat platform **Seahorse**. The new platform has been equipped with a state of the art sensor platform and is now used within the Reeds project to collect the world's largest dataset for robot perception research. The activity is followed by a large international community, representing 18 different countries and is expected to seed a large number of follow up and spin-off projects.

In 2023 several PostDocs who will join Revere to continue their research careers as part of the team behind Revere. We are excited to have them joining and to strengthen the overall competence behind our closely connected research resource.

SAFER'S ECOSYSTEM, LOCAL AND GLOBAL COLLABORATIONS

Figure 2: SAFER's Swedish ecosystem

A CORNERSTONE IN THE STRATEGY is to be a multidisciplinary research environment that also serves as a physical meeting place, open to all partners. This also contributes to the development of larger clusters and SAFER is an important part in the open research and innovation ecosystem around sustainable automated transport systems and smart cities. The purpose is to form an extended safety research environment, which connects researchers from academia, industry, institutes, and the public sector and which combines and enhances work carried out within SAFER with research activities financed through other programmes. In SAFER Stage 5 the aim is to take even more advantage of the ecosystem and world around us in order to leverage the efforts put in by the partners, see example of actors in our Swedish ecosystem in figure 2.

ACTIVITIES IN SWEDEN

A national centre for AI was launched in 2019, AI Sweden, which has the task to promote the development and use of artificial intelligence in selected areas, where transport is one. AI Sweden provides resources, knowledge, data and capabilities that will accelerate applied AI research and innovation. The centre is a partner in SAFER's work to utilize AI as a tool in traffic safety research and during the year our connection has been strengthened since SAFER has been leading a focus group on traffic safety, included in the **AI Enhanced Mobility program**, read more about the research we generated via this collaboration on page 46.

The project portfolio within Care and Rescue, a former research area within SAFER, was moved to PICTA, the Prehospital ICT Arena at Lindholmen Science Park, in 2019.

In this context, research can be conducted more efficiently because the arena has access to additional, crucial community actors to achieve results. SAFER's partners still have the opportunity to conduct post-crash research through SAFER, but the project portfolio is hosted in close collaboration with PICTA. This approach has proven to be effective and several projects have started up. As a result of the collaboration with PICTA a knowledge sharing group with members from many different disciplines, meet regularly to map the needs for knowledge in safety linked to accidents with vehicles propelled by alternative fuels. The interest in collaboration has been great and we jointly explore and discuss the needs for rescue service, for example in terms of risk assessments. Future standardization and legislation as well as potential research questions are also being discussed. Furthermore, knowledge sharing on this topic and information about upcoming activities are included in the group's agenda.

Cykelcentrum is a national knowledge centre for research and education about cycling. Cykelcentrum and SAFER intend to jointly contribute to increased cycling safety in Sweden through a closer cooperation. We will do this by, for example, sharing knowledge between us, such as publications and other research results generated within our respective centres. We aim to arrange various knowledge building activities, gather around common research questions to create projects and inspire each other to think more broadly. Another purpose is to support our researchers with access to a wider network of expertise and to find project funding. The two centres also want to encourage financiers and demonstrate the needs of continuously creating relevant knowledge, in-depth research and implement safe solutions for increased cycling.

Another example of a new link in the Swedish ecosystem is K2; Sweden's national centre for research and education on public transport. We see great potential for collaboration in public transport, for example to include and contribute with knowledge in the safety aspect and to clarify and resolve goal conflicts in various solutions for public transport.

In 2022, we have had a specific focus to contribute to the updated strategy of FFI, the governmental vehicle and innovation research programme, which was launched in the spring. Road transport and the automotive industry are changing rapidly. The pace from innovation to societal benefit needs to increase if we are to succeed in switching to a sustainable transport system – it is the planet itself that have set the deadline. Therefore, FFI has updated its research and innovation program to contribute even better to the needs of the automotive industry and the society. FFI is currently SAFER's most important fundings program; about 50% of our project funding comes from FFI. The main changes of the funding programme are to even more

connect the research to Agenda 2030, involve a wider base of actors and more efficient work with road maps; each sub-program now has its own roadmap that will be updated regularly. Also, the projects' opportunity for societal benefits and utilization will be given greater consideration in the evaluation and the program aims to contributing to stronger and more efficient knowledge dissemination.

SAFER's director Magnus Granström is Profile leader for traffic safety within the Area of Advance for Transport at Chalmers which supports a closer collaboration with top researchers at the university, as well as a closer link to education and students. The Area of Advance provides funding for research projects and the possibility to employ post docs within the area, and it is also an important contact between the SAFER partners and the research community within Chalmers, both for knowledge exchange and project creation. During 2022, there have for instance been two postdocs recruited to relevant research topics for the SAFER partnership; Nudging bicyclists towards safer

In December, the SITIS team met in Bangalore to discuss project success and future joint research activities.

and more efficient behaviour using Gothenburg and Curitiba as examples and Evaluating and promoting sustainability of micro-shared mobility systems. Also, four projects in the Traffic Safety profile have received Area of Advance funding in 2022, covering aspects such as ITS systems for safe micromobility, interoperability for safe automated transports, and human-centred assessment algorithms for AD and ADAS.

Drive Sweden is one of Sweden's Strategic Innovation Programs (SIP) financed by Vinnova, addressing opportunities and challenges with the next generation mobility system for people and goods. SAFER's director is a member of Drive Sweden's program committee. This, in turn, contributes to SAFER's project creation and funding, as well as more knowledge building in the development of a sustainable transport system in a broader context. From a SAFER perspective, this collaboration provides both possible funding opportunities, but also an extended network of partners, something that has been very useful in the ongoing AI for traffic safety activities. Some examples of relevant Drive Sweden funded projects are **AI Aware, HEUDRIS** and **AI Enhanced Mobility.**

TRAFFIC SAFETY RESEARCH ACTIVITIES WITH CHINA

CTS (China Sweden Research Centre for Traffic Safety), with the Swedish partners Chalmers, Autoliv, Volvo Cars, Volvo Group and the Swedish National Road and Transport Research Institute (VTI) and the Chinese partners Tongji University, RIOH Institute for Highway Safety, Tsinghua University in Beijing and Geely Automotive Research has due to the pandemic not developed so much in 2022. SAFER constitutes the Swedish research platform in this collaboration. Joint projects are ongoing as well as other activities to enhance road safety in China, for instance though road

mapping workshops and development of joint project proposals. In 2018, a first bilateral call for research projects was launched in both China and Sweden and no less than three SAFER projects were granted funding. A second call was held in 2019, where three projects were approved, all with SAFER partners involved. The continuation of the programme is currently being negotiated, and in 2022, the collaboration platform celebrated its 10 years anniversary but due to the pandemic we plan to communicate the main research highlights and the value of the partnership at a later stage.

PROGRESS IN THE SITIS PARTNERSHIP

SITIS (Sweden-India Transport Innovation and Safety Partnership) was launched in Stockholm in February 2020 on the third global conference on road safety within UN with the vision to leverage the know-how of India and Sweden to accelerate progress and deployment of safe and sustainable transport solutions and actionable policies, contributing to significant progress of Indian transport system.

The first project, **Safe and Secure Transport corridors in India**, within the SITIS platform partnership, is about collecting naturalistic driving data from buses in India. The project entails two long-distance coaches, in regular service, in a connected communication corridor outside Bangalore. The aim is to collect data e.g. about the drivers, the vehicles, the passengers, the infrastructure as well as the surroundings like other vehicles, weather and road conditions. Example of research questions to be address are related to data analysis of the traffic system, weather conditions, driver behaviour, overall logistics, deploying connectivity solutions for critical moments, emergency response systems and the ability to communicate with the infrastructure. In the collaboration, Sweden also shares Vision Zero and how to build a successful structure for implementing traffic safety-enhancing measures at several different levels in society in a strategic and systematic way.

During 2022, the SITIS team met in India, to discuss project success and future projects. Meetings with funding agencies from Sweden and India were also held.

In 2023, more projects are about to start, for example a project about creating a national database for traffic accidents in India. In addition, research activities related to emergency vehicle response to support faster and safer transit from the accident spot to the trauma centre, will be explored. SAFER partners include Autoliv, Volvo Group, Chalmers University of Technology, RISE Research Institutes of Sweden, Swedish National Road and Transport Research Institute (VTI) and the Swedish Transport Administration.

See more examples of actors in SAFER's Ecosystem in appendix 5.

THE EUROPEAN RESEARCH FRAMEWORK – PROJECTS AND POSSIBILITIES

SAFER HAS CONTINUED the long-term efforts to secure the traffic safety content in Horizon Europe. This has been done through active participation in selected organisations, such as ERTRAC (the European Road Transport Advisory Council), EARPA (the association of automotive R&D organisations), EUCAR (European Council for Automotive R&D), ECTRI (The European Conference of Transport Research Institutes) and CLEPA (the European Association of Automotive Suppliers).

During 2022, focus has been on three major efforts: commenting on the final versions of the draft work programme for 2023–24, based on the ERTRAC roadmap from December 2021, supporting the work in the CCAM partnership through active participation by SAFER partners in several workshops as well as initial preparation of proposal planned for submission during 2023.

Another major activity on the European arena during 2022 was the Transport Research Arena conference held in Lisbon in November. Jointly with the European Commission and our eco-system partner ika Aachen, SAFER proposed and was awarded an invited session at the conference, fully focussed on road safety and with the SAFER director as moderator. There were no other sessions planned with a clear road safety focus, therefore it was important to address this. The main topics discussed were:

- Safety in active modes of transportation
- CCAM contribution to Vision Zero
- Safety on rural roads

The outcomes of the session will be used when exploring and defining the mid-term needs for road safety research in a continued dialogue with the European Commission as well as other relevant stakeholders.

As always, it is important to be persistent and have a long-term vision, as well as a good overview of ongoing activities, as the processes leading up to the work programme content stretches over several years. Several position papers, roadmaps, meetings, and workshops are required to make sure that the desired topics are included in the final version. Also, having a platform such as SAFER means that we have a clear advantage in this kind of work, being able to communicate easily and also share the workload in an efficient way.

Another important result during 2022 was the kick-offs of several projects approved in the 2021 calls, where at least two of these, **ROADVIEW** and **AfroSAFE** originated from project creation workshops arranged by SAFER.

FINANCIAL REPORTING

SAFER HAS TWO main types of financing, one being SAFER Core which is the base for the core activities as well as the SAFER Pre-study program 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 through funding from Västra Götalandsregionen and partners' cash contributions according to the overall partner agreement for the fifth stage of SAFER. The framework agreement stipulates an annual contribution of:

LEVEL 1: A total contribution to SAFER Core amounting to 1 MSEK per year, 650 kSEK in cash for industrial and public partners and 125 kSEK for other universities and research institutes. The remaining amount is provided through in-kind contributions. Chalmers, as the host of the centre, has a commitment of 1 MSEK in cash and 450 hours in-kind.
LEVEL 2: Contribution to SAFER Core funding in an amount of minimum SEK 125 KSEK in cash contribution per year for industrial partners and public partners. Other universities and institute partners contribute with 75 KSEK/year.
LEVEL 3: The cash contribution is 10 KSEK/year.

The contribution from Västra Götalandsregionen (VGR) is 2,5 MSEK per year. The total funding sums up to about 40,5 MSEK cash and minimum 25 000 in-kind hours for the entire stage five (April 1, 2019 to December 31, 2023). Partners on level 1 contributes with 450–950 hours per year in-kind to SAFER Core, depending on type of partner. The roles/ functions that the in-kind hours are used for are e.g. Research area directors, Competence network leaders and other management group members.

The result for the SAFER Core finances for the fourth operational year in SAFER Stage 5 is shown in figure 3. The year's result is positive compared to the budget, which was planned to end up close to zero. Three new partners have joined SAFER during the year, and this increased the revenues, whereas we have also seen some delays in payments.

The costs for the fourth year were in total lower than budget, primarily because of lower personnel costs, mostly thanks to other external project initiatives involving the SAFER secretariat. Also, running costs for the office are lower because planned premises improvements have been moved to year five. The costs for premises are somewhat higher than budget due to a new contract and slightly increase

housing tax. In addition, IT costs for our databases have increased this year, but will be lower next year.

The overall financial plan for Stage 5 holds, aiming at a balanced or somewhat positive result at the end of the stage.

The cash resources for SAFER are governed by the Board, who has continuously monitored the budget and decided on changes in expenditure when required.

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, Trafikverket and Energimyndigheten. Also, Skyltfonden, Drive Sweden and others are providing project funding from a national perspective.

The other important project funding source is through EU's Horizon 2020 programme and now of course the Horizon Europe programme that started in 2021. In addition to this, internal funding from all partners play an important role, whether it's academic, institute or industry partners.

The overall budget for the projects in SAFER's fourth year of Stage 5 sums up to 1 848 MSEK for all project partners and 558 MSEK for Swedish partners. That clearly shows the benefit for the partners to join in the SAFER projects that generally have a high hit rate in the competitive pro-grammes. Also, the leveraging factor of collaboration projects is clear, especially when accessing the knowledge and financing power on the European arena.

Figure 3
The expenses and income of SAFER in 2022

EXPENSES (KSEK)

Personnel	5 221
Premises	992
Running costs office	133
IT costs	114
Knowledge sharing and communication activities	488
Other costs, e.g. travel etc	480
SAFER Partner cash contribution prestudy program and strategic tasks	756
SUM	**8 184**

INCOME (KSEK)

SAFER Partner cash contribution	5 067
Partner cash contribution to SAFER's pre-study program	800
Funding from Region Västra Götaland	2 394
Other income	161
SUM	**8 422**

RESULT	**238**

THE
RESEARCH

In SAFER Stage 5, we focus our research primarily in four areas, representing world-class, multidisciplinary research – all with the single-minded vision to save lives, prevent injuries and enable safe mobility. Our research areas also create an open arena where our partners meet and identify key issues to initiate new research, based on real-world needs.

· Road user behaviour
· Systems for accident prevention and automated driving
· Safety performance evaluation
· Human body protection

In addition to these four areas one part of our project portfolio includes cross functional activities and projects and one part, the Post-crash area, is hosted jointly with PICTA Prehospital Innovation arena..

RESEARCH SCOPE
SAFER'S RESEARCH includes road traffic, for example, pedestrians, cyclists, various vehicles and goods services. However, rail traffic is not included in our scope of work. We cover a "complete-travel-perspective", from door to door, in which a human is interacting with a vehicle in the road traffic environment. For example, our research does not generally include single pedestrian accidents. However, there is no obstacle if there are a number of partners who want to start a project that is beyond the scope of the above.

THE SAFER PRE-STUDY PROGRAM
SAFER's pre-study program successfully started in October 2019 and have been developed further during the last three years. New research areas have been explored, collaboration partners found, workshops organized, competences acquired, knowledge distributed, reports written, and funding for larger projects secured, making SAFER's pre-study program a success story with well spent efforts.

In 2022 11 out of 15 submitted proposal have been granted. One was withdrawn and ten pre-studies were initiated. Five have already been successfully finalized and five will end during 2023. In 2023 the program will continue with three calls providing at least 600 KSEK to grant 6-8 new pre-studies that will help to lead SAFER forward and contribute to the constant development of our collaboration platform.

OPEN DATA FOR BICYCLE CLASSIFICATION FOR BETTER PLANNING AND SIMULATION, AND FOR BETTER DETECTION FROM MOTORIZED VEHICLES (OPENBIKE-CD)

PARTNERS: VTI, VISCANDO, FOLKSAM, SCANIA, STATENS VEGVESEN, VÄTTERNRUNDAN, TRAFIKIA

Virtual reality (VR) is a hot topic at many institutions and companies, but there seems to be no real consistency in using it in research. The newly established Virtual Reality Hub on Traffic Safety at Lund University will change that. The connected pre-study started to investigate how a VR environment can be used to study interactions between connected and automated vehicles (CAVs) and vulnerable road users (VRUs). Relevant research questions have been worked out to explore how different infrastructure designs and vehicle behavior affect the safety perception of VRUs. In a workshop previous experiences with CAVs and VR were discussed, collaboration partner approached, and relevant project ideas collected, resulting in an approved FFI-project.

TRUSTWORTHY AI FROM A TRAFFIC SAFETY PERSPECTIVE

PARTNERS: ZENSEACT, VOLVO CARS, MALMEKEN, REVERE, BLACKBIRD LAW

To create trustworthy AI, it is imperative to ensure that the AI is not only technically safe and robust but also that it is ethically and legally compliant. In this pre-study we aimed to identify which data will be collected by autonomous vehicles, which must be handled appropriately and which stakeholders to involve addressing the legal and ethical risks and opportunities in data handling. If data handled correctly the results will create opportunities for SAFER and its partners to use AI in automated solutions which support fulfilling the UN Sustainable Development Goals and Vision Zero.

HOW WE ROLL

PARTNERS: VTI, IF, TRIVECTOR

In this pre-study an innovative approach has been taken to build a realistic bicycle simulator which make it possible to steer freely on a simulated road/cycle path by using the principle of a bicycle roller and extending it to the width of a cycle path, at least 200 cm. In combination with virtual reality (VR) it can be used for planning of bicycle infrastructure, testing dangerous situations, studying cyclists' movements in relation to other cyclists and pedestrians, etc. Without VR it can be used to study aerodynamic effects of other vehicles on different types of cyclists in a safe and realistic way, for example on test tracks.

GENERATING SYNTHETIC SCENARIOS TO TEST AN AI-ENABLED TRAFFIC MEASUREMENT SYSTEM

PARTNERS: RISE, LUND UNIVERSITY, VISCANDO

Building on initial work on simulation-based testing, this pre-study intent to pave the way for evolutionary algorithms to generate test scenarios in CARLA that stress OTUS3D to its limits. OTUS3D is Viscando's infrastructure sensor which is used for collection of accurate traffic movement data. In this pre-study a digital model of an intersection in Lindholmen was developed and published under an open-source software license. The model is available in two formats to allow importing into MathWorks RoadRunner and the open-source simulator CARLA. A set of trajectories for road agents is also provided. All source code and the digital model of the Lindholmen intersection is publicly available on GitHub: https://github.com/EliasSjoberg/rise-viscando-thesis.

DRIVER INTERACTION WITH AUTOMATED VEHICLES IN REAL MOTORWAY TRAFFIC

PARTNERS: VOLVO CARS, CHALMERS

This pre-study aimed to finalize a previous analysis and write the corresponding paper for publication. The publication with the title "Driver interaction with automated vehicles in real traffic" was submitted to the International Conference of Traffic and Transport Psychology. The extended results were presented at the conference in August 2022. The data collected in the L3Pilot EU project are the enabler for making automated driving safe. Publishing and presenting the methodologies and the results from the project at a scientific conference is a strategic competence that will help SAFER partners to continue to be leading actors within one of its core areas.

THINK TANK TRAFFIC SAFETY FOOTPRINT

PARTNERS: VOLVO GROUP, AUTOLIV, FOLKSAM, SWEDISH TRANSPORT ADMINISTRATION, VTI

The Think Tank members have started to identify relevant research questions and share knowledge on how to address the challenges connected to using traffic safety footprints as a tool to improve traffic safety. The Think Tank aims to define a framework to approach and identify organisations' traffic safety footprint. Organisations are responsible for many transports produced by own employee, or contracted, as a direct result of their activities. Those transports are directly impacting employees, but also third party, i.e., traffic road users, who might be involved in road traffic accidents. This creates a clear need for measurements, traceability, and follow-up, which has an impact on physical environment, vehicles and procurement among others. The pre-study has started to collect challenges of this kind with the aim to address them in future projects.

DRIVER INTERACTION WITH SAFETY SCALES AND SCORING SYSTEMS BASED ON DIFFERENT USE CASE SCENARIOS (DISC)

PARTNERS: UNIVERSITY OF SKÖVDE, AUTOLIV, SMART EYE, VISCANDO

This pre-study will create a basis for a traffic safety information to be used in interaction with drivers in different use case traffic situations. The central question is the potential role that safety information (safety score) can have in interaction with car drivers. Safety information will include data from external and driver data to be trustfully relevant for human drivers and autonomous vehicles. The pre-study will create a scientific survey of the basis for traffic safety information and scores and possible different reactions from different drivers based on gender and possibly age and culture.

SAFE MICROMOBILITY

PARTNERS: CHALMERS, AUTOLIV, FOLKSAM, SWEDISH TRANSPORT ADMINISTRATION, CITY OF GOTHENBURG, NTF

June 11–26, 2023, Marco Dozza, professor at Chalmers, will go by bike from Sweden to Italy, collecting data and giving presentations on traffic safety research. He will reach for society and several stakeholders to show how research results may help create consensus and improve safety. Every presentation will be different because it will include footage and data from the most critical events of the latest stages of the trip. You can follow Marco on his tour on his Instagram channel: https://www.instagram.com/marco-chalmers/ and on Micromobility Safety (microsafety.eu).

SYNCOPE – UNRESPONSIVE DRIVER & SUDDEN ILLNESS DETECTION

PARTNERS: CHALMERS, VTI, AUTOLIV, VOLVO CARS, SWEDISH TRANSPORT ADMINISTATION, VGR/SU

Sudden illness in drivers is a common cause of fatal crashes and accounts for about 10% of the fatal crashes in Sweden. The pre-study intent to fill the knowledge gap regarding in-vehicle sudden illness detection by gathering people with background in traffic safety, biomedical engineering, medical science and transportation authority in a collaborative project. As a first step, a background review for in-vehicle illness and medical condition detection has been performed. The results will create knowledge for guiding future research and development as well as policy making.

DIGITAL TWINS FOR ACCESSIBLE REAL TESTING GROUNDS FOR AUTOMOTIVE ENGINEERS AND RESEARCHERS (DARTER)

PARTNERS: UNIVERSITY OF GOTHENBURG, ASTAZERO, COMPUTER VISION CENTER

The goal of this pre-study is to create a validation and verification (V&V) strategy that is more effective and efficient in the early stages of AD development. The objective is to close the gap between virtual environments and testing sites in the real world. A comprehensive and seamless V&V strategy for early AD development is one of the anticipated outcomes of this pre-study. Additionally, the foundation (technologies, methodology, partners) for the development of a comprehensive, open, and reusable tool for academic researchers will be laid. To achieve this goal, the pre-study will focus on the integration of virtual assets and physical test sites, e.g. AstaZero, using tools such as digital twins and simulation environments, for example CARLA.

PROJECT PORTFOLIO

THE PROJECT PORTFOLIO is the base for the SAFER collaboration, comprising of different types of projects, but all focusing on one or more of the issues addressed in our joint strategic research agenda. The project portfolio is created, maintained and developed through the joint efforts in the Research areas and among the partners. Throughout 2022 the focus has been to boost the SAFER pre-study program and to secure a solid foundation of projects and related activities through 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 four Research areas. Projects that cover multiple Research areas or focus on general questions are called Cross functional activities and projects. The distribution of projects between the Research areas is illustrated in figure 4. The primary forum for initiating and discussing projects at SAFER is the Research areas, 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 questions and conferences as well as seminars and international collaborations and calls. Each Research area include representatives from level 1 and 2 SAFER partners and are the base for establishing world class competitive project portfolios. Each Research area hosts a mix of projects; pre-studies for future projects,

small and large national and international projects. 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 into 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 successfully performed pre-study, financed by SAFER.

Since interdisciplinary collaborative research is a key to excellence and successful dissemination, we encourage projects to involve at least two partners, preferably from different stakeholders. Some projects, however, have only one part for natural reasons, e.g. PhD students' projects and special investigations and assignments. The majority of the projects involve 2-4 SAFER partners and some 23% involve 5 or more, see figure 5.

During operational year 17, 10 SAFER funded pre-studies, one SAFER funded strategic task and 21 projects with external funding have been added to the project portfolio adding up to a total of 86 projects that have been ongoing during the year. 72 of them belong to one of the four research areas whereas 14 projects were cross functional activities and projects (complete list in appendix 6). 36 projects have been successfully finalized during the year and SAFER will enter its 18th operational year with 52 ongoing projects.

Figure 4
Ongoing projects during stage 5, year 4. The distribution of projects between the research areas.
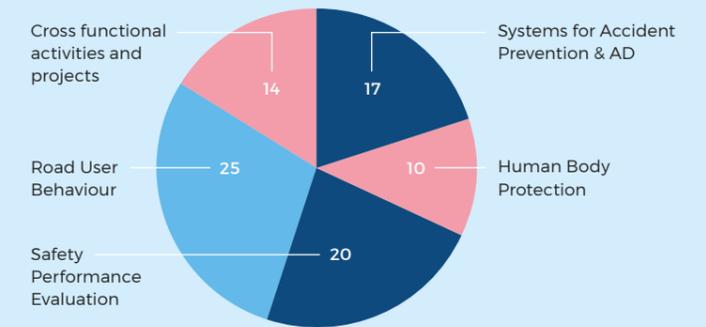

Figure 5
The number of partners in SAFER's projects.

Figure 6
Number of projects in SAFER's project portfolio. Cross functional activities and projects are not included in the diagram.

RESULTS FROM THE RESEARCH AREAS

ROAD USER BEHAVIOUR

HOW DO PEOPLE BEHAVE IN TRAFFIC and how can they be stimulated to a safe behaviour? In an era where traffic complexity is increasing as quickly as the technology is evolving, answering this question becomes vital. Taking a broad multidisciplinary approach, the research area Road User Behavior at SAFER focuses on developing scientific methods and attractive solutions that facilitate safe behavior in traffic. It covers a variety of topics, from understanding pedestrian behavior to developing algorithms that enable assessment of vehicle occupant behaviours, as well as exploring safety implications of new mobility means such as electric scooters.

RESULTS FROM OUR PROJECTS

Several projects within the Road User Behaviour area have during the past year delivered impressive results that are in line with the objectives of this area. Two projects, **GLAD** and **Enhanced ADAS** are highlighted below. Interactions between automated vehicles and other road users in their vicinity is a topic of great interest right now and several projects have delivered results in 2022. This area of research includes remote operation of vehicles, interactions between automated vehicles and people outside the vehicle as well as interactions between the driver and vehicle. Several projects have focused on interactions with heavy vehicles. The **EHMI** project investigated external interaction principles and external indicators help build trust and acceptance for heavy autonomous vehicles on public roads. It addressed interactions between heavy automated vehicles, both buses and trucks, and other road users including pedestrians, cyclists and car drivers. One insight from the study is that both implicit communication, such as driving style and movement patterns, and explicit communication, for example light signals, are important in the interactions with automated vehicles.

Remote operations of heavy vehicles and interaction with autonomous vehicles in transport hubs have been studied in the **HAVOC** and **In the Hub** projects. The purpose of the HAVOC project was to study operator work and HMI for remote monitoring and control of heavy autonomous vehicles. One of the major takeaways from the project is the importance of a system perspective in the analysis and design of future remote operation centres. The ability to deal with the dependencies between factors such as operators' skills and knowledge, operator tasks and training, HMI, vehicle capabilities, operational context,

etc., lies in defining the envisioned work system and deciding what to design for. In the Hub has investigated how to incorporate emerging interaction technologies into autonomous transport systems to facilitate efficient and engaging experiences in hubs, such as logistics centers and mine sites. The research has shown that natural interaction technologies, such as voice and gesture interaction, has great potential to improve user experience during such interactions. Furthermore, the **Re-engage** project focuses on the in-vehicle interactions by investigating how to create safe transition strategies in future partially automated vehicles by studies on re-engagement in manual driving after being engaged in another activity.

STRONG PROJECT PORTFOLIO

The Road User Behaviour project portfolio continues to host a wide variety of projects. In 2022, the portfolio has been enriched through the association of six new projects and financing of four new SAFER pre-studies. The newly associated projects connect to several of the research area's stage five objectives. The aims of all new studies are listed here:

1. **THE WORK ON SAFETY CULTURE AND AUTOMATION** has continued through the association of the **SCAV** project that aims to explore existing practice and knowledge of safety culture, and to identify methods to support safe introduction of automation.

2. **ADVANCED VIRTUAL DEVELOPMENT METHODS** for evaluating Communication of Automated Vehicles and Vulnerable Road Users **(AdvICE)** is an FFI pre-study that uses Virtual Reality to study multi-modal communication between automated trucks and cyclists.

3. **ENHANCED ADAS II** is a continuation of an associated project ending in 2022 and it intends to further improve both functionality and usability of ADAS through opportunities for improvements provided by driver and cabin monitoring.

4. **SAFE CAR DRIVING WITH HEAD UP DISPLAYS AND CAMERA MONITOR SYSTEMS (SCREENS)** aims to understand how new technology in cars for giving visual information can enhance safety and visibility. The project will investigate how to make Head-Up Displays (HUD) and Camera Monitor Systems (CMS) technologies adapted to the human senses.

In the Skara Guardian Angel project the researchers are looking into if drones can be used to increase road safety by lighting bicycle paths.

5. **SKARA GUARDIAN ANGEL** is a continuation of the SAFER pre-study **Drone lighting**, and it aims at developing innovative and economically viable solutions with drones for both lighting bicycle roads as well as providing companion support to improve the cycling safety and comfort in rural areas.

6. **MICROMOBILITY AND SAFETY OF NEW MOBILITY SOLUTIONS** is an area of increasing research activity. The newly associated project **DREEM** is a Horizon 2020 project that aims at finalising and testing a safer and modular e-kickscooter for personal urban and suburban mobility. In 2023, a pre-study focusing on safe micromobility will also start.

The Road user behaviour area has been successful in starting new collaborations between partners through the SAFER pre-study program. Four SAFER pre-studies were completed in 2022. **Embodied cognition** explored new research avenues of Embodied Cognition to identify new design solutions for current design of human-machine interaction challenges in the design of semi-automated vehicles. In the **Drone lighting project**, it was investigated whether drones equipped with lighting capability could be a be a viable replacement for light poles in rural areas with long cycling distances and a low frequency of cyclists. The **Openbike-CD** project increase the knowledge about bicycle flow and the needs of different stakeholders when it comes to bicycling data. Finally, **How we roll** developed a new type of bicycle simulator, combining VR with a wide bicycle roller to improve the riding experience.

COMPETENCE NETWORK HUMAN BEHAVIOUR

The competence network focusing on Human Behaviour is led by Dr. Giulio Bianchi Piccinini, Chalmers. Combining knowledge from different disciplines, this competence network aspires to be a forum to discuss methodologies and challenges for the research on human behavior, with the final aim to improve the safety of the road transportation system. During 2022, the network has conducted two seminars: "Safety and ease-of-use assessment of new electric vehicles for personal mobility in urban environment" on 25th of February and "Towards the Development of a Fleet Concept of Operations for Managing Automated Driving System-Equipped Trucks in a Mixed Fleet" on 27th of April.

OUTLOOK FOR 2023

In 2023, the Road User Behaviour group will continue to work on the current research objectives for this area of research. This research includes the development of safer vehicles on our roads, research on the safety of new mobility solutions and on traffic safety in relation to health and sustainability. The introduction of automated vehicles on public roads and increasing number of automated functions in vehicles implies new types of interactions between vehicles and road users. The driver role is also changing as automation turns vehicle operation into more of a monitoring task than a driving task. Therefore, we see an increased need of research on interactions between automated vehicles and humans in the coming years. We will also continue to encourage research focusing on the shift towards more active means of travel and how such modal shifts will impact traffic safety. In addition, the group has started to identify the main research challenges for SAFER stage 6 and this strategic work will be finalized in the spring of 2023.

KEY HIGHLIGHTS FROM PROJECTS

ENHANCED ADAS

The aim of this Vinnova/FFI project has been to explore how safety, efficiency and drivers' experience, acceptance and trust in Advanced Driver Assistance Systems (ADAS) can be enhanced by enriching the situation awareness of existing ADAS with real-time information on driver behavior and maps, and by incorporating dynamic driver-vehicle interaction strategies. The results include for example novel knowledge on how driver-vehicle interactions need to be designed, and knowledge about understanding of how threat assessment can be enhanced by extending situation awareness in terms of real-time driver behavior and maps. By utilizing human-centric methodologies, the SAFER researchers have specified drivers' support needs in selected use cases and integrate existing systems for environmental sensing, vehicle behavior, driver monitoring and maps into proof-of-concept ADAS-prototypes with novel threat assessment and dynamic driver-vehicle interaction strategies. These have been evaluated with drivers on public road and/or test track using evaluation methodologies specified in the project. Finally quantified effects of enhanced ADAS in terms of safety, efficiency and drivers' experience, acceptance and trust have been evaluated. The SAFER partners RISE, Aptiv and Smart Eye have been working in the project that was finalized in October 2022.

In the GLAD project we have got valuable insights in communication between an autonomous vehicle and other road users.

GLAD

Goods deliveries under the last mile with automated delivery vehicles is a recently completed project that was partially financed by the Swedish Transport Administration and carried out by RISE, Clean Motion, Combitech and Aptiv. The project explored how so-called Autonomous Delivery Vehicles (ADV) can be used and what challenges need to be addressed in implementing such vehicles for last mile deliveries. It also examined interactions between ADVs and other road users, and operators interacting with ADVs in the terminal environment. Several of the studies were carried out using ADV prototypes developed during the project. Prototypes with self-driving capabilities had an Autonomous Transport Management System (ATMS) placed in a cloud service with remote control capabilities. The results from the studies on interactions between humans and ADVs showed, among other things, that the vehicle's driving behavior had a role in conveying the vehicle's behavior and intention to leave/not leave the right of way, and that light signals on the vehicle (e-HMI) can contribute to an easier understanding of the vehicle's behavior. A study conducted in a simulated terminal environment also showed that the context, i.e. the terminal scenario, the situations and the tasks were important for the participants to understand the meaning of the vehicle's eHMI. Seven reports have been published and a final report will be published in January 2023.

RESEARCH OBJECTIVES

- **STUDY** road user behaviour in their door to door travels.

- **MONITOR** driver and passenger state and position.

- **DIAGNOSE** driver fitness based on monitoring data.

- **ENSURE** safe interactions between automated vehicles and other road users.

- **DEVELOP** and evaluate novel interaction principles, including nudging.

- **DEFINE** and measure user experience indicators related to safety.

SYSTEMS FOR ACCIDENT PREVENTION AND AUTOMATED DRIVING

AUTOMATED DRIVING has been a topic for intense research for over a decade and the challenges for placing self-driving vehicles on public roads come and go whereas some challenges remain. Robotaxi services in the US are struggling with topics not anticipated during development such as customers are falling asleep during the trip and the car cannot wake the person up when arriving at destination. One major topic still being subject to much research is the overall safety – when is a self-driving vehicle safe enough to be operated on public roads without human intervention in for example higher speeds. Passenger cars took up the challenge of introducing self-driving cars from the beginning with the aim of taking the passengers from door-to-door but there has been a major shift towards addressing the driver shortage for heavy duty vehicles. You can say that the trucks have overtaken the cars on this topic. The passenger car industry is revisiting the SAE level 3 autonomy addressing pain points for drivers such as automated valet parking and driving support at lower speed in dense traffic at highways, whereas the truck industry is investigating the possibility for hub-to-hub operation without human intervention according to SAE level 4. Automated valet parking is an SAE level 4 functionality however it can be categorized as a confined area application since the environment can be controlled, e.g., no playing children in the parking garage.

Traditional advanced driver assistance system (ADAS) benefit immensely from all research conducted in the realm of automated driving. During the last years, several projects have been initiated looking into making sensors such as radars and cameras more robust in bad weather situation. This is research leading to an overall better traffic safety in heavy rain and snowfall for Sweden and other parts of the world experiencing four distinct seasons. There is a trend to also include wireless connectivity as a sensor for increasing traffic safety known as connected safety. Connectivity provides information that cannot be retrieved from any of the other onboard sensors such as intention, and it complements the line-of-sight sensors (i.e., radar, camera, and LIDAR) because it can "see" beyond physical barriers, and it is not affected by poor weather conditions. Sharing data directly between vehicles and between vehicles and smart road infrastructure (V2X communication) and via cloud communications, adds mouth and ears to the vehicle. Connected safety has its own challenges such as penetration rate of equipment but even at low rates depending on applications benefits are identified. Sharing data among multiple stakeholders with different origins also pose some new challenges such data integrity and data readiness level.

During the past year, the ongoing work on how to evaluate risks in autonomous mode has continued tirelessly in the competence network Automotive safety assurance led by Dr. Fredrik Sandblom. It is still not clear what the best practices in designing and proving safe automated driving will be, and, some may say, it is even less clear how safe automated driving will be proven. The underlying challenge is that the consequence of accidents involving automated vehicles need to be so low that proving these levels by means of driving long enough to count the outcomes becomes infeasible. In this competence network, we attempt to clarify how safe automated driving can be achieved and proven by means of pre-competitive discussions on terms and methods, by sharing research and other advances such as standards, inviting experts in related areas, and more. The network leader, Fredrik Sandblom, is one of the Swedish experts contributing to the creation of *ISO TS5083 – Road Vehicles – Safety for automated driving systems – design verification and validation* and the network is effectively also a reference group to Fredrik in this standardization work. The network is very vital in that it comprises both of members who have been there since the start and newer members, and the participants have expressed their appreciation in that the climate is welcoming, informal, yet the joint competence in the room is remarkable.

During the year, there has been several exciting and esteemed presentations given by invited speakers to the SAFER community. One of the invitee was Dr. Hans-Peter Schöner talking about *Tactical Safety* and this can be best described as avoiding potentially dangerous situations by changing behavior as early as possible by using trusted indicators raising warning flags in due time. The experienced human driver is exceptional in anticipating possible risks down the line given the current situation. Self-driving vehicles are struggling with early risk reduction given the poor information horizon for possible dangerous events further into the future given the current status. Hans-Peter's presentation provided an excellent overview on tactical safety and how to increase the information horizon for self-driving vehicles by introducing connectivity as a sensor complementing the onboard line-of-sight sensors.

The reference group rushes into a new year with many exciting projects, presentations, and discussions on the horizon. Stage 6 of SAFER is around the corner providing great opportunities for adjusting research goals propelling towards the vision zero, in addition revisiting the way of working to further strengthening the great cooperation among partners. We hope that you want to follow and contribute to this exciting research field more important than ever.

KEY HIGHLIGHTS FROM PROJECTS

SEVVOS AND AI-SEE

SEVVOS (Simulering och Emulering av Vattenspray för Validering av Optiska Sensorer) is an FFI funded project addressing simulation and emulation of water spray for validation of optical sensors. The project is led by AstaZero and participants are Chalmers, RISE, and Veoneer. The project is associated to a greater European research collaboration project called **AI-SEE** where also AstaZero is participating. The overall goal of these initiatives is to extend the operational design domain (ODD) for automated vehicles to also cope with adverse weather and bad lightning conditions. **SEVVOS** will collect data using the AI-SEE sensor setup and develop a deeper understanding for the creation of aerosols in different traffic conditions considering vehicle parameters, weather, driving environment, and traffic situations. The data will be the basis for developing a test method for repeatable dynamic spray tests and it will be used as input to validate computational models. The outcome of the project will be a spray rig at AstaZero, which can be used for testing of sensors in a repeatable manner with the same characteristics as real spray found when driving in rain. AI-SEE will develop and test state-of-the-art sensors for adverse weather conditions and it will apply artificial intelligence for the perception-processing scheme for low visibility conditions. The projects are ending during 2024.

EVIDENT

EVIDENT – Enabling VIrtual valiDation and vErificatioN for ADAS and AD features – is investigating the possibility of enabling virtual validation and verification of ADAS and AD features to reduce cost and time for testing. Funded by FFI and led by AstaZero consisting of 9 partners in total. The challenge with virtual testing though is to identify necessary edge cases and feed enough tricky situations into the virtual verification and validation process. The needs for testing are increasing given the enlargement of the ODDs and the increase in software complexity. There is a trend in investigating the possibilities to use virtual testing as a complement to real-world testing. UNECE is investigating this through the initiative new assessment and test method for automated driving (NATM) and EuroNCAP is on the same path looking into virtual testing as part of the assessment towards 2025. This project is timely and boosts the area of virtual testing of AD and ADAS features. The project ends in 2024.

ROADVIEW

Halmstad university leads the European research project **ROADVIEW** addressing robust automated driving in extreme weather. The project consists of a mixture between

The Horizon Europe project ROADVIEW will develop a unique approach to automated mobility, so that autonomous vehicles can have more powerful and reliable onboard perception and control technologies addressing complex environmental conditions.

vehicle manufacturers, automotive suppliers, research institutes, and universities, in total 16 partners spread over Europe. ROADVIEW is not only considering the line-of-sight sensors such as radars, cameras and lidars but include collaborative perception to increase robustness using wireless communications (V2X communication). Early noise filtering improving detection of objects and vulnerable road users, digital twins of real-world environments, and generate realistic synthetic sensor data are amongst other things the project is addressing. The project will run until 2025.

RESEARCH TARGETS

- **We can evaluate different ways to act** in the traffic situation and decide upon how to progress safe and efficiently.

- **We have developed a methodology** to verify and validate assisted and automated systems in cooperation with international researchers in this area.

- **We have developed prediction models** for human cognition and behaviour in the areas of "driver engagement", transitions between manual and automatic driving, and interaction between human and ADAS features.

- **We have obtained knowledge essential** for development of new perception components that enable high-performance, reliable information about the vehicle environment and the driver/riders in the vehicle.

SAFETY PERFORMANCE EVALUATION

THIS RESEARCH AREA is essential 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. 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, recording and sharing of data, are 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. The datasets available cover about 6.5 million km of real-world driving in different contexts, countries and vehicle types. The 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 analysis and SAFER has become a data node for in-depth naturalistic driving data. The main current ongoing projects are described in the following part of this chapter.

WELL POSITIONED FOR THE FUTURE

The introduction of advanced driver assistance systems 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. For example, during the past year, projects within a strategic collaboration with India have continued to develop positively. Within the framework of this platform, data collection is ongoing, giving valuable information about the traffic environment back to the researchers, read more on page 22. Also, a major upgrade of SAFER's data bases is ongoing, with the goal to enable us to use the databases to a much higher degree than today, for example to validate safety systems in future vehicles that keeps track of the driver's attention and drowsiness.

The reference group's engagement has been great during the year and the group is developing; focus has, among other things, been directed towards exploring how large amounts of data could be used in real time to increase traffic safety. Several inspiring workshops have been carried out with the aim of exchanging knowledge and shaping new projects to address the common challenges. In one workshop, the experts discussed the pros and cons of using traffic simulations for safety benefit assessment of autonomous driving systems and in another the dialogue was deepened around differences and similarities between safety performance indicators for humans and automated driving systems. The latter generated several new project ideas, including a SAFER pre-study, **Driver interaction with Safety Scales and Scoring Systems based on different use case scenarios (DISC)**, which you can read more about on page 29.

Algorithms and technology for efficient real-time traffic data collection are other interesting areas of research, as well as how we can best link our research to the global sustainable development goals. ITS and connectivity means new security challenges; in this area we need more knowledge and new competence. The important question "How safe is good enough?" is of course also an important research question that goes across the entire research platform. Other new research questions to address are safety in big number, Swedish micro-cultural differences and definition of the concept of road safety. 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.

KEY HIGHLIGHTS FROM PROJECTS

FAME

The EU Horizon Europe funded project **Framework for coordination of Automated Mobility in Europe (FAME)** aims to establish a European framework for testing on public roads, enable evaluations with common methodology, engage an active community of stakeholders across the complex cross-sectoral value chain, and capitalize on shared knowledge, to improve cooperation, consensus building and data sharing for CCAM testing and large-scale demonstration activities in Europe.

The development of the FESTA handbook starting in 2007 was the starting point for a systematic approach for testing vehicle functions on public roads in Europe, then followed by the Data Sharing Framework. FAME continues this work by including components of legal and ethical approvals, a common evaluation methodology to ensure comparable high level analysis results, and a data exchange platform. All these components as part of one framework will have a positive effect on the rapid development of CCAM in Europe.

Data from tests on public road will become ever more important for development, validation, and analysis of the effects of CCAM applications. The standard for federated data sharing is something EU commits to and invests heavily in and by using the CCAM test data space early on in the development, future applications will be easier to adapt to data spaces for production purpose. Volvo Technology and

Chalmers are partners in the consortia. Volvo is mainly contributing to the Common Evaluation Methodology whereas Chalmers are work package lead for WP5: "Test and Data Exchange Framework for CCAM", focusing on the implementation of a European federated data exchange platform.

SUNRISE

The project **Safety assUraNce fRamework for connected, automated mobIlity SystEms (SUNRISE)** is also funded by EU Horizon Europe and aims to pave the way for safe large-scale deployment of automated vehicles on European public roads. The scope is to define, implement and demonstrate the building blocks of safety assurance technologies and systems. It also aims at defining a harmonised approach to enable the massive deployment of highly automated vehicles.

SUNRISE will define, implement and demonstrate the building blocks of this safety assurance framework through harmonised and scalable safety assessment methodologies, procedures and metrics. The project consortium will work on tailored use cases, a federated European scenario database framework and its necessary data interfaces, and a commonly agreed simulation framework, including tools and interfaces. SUNRISE will work closely with CCAM stakeholders such as policymakers, regulators, consumer testing and user associations.

The traffic environment in India is different from other parts of the world, e.g. when it comes to culture, infrastructure and vehicles. Thanks to the ongoing data collection through our joint partnership SITIS, these aspects are included in our traffic safety work.

SUNRISE will further develop on the work carried out and methodologies initiated in the **HEADSTART** project, a previous EU-funded SAFER project.

SAFE AND SECURE TRANSPORT CORRIDORS IN INDIA

The aim of this Vinnova/FFI funded project is to gather an in-depth understanding of road user behavior in the context of intercity bus transport in India, and to identify what solutions might be needed to improve safety, security and efficiency. This will be done by collecting and analyzing various data related to behavior of different road users (e.g., coach drivers, passengers, pedestrians) as well as security (e.g., cyber-security, robberies, theft, vandalism, assault) and efficiency (e.g., traffic flow, incident handling, fleet maintenance, rescue time). This project is a part of the SITIS partnership (Sweden-India Transport Innovation and Safety Partnership).

HI-DRIVE

The Horizon 2020 project **Hi-Drive** was started during 2021 and secures funding for SAFER's FOT databases for several years to come. Hi-drive builds on the recently finished project L3Pilot, one of our largest projects, engaging several SAFER-partners. Hi-Drive will test and demonstrate high automation driving by taking intelligent vehicles technology to conditions neither extensively tested nor demonstrated earlier in European and overseas traffic. The project concept builds on an extended and continuous ODD (Operational Driving Doman) making it possible to operate vehicles longer periods and stay interoperable across borders and brands.

FOT-E

Other challenges that will be in focus for the years to come is to further investigate how the FOT databases can be of even better value for more SAFER partners. How to relate to open sources and other data sharing initiatives are other examples.

ICV-SAFE

ICV-SAFE is a Sweden–China bilateral project with focus on investigating the safety aspects of intelligent connected vehicles (ICV) in mixed traffic environments. The project aims at taking advantage of the rapid development environment in China for ICV risk analysis, mitigation, as well as testing and validation. The ultimate goal is to develop safety assessment methods that take account of risk factors from both ICVs and road environment and contribute to accelerated deployment of ICV. With the test site as a partner and rapid infrastructure introduction, the project will also improve the understanding of infrastructure support for ICV.

FOLLOW-UP OF ROAD SAFETY REQUIREMENTS WHEN PROCURING FREIGHT TRANSPORT

The project aims to improve safety on the roads by creating a methodology for following up traffic safety requirements in the procurement of freight transport. Today's procurements, which include road safety, often contain developed and carefully defined requirements for road safety, such as sobriety requirements or requirements to comply with rules and laws that exist in the country where the transports take place. However, when it comes to following up on the requirement, it is often thin and deficient. One reason may be that there are difficulties in following up on these requirements. The difficulties can be, for example, technical or organizational. This project aims to identify these difficulties, categorize them and propose solutions to be able to follow up road safety requirements in procurement of freight transport.

TRAFFIC ACCIDENTS AND RISK FACTORS AMONG ELDERLY DRIVERS

We have an aging driver population and studies show that our elderly drivers are overrepresented in fatal and serious crashes. Cars have never been safer, but may, in some cases, be less optimized for older and more fragile occupants. Some drivers adjust their behaviour when they become older, for example by only driving closer to home. But this is not always the case; some also lose automated driving tasks and may overestimate their driving capabilities. The overall aim of this SAFER associated project is to investigate motor vehicle accidents with elderly drivers (65+) involved regarding accident circumstances, driver diagnoses and medications as well as occupant injuries versus vehicle safety level.

RESEARCH OBJECTIVES

- **Identified safety gaps**, e.g. long-term injury types.

- **Identified critical use cases**, e.g. driving a heavy truck in fog among vulnerable road users.

- **Identified new critical load cases**, e.g. multiple impact car crash.

- **Evaluation of implemented safety systems performance**, i.e. safety benefit analysis.

- **Prediction of safety benefits** of new safety systems.

- **Prediction of future safety critical scenarios**, automation included.

- **Determination of required safety level** for automated drive.

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The Safety performance evaluation research area determines road safety priorities and examines safety benefit.

HUMAN BODY PROTECTION

RESEARCH TO UNDERSTAND injury risks arising from transport events and collisions lies within the **Human Body Protection** Research Area. Specifically, Human Body Protection covers traffic-related injury mechanisms, biomechanical responses and consequences, and the principles for protection including safety system usage. This area aligns with the work of our partners in the development and evaluation of counter-measures to protect the body, to prevent injuries or at least to mitigate them.

There continues to be a focus for the research area on emerging challenges in transportation, as we try to create the knowledge-base for future human body protection evaluations and enablers. We are addressing the needs for occupant and vulnerable road user models for use in complete crash sequences including the immediate pre-crash period. In addition, through our links with the Structures and Materials Competence Network, it includes research to develop new simulation approaches for the development and assessment of novel, lightweight, crashworthy structures.

KEY HIGHLIGHTS FROM PROJECTS

VIRTUAL

The objective of **VIRTUAL: Open Access Virtual Testing Protocols for Enhanced Road User Safety**, was to provide virtual testing procedures and open access tools to assess the safety improvements for all road users. This EU project started in 2018 and closed in November 2022. The project developed the Human Body Models VIVA+ 50F (average female) and 50M (average male) and the equivalent physical models for low severity rear impact testing, the Seat Evaluation Tools, SET 50F and 50M. It has been receiving media attention as it addresses the historic provision of predominantly male crash test dummies for safety testing. Indeed, not only are the concerns over safety equality raised but VIRTUAL also provides tools and procedures for how it can be addressed.

The research news of the world's first average female model for crash safety assessment has been spread widely around the world and has been picked up by, among others, the BBC, the World Economic Forum and Firstpost, and previously also by the Guardian. During Oct 22 to Feb -23 450+ media occurrences was recorded in 15 languages with largest coverage in Germany and the US.

The list of open-access tools and scripts generated within the project, and now offered on the 'virtual.openvt.eu' repository, is extensive. The VIVA+ models can be scaled and positioned to represent male and female vehicle occupants and vulnerable road users, pedestrians and cyclists as well as standing occupants in public transport.

"A-HBM IV"

Whilst VIRTUAL concerns open-source models, the FFI-funded project **Active Human Body Model (HBM) Step 4** was devised to develop the SAFER HBM further. The SAFER strategic investment in the HBM began more than ten years ago, with previous funding mainly from the FFI programme. It has helped to speed up the process of industrial implementation significantly, providing the SAFER partners with a state-of-the art human body model.

In the future, almost all collisions will be preceded by some automated action from the vehicle and restraint system. To recreate this phase in simulations, an occupant model should move like a human pre-crash as well as during the crash. The A-HBM projects have been adding 'active' musculature to the HBM, so that muscle groups can be tensed during a crash event or the time immediately preceding it, in such pre-crash manoeuvres.

Prior projects developed and implemented muscle activation methods to recreate aspects of occupant motion in braking or steering manoeuvres. This project developed a more omni-directional approach for use in combined lane changing and braking pre-crash movements. A new muscle controller was implemented, automatically reacting to disturbance of the head and activating the muscles to restore a neutral position. During the project data were collected from volunteers undergoing tests which generat-ed vertical and roll motions (not just forward-backward or side-to-side), these present a target for future A-HBM controller validation. Further fundamental data were obtained regarding volunteers' muscle activation in response to shoulder movements. These can be used in defining control strategies for the shoulder muscles and even in predicting human-like elbow and upper arm kinematics. Importantly these incremental development steps move us towards active muscle simulation for whole crash sequences, thereby enabling evaluation of both collision mitigation and crash technologies using the same HBM.
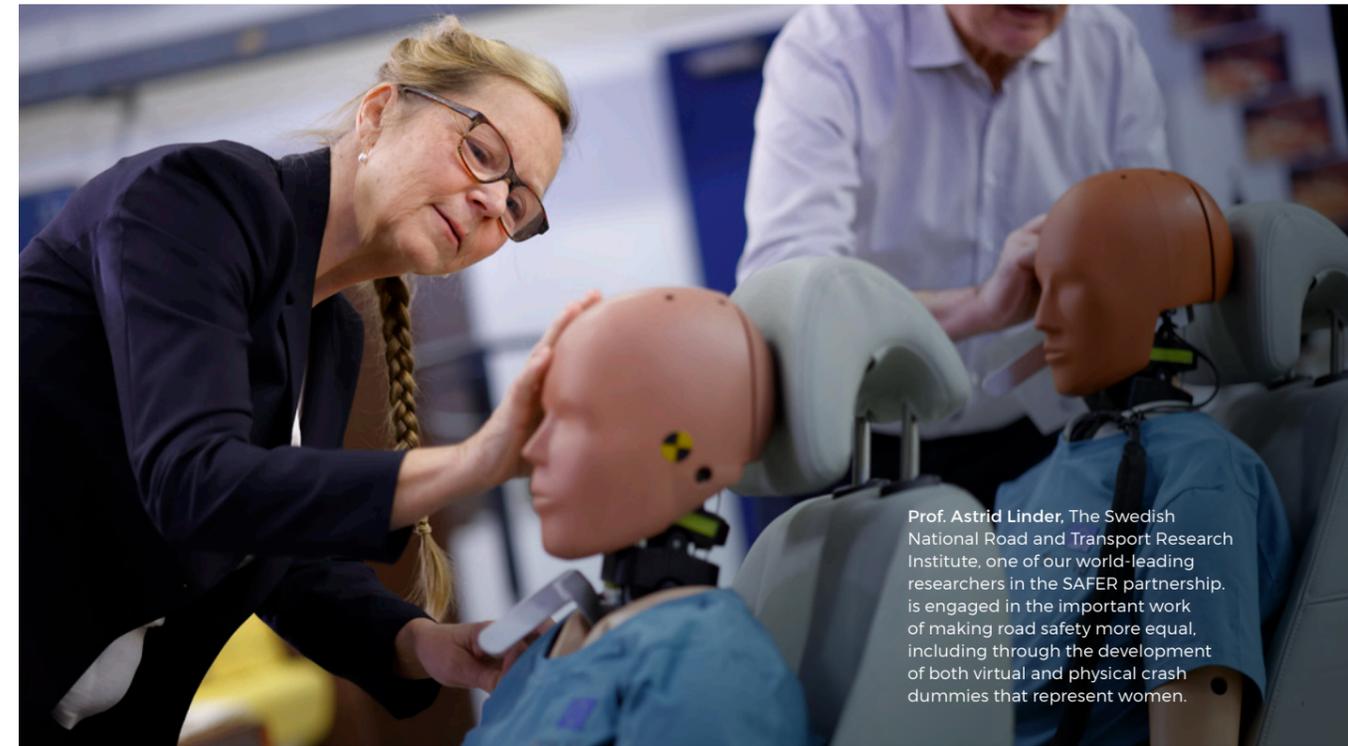
OSCCAR

The EU Horizon 2020 research project **OSCCAR (Future Occupant Safety for Crashes in Cars)** also finished in 2022. Running in parallel with the VIRTUAL and A-HBM IV projects, and building on many on the competencies they explored, OSCCAR developed a simulation-based approach to help safeguard occupants involved in future vehicle accidents.

One of the opportunities presented by highly automated vehicles is for new, more comfortable, sitting positions; but this poses a challenge for restraint systems to protect all occupants in these novel positions and in emerging future crash scenarios. Therefore, OSCCAR looked into potential future collision scenarios, proposals were made for new advanced occupant protection principles and bases were set for virtual testing needs for future vehicles. OSCCAR calls out the need for safety assessments with improved HBMs (which are biofidelic omni-directionally, active and robust), considering gender and demographic factors as well as improved material properties for soft tissues.

CAR PASSENGER PROTECTION – TO THE NEXT LEVEL

The FFI-funded project **Car Passenger Safety – To the Next Level** began in 2020; but unlike the previous projects, will not finish until 2023. A highlight from this project for 2022 was the resumption of the international, biennial, seminar series; Child Occupant Protection: Latest Knowledge and Future Opportunities. Starting in 2009, the 2022 event was the sixth seminar in the series. This whole day seminar featured presentations from international researchers, bringing state-of-the-art safety research to the audience of 75 participants from 13 countries. Fruitful multidisciplinary discussions took place on how to spread information to the users, the role of consumer rating programs and the next challenges including the tools such as human body models and the crash test dummies.

MOTORCYCLE RIDER MODEL FOR INJURY PREDICTION

Another international workshop was held on behalf of the FFI-funded project **Motorcycle Rider Model For Injury Prediction**. The topic for the workshop was mechanisms of thoracic injury for motorcyclists and 24 participants called in from 6 different countries (Sweden, Spain, France, Italy, Germany and the US). Agreement was reached that existing initiatives to generate data regarding chest injuries in motorcycle crashes were valuable, that mechanisms may be different to those seen in experimental car occupant testing and that human body modelling will be vital for predicting these injuries in motorcycle crash safety research and development.

HUMAN BODY MODELS FOR VIRTUAL TESTING

All of these projects having been shining a spotlight on future applications of virtual vehicle-safety testing. Exploitation of the opportunities involves the use of Human Body Models (HBMs) and presents many advantages over physical testing. For instance, physical testing is tied to crash test dummies which provide just a few points to represent the diversity within the population and whose injury prediction capabilities are limited by the mechanical construction and measurement systems. Without such constraints CAE (computer aided engineering) will be vital in the future of protective system development and testing.

continuing the work initiated in the previous projects on this topic. The new FFI-funded project, **GLOBAL SAFER HBM – Taking SAFER HBM to the global arena**; focusing the cervical and thoracic spine, was awarded in 2022 but will start work in 2023. This has a primary focus on replacing the last few parts so that the HBM is compiled completely from SAFER contributions, an essential step in providing this model for industrial use outside of SAFER.

2022 saw another FFI-funded project associated to the group, **UTMOST**, the modelling of biocomposites in occupant safety analyses. This project reflects the increasing use of biocomposites in place of traditional plastics and composites due to their superior environmental potential and often lower weight. However, due to their microstructure, current CAE crash analysis tools are not sufficient to predict the behaviour of components in crash analyses accurately. Therefore, the goal is to deliver a methodology for crash analysis, which is predictive and effective for industrial use. Again, this helps develop a leading competence in the Swedish industry for crashworthy and sustainable composite materials and places SAFER at the forefront of in-crash modelling of complex materials.

With just a year to go until the end of SAFER Stage V, the Human Body Protection research area keeps a focus on the objectives for the period, against all of which we continue to make progress.

As stated in previous reports, for those partners involved in human body modelling, SAFER provides a competence platform as well as a natural contact point for external cooperation. This has already placed SAFER amongst other well-known organisations active in this area, and the interest shown by universities outside of Sweden proves its high academic relevance globally. SAFER's HBM vision encompasses a scaleable, 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 vehicle manoeuvre events.

The projects from the Human Body Protection portfolio having been contributing to this vision. However, there is more to do in order to maximise this potential. The research road map set out by the Human Body Protection reference group reiterates the needs: for a child HBM to represent more age groups (particularly an older child of around 10 years old), to demonstrate the eligibility of our HBMs in virtual testing protocols, to support further research around injury mechanisms for human organs and soft tissues, to predict injuries leading to long-term consequences, and to continue working towards use in specific applications like the evaluation of non-driving postures in automated vehicles and as a rider of a motorcycle, bicycle, e-scooter etc.

OUTLOOK FOR 2023

In 2023, the Human Body Protection group will continue working with the SAFER-HBM via the A HBM V project

RESEARCH OBJECTIVES

- **HUMAN BODY MODELS** with enhanced omnidirectional injury prediction capability, and posture adjustments, capable of serving as industrial and research tools; and furthermore, also addressing the needs arising from increased vehicle automation.

- **METHODS TO SCALE AND TUNE** human body models, accommodating the need to simulate the variety of humans in a crash, including preceding events.

- **AN INCREASED UNDERSTANDING** of how pre-crash factors and individual differences influence injury outcome, by monitoring and quantifying sitting postures and behaviour in vehicles and other road users together with the research area Road User Behaviour.

- **BIOMECHANICAL INVESTIGATIONS** addressing future challenges which require more in-depth understanding of injury occurrence and tolerances. For car occupants, the pelvis area is one key area in which significant steps will be taken.

- **MODELLING CHALLENGING MATERIALS**, e.g. fat tissues and complex structural composites.

- **EXPANDING THE APPLICATION** of tools and knowledge on road users beyond vehicle occupants, such as the different interactions for pedestrians, two-wheelers, scooters, boards and other emerging transport trends.

LAUNCH OF THE SAFER DATA CATALOGUE

In September, it was time for celebrations at SAFER – the launch of another important asset for our researchers: The SAFER Data Catalogue!

KNOWLEDGE OF DIFFERENT datasets available in SAFER's network is important for efficient work within projects, providing new perspectives on past and present research, and being able to create completely new projects through data-driven research. To facilitate access to data, the SAFER Data Catalogue has been created, where relevant datasets within the network are described. This will help ensuring that SAFER continues to be relevant for its partners, and also attractive to other research groups in the world.

This is the rationale behind the SAFER Data Catalogue, that aims to cover relevant datasets available at the SAFER partners. The first edition of the catalogue was released in 2022 and holds metadata descriptions of 15+ datasets. The datasets cover different types of data, from field operational tests with a vehicle or location-based focus, real-time data described in the Swedish National Access Point (NAP), and accident databases.

In festive forms, Erik Svanberg, the project leader for the initiative, presented the setup for and the content in the data catalogue. In addition, three different partners presented their contributions and the added value for them to participate in the initiative. The launch event was well attended, and our partners could also follow the activity online for those who did not have the possibility to travel.

"The aim is to create a valuable asset and provide our SAFER partners with information about available datasets for future research and collaboration activities. We do not

In September the SAFER Data catalogue was officially launched in festive forms.

intend to offer the dataset itself, but primarily the information about the content and how to access it", says Erik Svanberg.

The datasets, available to the partners in our tool at Webforum, are declared by the partner providing the information, who also takes responsibility for the validity. The development and use of the data catalogue will continue in SAFER's research areas and future updates of the catalogue will be made continuously.

CROSS FUNCTIONAL ACTIVITIES AND PROJECTS

PROJECTS THAT COVER multiple Research areas or focus on general questions are called Cross functional activities and projects. As the road safety issue is becoming increasingly complex and cross-dimensional, we see value in continuing to stimulate projects that supports development in several research areas and is targeting several objectives. During the year, 14 projects have been ongoing and below you can read about some examples:

TRAFFIC SAFETY FOOTPRINT – A TOOL TO ACHIEVE A SUSTAINABLE TRANSPORT SYSTEM

In this project, representatives of Gothenburg's Traffic office and Partille municipality together with experts from SWECO, DuWill, SAFER and NTF Väst have explored how municipalities can benefit from identify their traffic safety footprint as a part of their sustainability agenda. The researchers investigated how various indicators could be used as a tool for measurement, follow-up and reporting. Skyltfonden was the financier to this project.

DATARIGHT INNOVATION (DRIV)

Today, legal uncertainties in research projects pose major challenges for the implementation of research projects and the utilization of knowledge and solutions based on datasets and AI. The **DRIV project** will create a platform for knowledge sharing relating to the legal challenges that occur in collaborative projects for data-driven innovation and help the participating organisations to manage legal questions at an early stage to create the right prerequisites to share and utilize data and enable the intended use of project results. The project is strongly connected to AI Sweden.

HEUDRIS

This new project, starting in May 2022, will contribute to opportunities for knowledge enhancement and research funding via European platforms. **HEUDRIS** (Horizon, EUrope och DrIve Sweden) is a continuation of the successful influential activities carried out in the strategic Drive Sweden project on EU-coordination, where several of SAFER's partners have been instrumental. This project, which in turn has its roots in a SAFER project on influencing European policy, was run between 2020–2021. To concretise the work with EU involvement, HEUDRIS focuses on CCAM-related areas, and, where relevant, matters related to other partnerships.

AI ENHANCED MOBILITY

The **AI Enhanced Mobility program**, previous called AI driven mobility, has in 2022 entered its second phase. This strategic project focuses on bridging the knowledge gap that exists between needs owners and AI experts. More than 20 SAFER partners are engaged and the project has a strategic role to further explore how AI can be used as a tool to improve traffic safety. SAFER is leading the focus group that will join forces to create projects to connect AI expertise with traffic safety researchers. New ideas and pre-studies will be developed in the group as well as to creating consortium and finding suitable financing for larger projects, based on the results in the first phase of the project. In 2022, two new pre-studies have been granted; Intention Recognition of Vulnerable Road Users and Improve traffic safety through advanced and automatic driving evaluations using AI and eye tracking.

SMART URBAN TRAFFIC ZONES

The objective of this project has been to enable and create the prerequisites needed to create and implement smart urban traffic zones (smart zones), through geofencing technology, in urban traffic environments. The purpose has been to tackle problems connected to congestion, high road usage, air quality, noise and traffic safety. Smart urban traffic zones involved an extensive network of players from stakeholders to end customers. The aim was for them to ensure that the smart zones met the right requirements and that they were usable and could be implemented. In this project SAFER has had an advisory role and the connected research resource Revere participated in the demonstrations.

WHICH ARE THE TRAFFIC SAFETY RESEARCH NEEDS TO ENABLE A SAFE AND SUSTAINABLE URBAN ENVIRONMENT?

The year is 2035. Imagine a truly sustainable and safe traffic environment, which is designed on human terms. Is it possible to change the current mobility system in such a way that we get there? We think it is possible, but we need to figure out how to do it, together. Within the Gothenburg Green City Zone, various actors gather to collaborate to explore different possible solutions.

DURING THE AUTUMN of 2022 close to 30 stakeholders meet in a co-creation process to identify the traffic safety research we need to initiate to contribute to the city's vision.

GREEN AND SUSTAINABLE INITIATIVE IN GOTHENBURG

Gothenburg and its region are growing. By 2035, 120,000 new jobs will be created and the number of tourists and visitors will double by 2030. This means ever-increasing transport needs. At the same time, we must reduce emissions in line with the climate goals and be an attractive city to visit, live and work in. To find solutions, the Gothenburg Green City Zone will take lead in the transition work and support the city to become emission-free as early as 2030. Road safety will be an important component in the work, a boundary condition for sustainability.

Initially, the Gothenburg Green City Zone consists of Lindholmen, the Event district in central Gothenburg and Forsåker, in Mölndal. Three selected areas with different character and challenges together form a full-scale test environment where the transport environment of the future is tested and developed live.
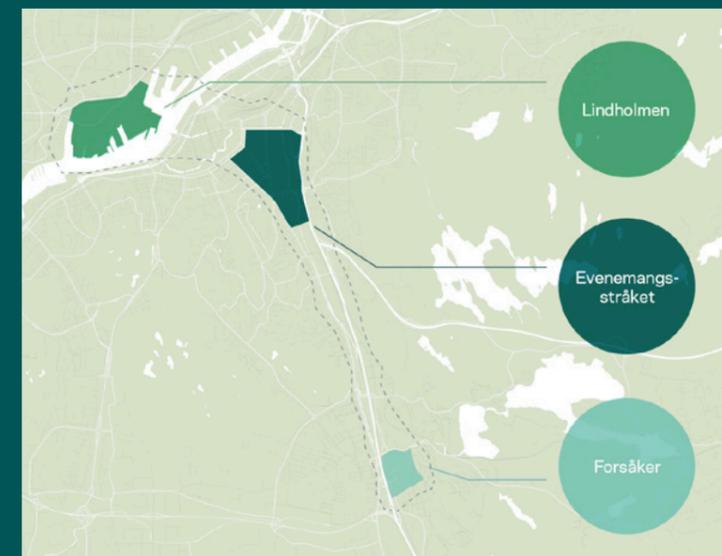
Three areas in the Gothenburg Green City Zone will be used for large scale testing of sustainable products and services.

> **In order to solve our common societal challenges, we need a systems perspective and work together with many different actors. The Gothenburg Green City Zone initiative is an opportunity to develop a sustainable mobility system, traffic safety included.**

About 30 stakeholders from various disciplines contributed through the co-creation process to identify and better understand the traffic safety needs in a future, sustainable city.

CO-CREATION TO FIND A COMMON GROUND FOR CHALLENGES AND DEVELOPMENT

SAFER's project aims to identify future research needs in the field of traffic safety, using the Gothenburg Green City Zone Initiative. The project has been carried out through a series of workshops together with various actors from the industry, academy, research institutes and society. The results of the research will contribute to build valuable knowledge to strengthen the regional actors' competitiveness and at the same time contribute to a more sustainable future for all.

"By gathering these competent people from various disciplines in a co-zcreation process we learnt about long-term traffic safety needs and better understand sustainable mobility in livable, future cities", says Malin Levin, project leader at SAFER.

Areas that need to be understood better in order to meet future needs and challenges were identified. The group mapped research questions and project ideas that will contribute to sustainable future products and services, meeting the societal needs and using the competences available within the region.

"As a result of the process we developed an inspiring list of new project ideas, also including new actors, that we will start up as a next step", Malin concludes.

During the process, the project team identified no less than seven different areas where the participants now aim to create projects to learn more about a future, sustainable transport system. The stakeholders identified **shared spaces**, areas for many different types of transport where the urban space is shared, as one interesting subject to learn more about. How can everyone safely coexist? Questions like how the environment itself can be designed so it becomes easier to coexist and if there are contradictions

between actual safety versus perceived safety, were added to the list of future research.

The participants found a need for **flexibility in how spaces are used**. Dynamic geofencing, where different types of vehicles are allowed in at different times or occasions, is a suitable topic to further explore. Digital queues could also be explored, for example, to drive in and unload cargo during a specific time slot. One-way lanes at different times, e.g. a car lane that becomes a bike lane in rush hour, were also identified as interesting areas to develop further. What are the technical and road safety challenges to utilize flexible environments?

Fast cycle routes and **infrastructures for speed differences on cycle tracks** were other topics that came out as a potential enabler for a future sustainable transport system in the workshop series. A slightly narrower area that was identified as very relevant for future research was **micro simulation of cyclists and electric scooters riders' movement patterns**, mainly to enhance automated vehicle's capability to interact with this type of vehicles.

The concept of **mobility hubs** was also a clear output of the co-creation process. A hub means that many different types of vehicles and pedestrians all meet at the same point, like at a bus stop or where, for example, you change modes of transport. Which road safety problems can arise in a mobility hub? How should hubs be designed so that they are as safe as possible and at the same time efficient so that changing modes of transport is perceived as value-enhancing from a door to door perspective?

Finally, **mobility as a positive experience** was also a topic the working group would like to look into more in depth. How can we create mobility solutions that are not only perceived as safe, but actually contributes to a positive experience? Are there contradictions between road safety and creating a positive experience that we could benefit from better understanding?

THE SAFE SYSTEM PRINCIPLE APPROACH

SAFE INFRASTRUCTURE
Infrastructure providing conditions
needed to travel at maximum speed
limit, e.g. guard rails and separation
from other road users

**SAFE VEHICLES
AND SAFE SPEEDS**
Complying with speed limits,
use of preventative safety systems
and adaptive crashworthiness for
occupants and rod users

SAFE ROAD USERS
Human tolerance
to blunt force

THE SAFE SYSTEM PRINCIPLE APPROACH is an effective way to address and mitigate the risks inherent in our enormous and complex transportation system. It works by building and reinforcing multiple layers of protection to both prevent crashes from happening in the first place and minimize the harm caused to those involved when crashes do occur. It is a holistic and comprehensive approach that provides a guiding framework to make places safer for people. This is a shift from a conventional safety approach because it focuses on both human mistakes and human vulnerability and designs a system with many redundancies in place to protect everyone. This is an approach we in the SAFER community would like to learn from and explore further.

Vision Zero builds on the aspiration to keep kinetic energy below human tolerance to prevent fatalities and serious injuries. In this work, a Swedish expert group within the SAFER partnership estimated the maximum safe speed limits for the 2030 motor vehicle based on the boundary conditions of vehicles, road infrastructure and human crash tolerance to achieve close to zero road fatalities and serious injuries.

The present work was based on expert consensus, rather than a retrospective quantitative analysis of crash data. Different load cases were discussed separately, with the involvement of a passenger car being the common denominator. The passenger car and its collision partner were assumed to be of model year 2030, thus reflecting the base safety level of the Swedish car fleet by approximately 2050.

The boundary conditions were set based on pre-crash autonomous braking ability and the maximum acceptable impact speeds that would result in a very low risk of death or serious injury among the car occupants and the car's collision partner. In the case of car to pedestrian impacts, the acceptable impact speed was set to zero, as any impact with pedestrians can lead to serious injuries as a result of ground impacts. It was expected that the responsibility to comply with speed limits will move from the driver to the car itself, and that travel speeds will be autonomously reduced when low road friction, sight obstructions, and other challenges in the traffic environment are detected. This function was expected to be non-overridable. Lateral control was also expected to be further enhanced with lane support technologies, although it was assumed that it will be still possible to override such technologies.
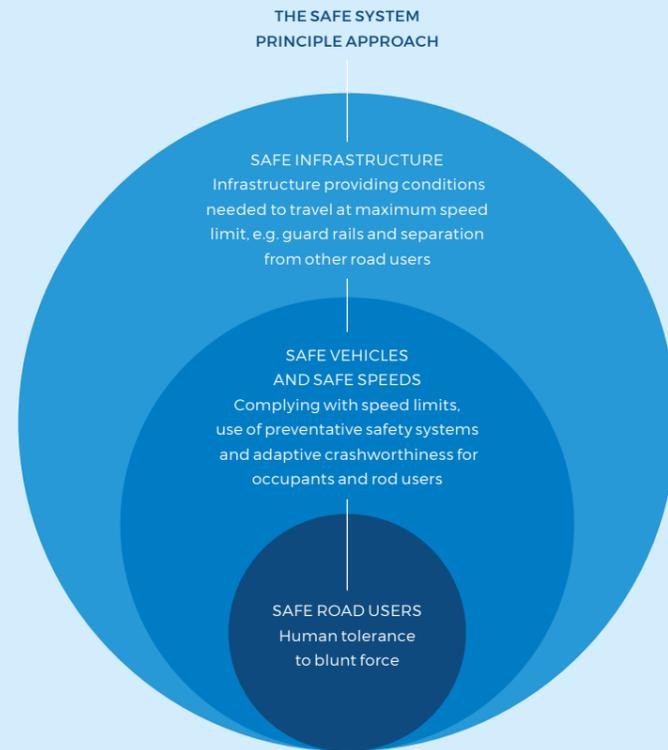
Over time, increased performance of vehicle safety technology will likely be able to prevent an increasingly large proportion of crashes in all load cases. However, in line with Vision Zero design principles, human crash tolerance will always be the ultimate boundary condition to guarantee a safe outcome in a crash. As a result, the recommended maximum travel speeds in the road transport system containing motor vehicles only of model year 2030 and beyond are:

- **5-7 km/h** in pedestrian priority areas,
- **40 km/h** in mixed traffic urban areas, if there are no obstructed sensor sightlines, e.g. due to parked vehicles along the sidewalk,
- **50 to 80 km/h** on roads without mid- and roadside barriers,
- **100+ km/h** on roads with continuous mid- and roadside barriers,
- **40 to 60 km/h** in intersections, depending on vehicle mass differences.

The results from this study can be used to inform the development and amendment of transport planning guidelines when moving away from the economical paradigm into Safe System boundary conditions in the setting of speed limits.

In 2023, the research group will continue to develop this work and take on the next steps in the challenge to define the prerequisites for a future, safe and sustainable transport system.

KNOWLEDGE DISSEMINATION & RESEARCH OUTREACH

PART OF THE SAFER MISSION is to disseminate results and knowledge to the partners and be a well renowned international centre of research excellence. To achieve this SAFER regularly arrange activities for knowledge sharing. SAFER has arranged and participated in a wide range of events over the year – primarily to present results and findings of the research and knowledge production activities, but also to connect researchers, discuss future needs and generate new projects and insights. A complete list of engagement to share knowledge, scientific findings and create future research is listed in appendix 7.

THE POST-PANDEMIC EFFECT

Finally, we can meet in person again! How we missed to do so! Although SAFER strongly developed during the pandemic, including implementation of effective digital tools that enabled online meetings, webinars and even project-creating workshops, the physical meetings are welcome back. These entails terms of creating trust and building long-term relationships, which are the basis of a successful research collaboration.

Our Thursday lunch seminars are back in physical form, and everyone who wants to meet for a networking lunch has been welcome to SAFER's office basically every Thursday since the Covid 19- restrictions were lifted. The seminars, however, have been conducted in hybrid form so that as many people as possible have been able to learn from the discussions.

Physical workshops of various kinds have also come back to our collaboration agenda again. We have continued to work on creating strong proposals for the second and third calls in the Horizon Europe framework programme. The purposes of the workshops have been to start up a dialogue about ideas and identify how the SAFER partner would like

to contribute in potential projects and which knowledge we jointly would like to build. Another purpose has been to get to know each other for future deeper collaboration, in EU projects and elsewhere, and to find further areas where joint projects could add value and inspire each other. The partners have also gathered to discuss, for example, Safety Performance Indicators and whether simulations can be an effective tool for safety benefit assessment of autonomous driving systems. 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.

CONNECTING TO OTHER SUSTANABILITY GOALS

Our journey to learn more about how we can integrate road safety into other global Sustainable Development Goals has continued in 2022. We are on a learning journey how we can do this in a value-creating way to create conditions for road safety and research. We held the most well-attended seminar of the year at the beginning of March. 175 registered participants were curious to know more about how municipalities and other organisations can work to contribute to a safer and more sustainable transport system at a webinar about traffic safety footprints. The purposes of the seminar were to give the participants inspiration, new knowledge and the opportunity to be part of the conversation about how we can make improvements together, using the concept of traffic safety footprint.

In September, Lindholmen Science Park invited to a physical Lindholmen Open Day. The event included an exciting exhibition and short seminars - all connected to the theme: Innovation - the way to a sustainable society. SAFER contributed at the event with a well-attended panel dialogue entitled "Road safety - an important part of Agenda 2030 – how do we approach the common challenges in practice?".

In 2022 SAFER co-hosted no less than three conferences – and we enjoyed the post-corona effect with physical meetings again!

Prof. Natasha Merat, University of Leeds, was one of the speakers at the International Conference on Driver Distraction and Inattention in Gothenburg.

In this panel dialogue we discussed how to strengthen the ties between road safety and other sustainability goals as well as how interaction and collaboration can contribute to a more effective Agenda 2030 and a sustainable, more equal world.

BRINGING OUR KNOWLEDGE FORWARD ON THE INTERNATIONAL ARENA

SAFER presented the necessity of collaboration at the **Join Sweden Summit** in June, an international high-level event arranged by Business Sweden, promoting strategic, direct foreign investments and expansions in Sweden . The forum explored how international companies can leverage Sweden's abundant dynamic automotive clusters, incubators and test beds, vehicle manufacturers and suppliers, tech start-ups, and academia. Magnus Granström, SAFER's Director, participated in the session "Safe, sustainable and automated transport" and discussed the need for collaborative research and other activities. 175 international guests from 18 countries representing 125 international companies were welcomed on site in Stockholm. We had over 1,000 digital participants listening to when we presented the core elements in creating a safe and sustainable transport system.

At the international **TRA Conference** (Transport Research Arena) in November, SAFER moderated a session on "Sustainable Road Safety – medium-term trends and needs for future R&I", planned and performed jointly by the European Commission and ERTRAC's Road Safety group. Some of the topics that were discussed included safety and sustainability, the benefits of connected, cooperative,

automated mobility (CCAM) for Vision Zero, and the rural perspective. The output will be used in our upcoming research agenda for 2024 and onwards.

### HOSTING LEADING CONFERENCES

During 2022, we have managed to be the proud hosts of no less than three large international conferences at Lindholmen Science Park in Gothenburg!

Leading researchers from all corners of the world gathered at the seventh **International Conference on Traffic and Transport Psychology** (ICTTP) in August to learn about the latest findings in traffic and transport psychology.

The conference philosophy was Taking the Swedish Vision Zero Initiative into a New Decade. The key focus of this conference was on the role that traffic and transport psychology can play in achieving a safe and sustainable transport system. SAFER and Swedish National Road and Transport Research Institute (VTI) hosted the conference.

In mid-October, over 160 delegates from 23 countries attended the **International Conference on Driver Distraction and Inattention** (DDI2022) held in Gothenburg. This was the eighth time that representatives from research institutes, industry, government and academia met to get up-to-date on current and recent developments and trends in the field of inattention and distraction in driving. The overall theme for DDI2022 was "Safety assessment of human interactions with vehicles and automotive technologies in the context of driver distraction and inattention". This theme targeted research on how to assess the safety

Figure 7
Number of SAFER publications per type

- Other — 5
- Conference papers/presentations — 32
- Doctoral and licentiate theses — 12
- Master theses — 7
- Reports — 23
- Peer reviewed journal articles — 24

Linda Pipkorn, Chalmers, discussed how automated vehicles should be designed to help ensure a safe transition between manual and autonomous mode in the podcast "Liv och Trafik".
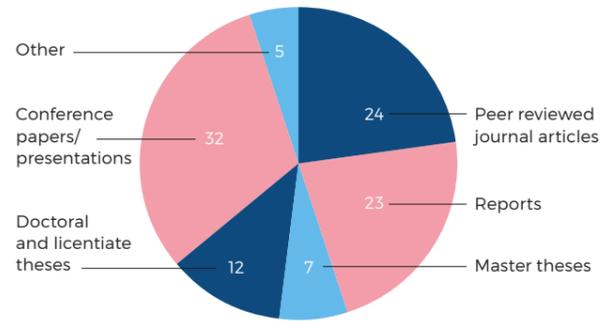
impact of driver distraction and inattention. For example, how human-machine interface designs could be quantitatively assessed with respect to safety and what the differences and requirements of such assessment in development, compliance assessment and consumer rating are, as well as even better understand how safety of disconnected drivers can be assessed. As a whole, the conference has moved our knowledge on driver distraction inattention, and their countermeasures, a substantial step forward.

For the second time, SAFER has been co-hosting the **Scandinavian Conference on System and Software Safety** (SCSSS) together with KTH, the Royal Institute of Technology. More than 100 experts from almost 30 different companies and organisations gathered at Lindholmen Science Park in Gothenburg for two days in November to take part in the conference and learn about the latest trends and developments in system safety research. The conference aimed to inspire, grow knowledge and increase networking through gathering experts from both industry and university to discuss techniques and methods for developing complex and safety regulated software-based systems. The research question of how we can ensure that self-driving vehicles are safe and contribute to a sustainable transport system is an extremely important issue for our research community and we see great opportunities to connect to this expertise and field of research even more.

All in all, more than 80 collaborative activities have been concluded in 2022. Welcome to read more about our activities in appendix 7.

TRAFFIC SAFETY PODCAST

Liv och Trafikpodden is a knowledge podcast about road safety with interviews about current research, successful practice and traffic policies. The podcast is hosted together with NTF Väst and in 2022 we have published results from our nudging research, traffic safety footprint, safe transition between manual and automated driving as well as an episode about driving distraction and inattention.

Take the opportunity to listen to the episodes at livochtrafikpodden.se

REGULAR REPORTING TO PARTNERS

SAFER's partners have been kept informed about the research results and ongoing activities and opportunities through regular newsletters and social media seedings. We have also continued with the SAFER Update concept which is an online meeting in connection with our Research area days. In these updates, we inform about our collaboration opportunities, main ongoing activities and upcoming events. More formal meetings with partners through the research areas have been performed six times during the period, including one Shareholders meeting. Ten board meetings have been held, including a two-day strategy meeting. Information about the project portfolio, activities and other news are also communicated through our website saferresearch.com

PUBLICATION VOLUME

SAFER's research projects have produced more than 100 publications during the fourth year in SAFER Stage 5, including peer reviewed journal articles (24%), conference papers and posters (32%), reports (23%), master theses (7%) and doctoral and licentiate theses (12%). 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. In the SAFER Knowledge library, www.saferresearch.com/library, you'll find most of the our public project publications that have been produced since the start in 2006.

SAFER DOCTORS AND LICENTIATE SEMINARS

During SAFER's 17th operational year eight students working in the SAFER environment have written her doctoral theses and two have written a licentiate thesis, see appendix 9.

"I am very happy for the award! For me, collaboration is a special mindset, an attitude, to really be able to truly use all people's thoughts and knowledge; the ability to contribute by seeing different thoughts as a buffet, where everyone can give and take", says Fredrik Sandblom.

> **"**
> We are proud to have Fredrik working with us in the SAFER partnership. He contributes very well with his collaborative skills, as well as his scientific knowledge, in his leadership role with us.

Magnus Granström, SAFER's director

THE COLLABORATOR OF THE YEAR AT LINDHOLMEN TO SAFER CONNECTED LEADER

Once again a person in the SAFER community gets the honorable award **The Collaborator of the Year**. This year, Fredrik Sandblom, Zenseact, who leads the successful network for knowledge building in safety assurance, was awarded. In his research group, the members are in a scientific way looking into how self-driving vehicles can be proven to be safe on public roads.

THE JURY'S NOMINATION

Fredrik is an expert collaborator! He is a network leader focusing on how to make autonomous vehicles safe, an important step in the transition to a sustainable future. In this work he knows how to engage the right people and bring them together to think, talk and deliver. He makes other people grow and generously shares all his knowledge.

SETTING THE TRAFFIC SAFETY RESEARCH AGENDA

There are still far too many people who die or are injured in traffic every year. The global trend looks bleak, while the conditions for creating a safe and sustainable transport system is increasing with, for example, digitalisation, connectivity and the development of even more advanced injury protection systems. We also see that the need for research becomes even more important, as the mobility system becomes more and more complex.

SAFER'S CURRENT PARTNERSHIP agreement enters its sixth stage in January 2024, and during the year we have worked intensively on the formation of the upcoming phase. The commitment from our partners and its researchers has been outstanding. In our analysis work, we have concluded that much of what we do today will continue to be prioritized within our following joint strategic research agenda, but we also see that several other areas will take a larger place in our portfolio. The ongoing transformation in the transport and innovation system is something we even better should take advantage of; working together has been a success factor in the SAFER partnership and we should take the opportunity to take on new ideas even more and test new approaches.

We have identified many new, also several cross-cutting, topics and research questions, in which we in the traffic safety research community are able to contribute. For example, to support the understanding of which technologies for increased road safety that will be most effective in the future, also taking into account future scenarios, as well as other societal needs, such as the environment and health as well as costs and conditions in different countries. Becoming even better at technology transfer also has a large traffic safety potential, such as even deeper look into how protection systems and preventive safety systems that are currently found in cars, can be used for two-wheelers.

The transition to a sustainable transport system through a shift to more physically active travel is a great enabler for us, but it also entails risks that more people will be injured as they may become less protected. We want to contribute to this transition and ensure that we provide a scientific basis for political decisions and policies as well as new products and innovations.

Knowledge transfer is another important issue – how do we ensure that the knowledge about road safety that we already have becomes available for everyone, in different parts of the world? How can we truly democratize road safety? Reliable data, and data that really creates added value and is useful, is another key to success. How do we ensure that we can collect, store and share data between different countries in an efficient way?

Below are some more examples of topics we believe will receive a greater focus in the SAFER partnership in the next phase:

- Safety principles of products, infrastructures and services.
- The traffic safety aspects of urban, rural and societal planning
- Human Body and Mind – how can we protect the human and support the human to act safer in traffic?
- Providing the science base for decision making (e.g. policies and legislation)
- Forecasting and prediction – how can we even better foresee trends, evaluate technologies and systems?
- An even stronger focus on road user behavior research, including how we can support organisations to take on traffic safety as a part of their corporate responsibility agenda
- Continue to explore the Safe System Principle approach
- Continue the integration of traffic safety in other global
- Sustainable Development Goals and connect to other actors to gain momentum

We strive to continue to be at the forefront of research excellence and knowledge creation, as well as to stimulate knowledge exchange and to be an actor and vision carrier for Vision Zero, in a global context. 2023 will be an exiting year and we are already now looking forward to the next stage of SAFER – SAFER Stage 6!

APPENDICES

APPENDIX 1: SAFER PARTNERS

The following partners have been engaged during operational year 17:

PARTNER LEVEL 1 & 2

- Aptiv AB
- AstaZero AB
- Autoliv Development AB
- BETA CAE Nordic AB
- Chalmers Industriteknik (as of March)
- Chalmers tekniska högskola AB
- China Europe Vehicle Technology AB (CEVT)
- Combitech AB
- Folksam
- Halmstad University
- If Insurance
- Institute of Transport Economics – Norwegian Centre for Transport Research (TØI)
- Jönköping University
- National Electric Vehicle Sweden AB (NEVS)
- RISE Research Institutes of Sweden AB
- Scania CV AB
- Smart Eye AB
- Swedish National Road and Transport Research Institute
- Swedish Transport Administration
- University of Gothenburg
- University of Lund
- University of Skövde
- Veoneer Sweden AB
- Volvo Car Corporation
- Volvo Group AB
- Zenseact

PARTNER LEVEL 3 (ASSOCIATED PARTNERS)

- Agreat
- Afry
- ASTUS AB
- Asymptotic
- Bookman Visibility (as of August)
- City of Gothenburg
- Consenz
- Cycleurope AB
- DuWill
- Hövding
- Knightec
- Malmeken AB
- Nationalföreningen för trafiksäkerhetens främjande (NTF Väst)
- Pionate AB (as of April)
- QRTECH
- Svanberg & Svanberg AB
- Swedish Transport Agency
- Tier Mobility
- Trivector
- Viscando
- Voi

APPENDIX 2: SAFER BOARD

The following members have been part of SAFER Board during the fourth year of SAFER Stage 5:

- Autoliv: **Cecilia Sunnevång**
- Chalmers: **Sinisa Krajnovic** and **Balázs Kulcsár** (as of April)
- RISE: **Stefan Nord** (until March) and **Anna Larsson** (as of September)
- Swedish Transport Administration: **Maria Krafft**
- Volvo Car Corporation: **Malin Ekholm** (until July) and **Linus Wågström** (adj)
- Volvo Group: **Claes Avedal** (until March) and **Sofie Wennersten** (as of June)

- VTI: **Astrid Linder**
- Independent chairperson: **Thomas Andersson**, Volvo Cars
- **Hans Fogelberg** (Region Västra Götaland) and **Eric Wallgren** (Vinnova) has joined the Board as observers.

APPENDIX 3: SAFER MANAGEMENT TEAM

The following members have been part of SAFER's management team during SAFER's operational year 17:

- **Anna Carlsson**, Connected research resource leader for Revere (as of April)
- **Anna Sjörs Dahlman**, Research area director for Road user behaviour
- **Fredrik Von Corswant**, Connected research resource leader for Revere (until March)
- **Fredrik Åkeson**, Connected research resource leader for AstaZero (until August)
- **Ines Heinig**, Project coordinator
- **Ingrid Skogsmo**, Senior research advisor
- **John-Fredrik Grönvall**, Connected research resource leader for Naturalistic driving data
- **Jolyon Carroll**, Research area director for Human body protection
- **Katrin Sjöberg**, Research area director for System for accident prevention and automated driving (as of February)
- **Linus Wågström**, Research area director for Safety performance evaluation
- **Magnus Granström**, Director
- **Malin Levin**, Communications and partnerships, Deputy director
- **Matteo Rizzo**, Research leader for Safe System Principles
- **Robert Thomson**, Chalmers
- **Sofia Fagrell**, Controller
- **Timo Kero**, Connected research resource leader for AstaZero (as of September)

Closely connected to the SAFER Management team are also our Co Research area directors:

- **Anna Theander**, Co-Research area director for Safety performance evaluation
- **Carina Björnsson**, Co-Research area director for System for accident prevention and automated driving (as of February)
- **Niklas Strand**, Co-Research area director for Road user behaviour
- **Sara Kallin**, Co-Research area director for Human body protection

APPENDIX 4: COMPETENCE NETWORKS AT SAFER

The following competence networks have been active during the reporting period:

Automotive Safety Assurance
Focus is preliminary around how to design L3-L4 automated vehicles such that the accident risk is tolerable, and how to prove that the risk is tolerable with sufficient confidence, and how to design with explainability at all times. Competence network leader: **Fredrik Sandblom**

Human behaviour
By applying an interdisciplinary approach, the scope of this competence network is to understand human behaviour in traffic and develop scientific methods and tools to create prerequisites for safe driving. It is also 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 network leader: **Giulio Bianchi Piccinini**

Future proof methodologies for validation of connected and automated vehicles
The group discuss validation of automated and connected vehicles. including e.g. relevant test cases, virtual methods and their connection to physical tests, the role of Operational Design Domains (ODD) and relevant connectivity scenarios. Competence network leaders: **Fredrik Åkeson** and **Viktor Johansson**

Perception, sensing & 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 network leader: **Lars Hammarstrand**

Structures and 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 network leader: **Christopher Cameron**

System Safety
For the Safety System network, we would like to broaden the view and learn from systems outside the automotive industry. Robotics, Health care and Medical Technology can be areas with which this type of thinking can be shared and new knowledge can be created. We also have the ambition to meet physically, since it is difficult to grow and maintain connections in a network only on distance. Competence network leaders: **Charlotta Uddh** and **Devansh Mehta**

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 network leader: **Bengt Jacobson**

APPENDIX 5: THE SAFER ECOSYSTEM

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)
- Cykelcentrum (Swedish Cycling Research Centre)
- Drive Sweden

- European Automotive Research Partners Association (EARPA)
- European Council for Automotive R&D (EUCAR)
- European Road Transport Research Advisory Council (ERTRAC)
- Forum för Transportinnovation
- HUMANIST
- K2 Centre
- Next Move
- Neuroscience Research Australia
- POLIS Network
- SDNS Northern Europe (Sustainable Development Solutions Network)
- SDNS Northern Europe (Sustainable Development Solutions Network)
- Swedish Electromobility Centre

- The Association for the Advancement of Automotive Medicine (AAAM)
- The Group for national cooperation (GNS Väg)
- The national network for Vision Zero
- WARA-CAT (Collaborative and Autonomous Transport)
- WASP (Wallenberg Autonomous Systems and Software Program)
- Swedish electromobility Centre
- The Association for the Advancement of Automotive Medicine (AAAM)
- The Association for the Advancement of Automotive Medicine (AAAM)
- The Group for national cooperation (GNS Väg)

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- The national network for Vision Zero
- WARA-CAT (Collaborative and Autonomous Transport)
- WARA-CAT (Collaborative and Autonomous Transport)
- WASP (Wallenberg Autonomous Systems and Software Program)
- WASP (Wallenberg Autonomous Systems and Software Program)

APPENDIX 6 / PROJECT PORTFOLIO

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Human Body Protection					
VIRTUAL – Open Access Virtual Testing Protocols for Enhanced Road User Safety	Astrid Linder	2018-06-01	2022-05-31	EU H2020	VTI, VCC, Chalmers, TØI, other EU/ international partners
SAFER Pre-Study: ADIPOSE TISSUE RATE DEPENDENT RESPONSE	Håkan Johansson	2021-06-01	2022-11-30	SAFER Pre-Study Funding	Chalmers, Autoliv
INJURY HBM, STEP 4 – Pelvis and spine injury predicting models for women and men in a variety of sitting postures in future autonomous cars	Bengt Pipkorn	2019-04-01	2023-05-31	FFI	Autoliv, VCC, Chalmers, GU/ Sahlgrenska
A-HBM 5 – Active human body models for virtual occupant response, step 5	Lotta Jakobsson	2021-04-01	2023-08-31	FFI, TSAF	VCC, Autoliv, Chalmers, DYNAmore
VIRTUAL EVALUATION TOOLS FOR PEDESTRIAN INTEGRATED SAFETY	Robert Thomson	2019-04-01	2023-10-31	VINNOVA MOST China Sweden call	Chalmers, VTI, Autoliv, VCC, Tsinghua University, University of Science and Technology Beijing (USTB), Geely , RIOH, Brillizance Auto
CAR PASSENGER PROTECTION – To the Next Level / Passenger Safety, part 2	Lotta Jakobsson	2020-11-01	2023-10-31	FFI, TSAF	VCC, Autoliv, Chalmers
ADOPTIVE – Application for Automated Design & Optimization of Vehicle Ergonomics	Erik Brolin	2021-03-01	2024-02-29	KK-Stiftelsen	University of Skövde, Volvo Group, Scania, VCC, CEVT, Fraunhofer-Chalmers Research Centre for Industrial Mathematics (FCC)
MOTORCYCLE RIDER MODEL FOR PREDICTION OF INJURY RISK	Jolyon Carroll	2021-06-01	2024-05-31	FFI	Autoliv, Chalmers, MIPS, Beta CAE
UTMOST – Modelling of biocomposites in occupant safety analyses	Renaud Gutkin	2022-05-01	2024-12-31	FFI	VCC, IAC Group (International Automotive Components), Chalmers, Beta CAE
GLOBAL SAFER HBM – Taking SAFER HBM to the global arena; focusing the cervical and thoracic spine	Jonas Östh	2022-11-01	2024-12-31	FFI	Autoliv, Chalmers, GU/ Sahlgrenska, VCC
Road User Behaviour					
HAVOC – Heavy Automated Vehicle Operation Center - Requirements and HMI design	Jonas Andersson	2020-11-01	2022-03-11	FFI	RISE, Scania
CO2 – Effects on driver state and driving performance	Ignacio Solís	2020-10-01	2022-03-31	FFI	VTI, SENSEAIR
SAFER Pre-Study: OPENBIKE-CD – Open data for Bicycle Classification for better planning and simulation, and for better Detection from motorized vehicles	Magnus Larsson	2022-01-02	2022-03-31	SAFER Pre-Study Funding	VTI, Viscando, Folksam, Scania, SVV, Vätternrundan, Trafikia

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Road User Behaviour					
SAFER Pre-Study: EXPLORING THE IMPACT OF EMBODIED COGNITION ON AD DESIGN	Henrik Svensson	2021-04-01	2022-06-10	SAFER Pre-Study Funding	University of Skövde, Autoliv, Folksam, Veoneer, VCC, Volvo Group, Volvo Construction Equipment
ADVICE – Advanced Virtual Development Methods for evaluating Communication of Automated Vehicles and Vulnerable Road Users	Carmelo D'agostino	2021-11-01	2022-06-30	FFI	Lund University, Volvo Group
SAFER Pre-Study: DRONE LIGHTING SYSTEMS	Henrik Svensson	2021-08-01	2022-08-01	SAFER Pre-Study Funding	Jönköping University, University of Skövde, RISE, Municipality of Skara
GLAD – Goods delivery under the Last-mile with Autonomous Driving vehicles	Mikael Söderman	2020-06-01	2022-09-30	Swedish Transport Ad-ministration	RISE, Aptiv, Combitech, Halmstad University, Clean Motion
EHMI – External Interaction Principles for Creating Trust in Heavy Automated Vehicles	Yanqing Zhang	2020-04-01	2022-10-15	FFI	Scania, Halmstad University, RISE
ENHANCED ADAS – Improving drivers' experience, acceptance and trust in assistance systems	Jonas Andersson	2020-10-15	2022-10-15	FFI	RISE, Aptiv, SmartEye
DRIVE2THEFUTURE	Anna Anund	2019-05-01	2022-11-30	EU H2020	VTI, TØI, other EU/ international partners
IN THE HUB – Interaction between operators and driverless vehicles in the transport system of the future	Yanqing Zhang	2020-04-01	2022-12-31	FFI	Scania, RISE, Boliden, Icemakers
SAFER Pre-Study: HOW WE ROLL	My Weidel	2022-04-10	2022-12-31	SAFER Pre-Study Funding	VTI, IF, Trivector
FIT2DRIVE	Katja Kircher	2020-04-01	2022-12-31	FFI	VTI, SmartEye
DREEM - Designing useR centric E-kickscooters & business models for Enhancing interModality	Cecilia Bergstad	2021-01-01	2023-01-31	EU H2020	PUNCH Torino, Three o'clock, ELAPHE, ICLEI EURO, DOMEL D.O.O., Bumpair, TRACTEBEL, University of Gothenburg, 5T
SAFER Pre-Study: SYNCOPE – Unresponsive Driver & Sudden Illness Detection	Ke Lu	2022-09-01	2023-02-28	SAFER Pre-Study Funding	Chalmers, VTI, Autoliv, VCC, Trafikverket, VGR/ SU
RE-ENGAGE – Driver re-engagement in autonomous driving by means of HMI adapted to human activity	Jonas Andersson	2020-04-01	2023-03-31	FFI	RISE, VCC, SmartEye
SCREENS – Safe Car Driving with Head Up Displays and Camera Monitor Systems	Kjell Brunnström	2021-04-01	2023-03-31	FFI	RISE, VCC
MEDIATOR – Mediating between Driver and Intelligent Automated Transport system on our roads	Anna Anund	2019-05-01	2023-04-30	EU H2020	VTI, Autoliv and Zenseact, other EU/ international partners
SAFER Pre-Study: SAFE MICROMOBILITY	Marco Dozza	2023-01-01	2023-06-01	SAFER Pre-Study Funding	Chalmers, Autoliv, Folksam, Trafikverket, Göteborgstad, NTF
SAFER Pre-Study: DISC – Driver interaction with Safety Scales and Scoring Systems based on different use case scenarios	Paul Hemeren	2022-11-30	2023-09-30	SAFER Pre-Study Funding	University of Skövde, Autoliv, Smart Eye, Viscando
DRIVER – Driver physiological monitoring for vehicle Emergency Response	Stefan Candefjord	2021-04-01	2023-09-30	FFI	Chalmers, Autoliv, VTI, VGR, Raytelligence
SKARA GUARDIAN ANGEL – On-demand infrastructure services for safer, more secure, and comfortable active mobility	Lei Chen	2021-10-01	2023-09-30	FFI	RISE, University of Skövde, Jönköping University, Skara Municipality
SCAV – Safety culture & automated vehicles	Christina Stave	2022-04-01	2024-03-31	FFI	VTI, RISE, Toyota, Combitech & Volvo Group, TÖI
PANACEA – Practical and effective tools to monitor and assess commercial drivers' fitness to drive	Anna Anund	2021-05-01	2024-04-30	EU H2020	VTI, Chalmers, SENSEAIR, Transdev, other EU/ international partners
ENHANCED ADAS II – Improving drivers' experience, acceptance and trust in assistance systems	Niklas Strand	2022-11-01	2025-10-31	VINNOVA	Aptiv, RISE, Smart Eye

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Safety Performance Evaluation					
Open Research project: SAFETY DATASET FOR TRAINING AND VALIDATION OF AI PERCEPTION FUNCTIONS IN AD AND ADAS	Jörg Bakker	2020-11-01	2022-03-31	Open Research at AstaZero Program	Asymptotic, Revere
RODL – Road Data Lab	Thomas Olsson	2019-12-09	2022-03-31	FFI	RISE, Lund University, Zensact, AI Sweden, Univrses
HETEROGENEOUS TRAFFIC GROUPS – Heterogeneous Traffic Groups Cooperative Driving Behaviours Research under Mixed Traffic Condition	Jiali Fu	2019-04-01	2022-03-31	VINNOVA MOST China Sweden call	VTI, Chalmers, VCC, Volvo Group, RIOH, Geely , Beijing Jingwei HiRain, Tsinghua University, Tongji University
SAFER Pre-Study: DRIVER INTERACTION WITH AUTOMATED VEHICLES IN REAL MOTORWAY TRAFFIC	Thomas Streubel	2022-03-30	2022-08-30	SAFER Pre-Study Funding	VCC, Chalmers
SAFER Pre-Study: GENERATING SYNTHETIC SCENARIOS TO TEST AN AI-ENABLED TRAFFIC MEASUREMENT SYSTEM	Markus Borg	2022-04-01	2022-08-31	SAFER Pre-Study Funding	RISE, Lund University, Viscando
STRADA – Swedish Traffic Accident Data Acquisition In-depth study	John-Fredrik Grönvall	2020-04-01	2022-12-31	FFI	Chalmers, Autoliv, Folksam, IF, VTI, VCC, Volvo Group
SAFER Pre-Study: HOVDING DATA FOR RISK ASSESSMENT	Viveca Wallqvist	2021-04-05	2022-12-31	SAFER Pre-Study Funding	RISE, Hövding
SAFER DATA PORTFOLIO	John-Fredrik Grönvall	2020-11-01	2022-12-31	SAFER Core	Chalmers, Svanberg&Svanberg
FOT-E – Field Operational Test-Feature Extraction from Video	John-Fredrik Grönvall	2019-11-01	2023-03-31	FFI	Chalmers, Autoliv, Smarteye
SAFER Pre-Study: THINK TANK TRAFFIC SAFETY FOOTPRINT	Tania Dukic Willstrand	2022-04-01	2023-03-31	SAFER Pre-Study Funding	Volvo Group, Autoliv, Folksam, Swedish Transport Administration, VTI
MIDAS – anonyMIsing DAta collection for traffic Safety	Cristofer Englund	2020-04-01	2023-03-31	FFI	RISE, Halmstad University, Viscando, Berge Consulting
SAFER Pre-Study: DARTER: Digital twins for Accessible Real Testing grounds for automotive Engineers and Researchers	Beatriz Cabrero-Daniel	2022-01-12	2023-04-30	SAFER Pre-Study Funding	GU, AstaZero, Computer Vision Center
FOLLOW-UP OF ROAD SAFETY REQUIREMENTS WHEN PROCURING FREIGHT TRANSPORT	Tania Dukic Willstrand	2022-01-20	2023-05-31	Skyltfonden (STA)	SAFER, DuWill, Volvo Group, VTI
SAFE AND SECURE TRANSPORT CORRIDORS IN INDIA – SITIS Project #1 (SSTCI)	"Sofie Vennersten John-Fredrik Grönvall"	2021-01-01	2023-06-30	FFI	Chalmers, VTI, RISE, Volvo Group, Autoliv, Ericsson and Saab (TechMahindra, ARAI, Altair, IIT, IISC, Manipal)
TRAFFIC ACCIDENTS AND RISK FACTORS AMONG ELDERLY DRIVERS	Jesper Sandin	2020-09-01	2023-06-30	Swedish Transport Administration	VTI, Folksam
ICV-SAFE – Testing safety of intelligent connected vehicles (ICV) in open and mixed road environment	Lei Chen	2020-08-01	2023-07-31	VINNOVA MOST China Sweden call	RISE, Chalmers, Alkit Communications, WSP Sverige, Fellowbot; Tongji University (CN), Changan University (CN), Shanghai Songhong, Intelligent Automotive (CN), Highway research institute Ministry of Transportation (CN), TuSimple (CN), Guangzhou O.CN (CN)
HI-DRIVE - Designing Automation	Ines Heinig	2021-07-01	2025-06-30	EU H2020	SAFER JRU (Chalmers, Svanberg & Svanberg, Chalmersindustriteknik), VCC, Volvo Group, other EU partners
FAME – Framework for coordination of Automated Mobility in Europé	John-Fredrik Grönvall	2022-07-01	2025-06-30	EU Horizon Europe	Chalmers, Volvo Group, other EU partners
SUNRISE – Safety assUraNce fRamework for connected, automated mobility SystEms	John-Fredrik Grönvall	2022-09-01	2025-08-31	EU Horizon Europe	SAFER JRU (Chalmers, RISE), other EU partners
HANDBOOK OF ROAD SAFETY MEASURES	Alena Hoye	2013-01-01	no	Norwegian Public Roads Administration	TØI

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Systems for Accident Prevention and Automated Driving					
ENSEMBLE – ENabling SafE Multi-Brand pLatooning for Europe	Xu Wen	2018-06-01	2022-03-31	EU H2020	Scania, Volvo Group, KTH, other EU/international partners
SAFETYNET FOR TRUCKS	Stefan Koychev	2018-10-01	2022-03-31	FFI	Volvo Group, Chalmers
ETAVEP – Enablers for Testing Autonomous Vehicles at Existing Proving ground	Albert Lawenius	2020-04-01	2022-03-31	FFI	VCC, Volvo Group, AstaZero, RISE, Chalmers, SafeRadar
SMILE III – Safety analysis and validation of systems based on machine learning	Cristofer Englund	2020-04-01	2022-03-31	FFI	RISE, QRTECH, Infotiv, Combitech, ESI Nordics, Semcon
SAFER Pre-Study: TRUSTWORTHY AI FROM A TRAFFIC SAFETY PERSPECTIVE	Else-Marie Malmek	2022-01-10	2022-08-31	SAFER Pre-Study Funding	Zenseact, VCC, Mälmeken, Revere, Blackbird Law
AUTOFREIGHT – Self-driving trucks for smarter logistics	Lena Larsson	2017-04-01	2022-08-31	FFI	Volvo Group, Combitech, Chalmers, City of Borås
REDO - Remote Driving Operations	Maytheewat Aramrattana	2020-01-01	2023-02-28	FFI	CEVT, NEVS, VTI, Einride, Ericsson, Ictech, KTH, Voysys
MICA 2 – Modelling Interaction between Cyclists an Automobiles	Marco Dozza	2019-11-22	2023-06-30	FFI	Chalmers, Autoliv, Veoneer, VCC, If, Viscando, VTI
SALIENCE4CAV – Safety lifecycle enabling continuous deployment for connected automated vehicles	Fredrik Warg	2021-01-01	2023-06-30	FFI	RISE, Veoneer, Zenseact, Agreat, Comentor, Epiroc, KTH, Qamcom, Semcon
VALU3S – Verification and Validation of Automated Systems' Safety and Security	Behrooz Sangchoolie	2020-05-01	2023-07-31	EU H2020	RISE, VTI, KTH, other EU/international partners
CLOUDIA – Methods for efficient searching of events in large volumes of data for analysis and development of ADAS	Fredrik von Corswant	2021-11-01	2023-10-31	FFI	Veoneer, Arriver, Folksam, Pionate
SAFESMART – Safety of Connected Intelligent Vehicles in Smart Cities	Alexey Vinel	2019-09-01	2024-02-29	The Knowledge Foundation	Halmstad University, AstaZero, Scania, H&E Solutions, Terranet, Gutec, Quviq, KPIT
SELF-DRIVING BICYCLE FOR ACTIVE-SAFETY TEST	Jonas Sjöberg	2021-03-15	2024-03-14	FFI	Chalmers, Mälardalens Universitet, VCC, Veoneer, Autoliv, Cycleurope, AstaZero
EVIDENT – Enabling VIrtual valiDation and vErificatioN for ADAS and AD feaTures	Viktor Johansson	2022-04-01	2024-06-30	VINNOVA	AstaZero, Asymptotic, CEVT, Einride, GU, Chalmers (REVERE), RISE, Veoneer, VTI
SEVVOS – Simulering och Emulering av Vattenspray för Validering av Optiska Sensorer	Peter Eriksson	2022-01-01	2024-12-31	VINNOVA	AstaZero, Veoneer, Chalmers, RISE
ASSERTED – Assuring Safety for Rapid and Continuous Deployment for Autonomous Driving	Ali Nouri	2021-11-01	2025-10-31	FFI	VCC, Chalmers, Zenseact
ROADVIEW – Robust Automated Driving in Extreme Weather	Eren Erdal Aksoy	2022-09-01	2026-08-31	EU Horizon Europe	Halmstad University, VTI, RISE, other EU partners
Competence					
TRAFFIC SAFETY FOOTPRINT	Tania Dukic Willstrand	2021-01-15	2022-05-01	Skyltfonden (STA)	SWECO, DuWill, NTF, Gothenburg City, Partille Kommun
SMART URBAN TRAFFIC ZONES	Felicia Hökars	2020-09-01	2022-09-01	FFI	SAFER/ Chalmers, GU, RISE, AstaZero, VTI, Gothenburg City, Scania, VCC, other Swedish partners
SUS – Sensor testing in adverse weather conditions	Valery Chernoray	2020-10-01	2022-09-30	FFI	AstaZero, Chalmers
IGLAD Phase 4 – Initiative for the global harmonisation of accident data	Ines Heinig	2020-01-01	2022-12-31	Consortium financed	SAFER/Chalmers, Autoliv, VCC, Volvo Group, Asymptotic, other EU/international partners
AI DRIVEN MOBILITY	Vanja Carlén	2021-01-01	2022-12-31	VINNOVA, Drive Sweden program	Zenseact, Ericsson, Volvo Group, Polestar, Viscando, Univrses, UniqueSec, VGR, Swedish Transport Administration, Kista Science City, Örebro kommun, Chalmers, University of Borås, Malmö University, Region Örebro län, Region Jönköpings län, Sjöfartsverket, AFRY, DOKIV AB, NSR

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Competence					
FUTURE-HORIZON Coordination and Support Action	Magnus Granström	2021-02-01	2023-01-31	EU H2020	Chalmers, Volvo Group
IMPROVE TRAFFIC SAFETY THROUGH ADVANCED AND AUTOMATIC DRIVING EVALUATIONS USING AI AND EYE TRACKING	Ravi Chadalavada	2022-12-01	2023-02-28	VINNOVA, Drive Sweden program	Örebro University, RISE, VTI, Region Örebro Län (hospital), QTPIE
GOTHENBURG GREEN CITY ZONE – Traffic safety research needs, utilizing the Gothenburg Green City Zone Initiative	Malin Levin	2022-08-23	2023-03-31	Trafikverket	Autoliv, Business Region Göteborg, Chalmers University, City of Gothenburg, Cycleurope, DHL, Gothenburg University, Halmstad University, Johannebergs Science Park, Lund University, Next Bike, NTF Väst, Pedalink/ Cykelpoolen, RISE, SAFER, Scania, Svenska Mässan, Swedish Transport Administration, Tier app, Trivector, Voi, University of Skövde, Volvo Cars, Volvo Group, VTI, Zenseact
DRIV – Data Law Innovation	Erika Gustafsson	2021-10-15	2023-11-30	VINNOVA	LSP (coordinator), Delphi, Chalmers, GU/ Sahlgrenska, Helsingborgs kommun, Lunds universitet, MAQS Advokatbyrå, NCC, Patent- och registreringsverket, Region Halland, Region Stockholm, RISE, Chalmers Industriteknik, Swedish Transport Administration, Tyréns Sverige, VGR,
INTENTION RECOGNITION OF VULNERABLE ROAD USERS	Sepideh Pashami	2022-12-15	2023-04-31	VINNOVA, Drive Sweden program	RISE, Volvo Group, Viscando, Univrses and Electricity
HEUDRIS – Horizon, EUrope och DrIve Sweden	Ingrid Skogsmo	2022-05-01	2023-12-31	VINNOVA	VTI, Autoliv, Chalmers, RISE, Volvo Group
AI ENHANCED MOBILITY	Ulrika Holmgren	2022-06-01	2023-12-31	VINNOVA, Drive Sweden program	Asymptotic, Chalmers, CEVT, Conzens, Embedl, Halmstad University, Iboxen Infrastruktur Sverige AB, TÖY, Jönköpings kommun, Stadsbyggnadskontoret, Linköping Universitet, Lund Universitet, Malmeken, Malmö Universitet, RISE, Region Jönköping, Region Örebro, Schenker, Smart Eye, SSPA, Svanberg och Svanberg, National Road and Transport Research Institute, Trafikverket, Technolution, Tekniska Högskolan i Jönköping , The Train Brain, Univrses, University of Borås, University of Skövde, Viscando, Voi Technology, VCC, Volvo Group, WSP, Västtrafik, Zenseact, ÅF, Örebro University
STRENGTH_M – Stimulating road Transport Research in Europe and around the Globe for sustainable Mobility	Verena Wagenhofer (AVL)	2022-09-01	2025-08-31	EU (CSA type of project)	Volvo Group, CIT, other EU partners
AFROSAFE – Safe System for radical improvement of road safety in low- and middle-income African countries	Aliaksei Laureshyn	2022-09-01	2026-08-31	EU Horizon Europe	Lund University, VTI, Autoliv, Volvo Group (GTT), Chalmers Industriteknik, Institute of Transport Economics, Norway, University of Education, Winneba, Ghana, NTU International, Denmark, Technical University of Delft, Netherlands, University of Dar es Salaam, Tanzania, Zambian Road Safety Trust, Zambia

APPENDIX 7: COLLABORATIVE KNOWLEDGE SHARING AND PROJECT CREATION ACTIVITIES

Conducted SAFER seminars, conferences, workshops and other events during year 17 include:

- SAFER lunch webinar hosted by NEVS: Open source AD on public road, January 27, 2022
- SAFER lunch webinar – theme Driver distraction and inattention, February 3, 2022
- Kick-off AI Driven Mobility – phase 2 (all SAFER partners invited), February 7, 2022
- SAFER Update, February 9, 2022
- SAFER Research area day, February 9, 2022
- SAFER lunch webinar: Rana el Kaliouby talks about Emotionally aware vehicles, February 10, 2022
- SAFER lunch webinar: SAFER lunch webinar: Collaboration opportunities through Drive Sweden, February 24, 2022
- SAFER Seminar: Safety and ease of use assessment of new electric vehicle for personal mobility, February 25, 2022
- Traffic Safety footprints, result webinar, March 3, 2022
- SAFER lunch webinar: Safety assurance for automated vehicles, March 3, 2022
- Licentiate seminar with Galina Sidorenko: "Safety of Cooperative Automated Driving: Analysis and Optimization", March 3, 2022
- SAFER Research and Project day, March 11, 2022
- SAFER Shareholders meeting, March 11, 2022
- SAFER lunch webinar: Disability-inclusive design of future transport systems - How can we ensure that mobility solutions are accessible for all people?, March 17, 2022
- SAFER lunch webinar: Project presentations from AstaZero: Ascetism & Vamlav, March 24, 2022
- SAFER lunch webinar: Projects from the Safety Performance Evaluation research area: Elderly drivers & MIDAS, March 31, 2022
- Safe System Principles – workshop, April 7, 2022
- SAFER Thursday lunch webinar hosted by Scania: A glimpse on "Traffic Safety 2030 - from Commercial Vehicle Perspective", April 7, 20227,
- SAFER Research area day #2 2022, April 20, 2022
- SAFER Update, April 20, 2022
- SAFER lunch webinar: New SAFER partners - Chalmers Industriteknik & QRTECH, April 21, 2022
- SAFER Seminar with Dr. Richard Hanowskii, Towards the Development of a Fleet Concept of Operations for Managing Automated Driving System-Equipped Trucks in a Mixed Fleet, April 27, 2022
- SAFER Thursday lunch webinar: Project Virtual, April 28, 2022
- Ron Schindler's Doctoral Thesis defense: A Holistic Safety Benefit Assessment Framework for Heavy Goods Vehicles, April 28, 2022
- Erik Brynskog's licentiate seminar "Towards the Inclusion of Pelvis Population Variance in Human Body Models, April 29, 2022
- SAFER lunch webinar: FFI's updated Research and Innovation program, May 4, 2022
- SAFER lunch webinar: Results from two SAFER pre-studies: Using data from Hövding and other sources for risk assessment and Report on the safety and traffic flow impact of mixed traffic condition, May 5, 2022

- SAFER lunch webinar: Road safety trends in Sweden 2021 - overview of the Swedish road safety performance indicators, May 12, 2022
- SAFER After Work with networking opportunities for the SAFER Partners, May 12, 2022
- Competence network for Vehicle dynamics annual conference: Vehicle Dynamics -- Connected and Electric, May 18, 2022
- SAFER Lunch webinar: Accident research teams at Volvo Trucks & Volvo Cars, May 19, 2022
- Workshop: Safety performance indicators for humans and ADS's – differences and similarities, May 19, 2022
- AHA dissemination event; How will we experience future mobility and transport?, May 20, 2022
- Seminar with Carol Flannagan: Adventures of a Woman Data Scientist in the U.S.: Looking for the "Culture of Respect", May 23, 2023
- SAFER Webinar: Human Factors in Developing Automated Vehicles: A Requirements Engineering Perspective, May 24, 2022
- Modal shift and safe active mobility workshop series – inspirational and project creation activities, May 28, 2022
- Idea creation workshop for the third set of calls in Horizon Europe, June 9, 2022
- SAFER's session at Transportforum in Linköping; From unprotected to protected road users, June 16, 2022
- Workshop at Transportforum in Linköping: Trafiksäkerhetsavtryck – ett verktyg för att nå ett hållbart transportsystem, June 17, 2022
- SAFER presented the necessity of collaboration at the Join Sweden Summit 2022 in Stockholm, June 21, 2022
- SAFER co-hosting the International Conference on Transport and Traffic Psychology in Gothenburg, August 23-25, 2022
- SAFER Breakfast seminar: Tactical Safety in Autonomous Driving - The Implementation of Precautious and Cooperative Driving, August 30, 2022
- Findings from the AHA-project: Engaging people in future mobility co-design activities, August 30, 2022
- Workshop to identifiy future traffic safety needs, utilizing the Gothenburg Green City Zone, August 31, 2022
- SAFER lunch seminar: The FIA Road Safety Index – what we learnt from the pilot study, September 1, 2022
- SAFER lunch seminar: Embodied Cognition & OpenBike-CD (SAFER Pre-studies), September 8, 2022
- SAFER Research area day #4, September 13, 2022
- SAFER Update about upcoming collaboration activities, September 13, 2022
- Launch event for the SAFER Data Catalogue, September 13, 2022
- SAFER lunch seminar with the partner Veoneer; Innovating, creating trust in mobility, September 15, 2022
- Child occupant protection: Latest knowledge and future opportunities, September 21, 2022
- Jordanka Kovaceva's Doctoral thesis defence: Methods and models for safety benefit assessment of advance driver assistance systems in Car-to-cyclists conflicts, September 21, 2022
- Final event for the GLAD-project (Goods deliveries under the last mile with automated delivery vehicles), September 22, 2022

- Lindholmen Open Day, September 22, 2022: Panel dialogue at Lindholmen Open Day: Road safety - an important part of Agenda 2030 – how do we approach the common challenges in practice?, September 22, 2022
- Lindholmen Relay – a great evening with running, energy and networking!
- SAFER lunch seminar: Driver behavior changes when interacting with automated vehicles in real traffic, September 29, 2022
- Emma Nilsson's doctoral defense: "Effects on cognitive tasks on car drivers' behaviours and physiological responses", September 30, 2022
- SAFER lunch seminar: Deep learning and its role in traffic safety and driving automation, October 6, 2022
- SAFER lunch seminar - Vehicles and safety: Current research priorities in the United States, October 13, 2022
- Study tour and networking dinner at Smart Eye, October 18, 2022
- The 8th International Conference on Driver Distraction and Inattention, Gothenburg, October 19-20, 2022
- SAFER lunch seminar: Horizon Europe projects FAME, October 20, 2022
- SAFER lunch seminar: The Influence of Alcohol on visual information sampling and driver attention, October 27, 2022
- SAFER lunch seminar: Trustworthy AI from a Traffic Safety Perspective and Generating Synthetic Scenarios to Test an AI-Enabled Traffic Measurement System (SAFER Pre-studies), November 10, 2022
- SAFER hosting the ISO TS 5083 Road vehicles – Safety for automated driving systems – Design, verification and validation, November 14-16, 2022
- SAFER-seminar: Driver-automation interaction – modeling, behavioral adaptation, and interaction design with Prof. David Abbink, Delft University of Technology, November 16, 2022
- Linda Pipkorn's doctoral defense: "The driver response process in assisted and automated driving", November 16, 2022
- SAFER lunch seminar: The Horizon Europe project SUNRISE, November 17, 2022
- Workshop at TRA: Sustainable Road Safety – medium-term trends and needs for future R&I", planned and performed jointly by the European Commission and ERTRAC, November 17, 2022
- Workshop: Is it a good idea to use traffic simulations for safety benefit assessment of autonomous driving systems (ADS)? , November 18, 2022
- SAFER is co-hosting the Scandinavian Conference on System and Software Safety, November 22-23, 2022
- SAFER Research area day #5, November 23, 2022
- SAFER Update about upcoming collaboration activities, November 23, 2022
- SAFER Day: Study tour to Autoliv and Veoneer in Vårgårda, November 24, 2022
- SAFER lunch seminar: Bike Helmet Rating – Factors that Can Influence the Rating, December 1, 2022
- Daniel Åsljung's doctoral dissertation: "On Statistical Methods for Safety Validation of Automated Vehicles", December 6, 2022
- SAFER lunch seminar: In the Hub: designing for future interactions between human operators and automated heavy vehicles using natural interaction technologies, December 8, 2022
- SAFER seminar with Prof. Duane Cronin, University of Waterloo, December 7, 2022

- I Putu Alit Putra's doctoral defense: "Occupant Neck Muscle Modelling in Rear-End Crashes", December 8, 2022
- Vivekendra Singh doctoral defense: 3-D rate dependent micromechanical model for polymer composites, December 16, 2022
- SAFER Christmas Breakfast networking event, December 21, 2022

APPENDIX 8: CONFERENCES

Conferences in which SAFER's research has been presented:

- CAIN 2022 – 1st International Conference on AI Engineering - Software Engineering for AI, Pittsburgh, USA & online, May, 2022
- DSN 2022 – 52nd Annual IEEE/IFIP International Conference on Dependable Systems and Networks, Baltimore, USA, June, 2022
- IV22 – 33rd IEEE Symposium on Intelligent Vehicle, Aachen, Germany, June, 2022
- AHFE International 2022 – 13th International Conference on Applied Human Factors and Ergonomics, New York, USA, July, 2022
- Transportforum, Sweden, June, 2022
- DHM 2022 – 7th International Digital Human Modeling Symposium, Iowa City, USA, August, 2022
- ICTTP 2022 – 7th International Conference on Traffic and Transport Psychology, Gothenburg, Sweden, August, 2022
- Tylösand conferernce, Sweden, September, 2022
- AutomotiveUI 2022 – 14th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Seoul, Republic of Korea, September, 2022
- EDCC 2022 – 18th European Dependable Computing Conference, Zaragoza, Spain, September, 2022
- IRCOBI 2022 – International Research Council on the Biomechanics of Injury Europe Conference, Porto, Portugal, September, 2022
- ITSC 2022 – 25th IEEE International Conference on Intelligent Transportation Systems, Macau, China & online, September, 2022
- SAFECOMP 2022 – 41st International Conference on Computer Safety, Reliability and Security, online, September, 2022
- SEAA 2022 – Euromicro Conference on Software Engineering and Advanced Applications, Maspalomas, Spain & online, September, 2022
- DDI 2022 – 8th International Conference on Driver Distraction and Inattention, Gothenburg, Sweden, October 2022
- RS5C 2022 – 19th International Conference Road Safety on Five Continents, Grapevine, USA, October 2022
- SIA VISION 2022 – International Congress, Paris, France, October, 2022
- ICVES 2022 – IEEE International Conference on Vehicular Electronics and Safety, Bogotá, Colombia, November, 2022
- PRDC 2022 – 27th IEEE Pacific Rim International Symposium on Dependable Computing, Beijing, China & online, November, 2022
- 10th Scandinavian Conference on Systems & Software Safety, Gothenburg, Sweden, November, 2022
- 20th International Conference Protection of Children in Cars, Munich, Germany, November, 2022

APPENDIX 9: THESES

Doctoral Theses
- Holistic Safety Benefit Assessment Framework for Heavy Goods Vehicles
  Ron Schindler, Crash Analysis and Prevention research unit of the Division of Vehicle Safety, Chalmers University of Technology, April 28, 2022
- Coordination and Analysis of Connected and Autonomous Vehicles in Freeway On-Ramp Merging Areas
  Jie Zhu, Urban Mobility Systems research group at the Department of Architecture and Civil Engineering at Chalmers University of Technology, June 10, 2022
- Methods and models for safety benefit assessment of advance driver assistance systems in Car-to-cyclists conflicts
  Jordanka Kovaceva, Division of Vehicle Safety at the Department of Mechanics and Maritime Science at Chalmers University of Technology, September 21, 2022
- Effects on cognitive tasks on car drivers' behaviours and physiological responses,
  Emma Nilsson, Volvo Cars & Division of Vehicle Safety at the Department of Mechanics and Maritime Science at Chalmers University of Technology, September 30, 2022
- The driver response process in assisted and automated driving
  Linda Pipkorn, Division of Vehicle Safety at the Department of Mechanics and Maritime Science at Chalmers University of Technology, November 16, 2022
- On Statistical Methods for Safety Validation of Automated Vehicles
  Daniel Åsljung, Zenseact and the Mechatronics research group, Electrical engineering, Chalmers University of Technology, December 6, 2022
- Occupant Neck Muscle Modelling in Rear-End Crashes
  I Putu Alit Putra, Division of Vehicle Safety at the Department of Mechanics and Maritime Science at Chalmers University of Technology, December 8, 2022
- 3-D rate dependent micromechanical model for polymer composites
  Vivekendra Singh, RISE and the division of Material and Computational Mechanics, Department of Industrial and Materials Science at Chalmers University of Technology, December 16, 2022

Licentiate Theses
- Safety of Cooperative Automated Driving: Analysis and Optimization
  Galina Sidorenko, Halmstad University, School of Information Technology, March 3, 2022
- Towards the Inclusion of Pelvis Population Variance in Human Body Models
  Erik Brynskog, Injury Prevention Group within the Division of Vehicle Safety at Chalmers University of Technology, April 29, 2022

SAFER is the research and knowledge sharing arena where researchers and expertise work together to create safe mobility. Our traffic safety approach covers people, vehicles and the infrastructure – and together we contribute to safer road transports and smarter, more sustainable cities.

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