SAFER STAGE 5 REPORT

APRIL 1 2019 – DEC 31 2023

SAFER

VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

SAFER Vehicle and Traffic Safety Centre at Chalmers is a collaborative platform to acquire and share knowledge to make a significant contribution to a safer road transport environment for all.

The knowledge generation platform is being realised through collaboration between universities, research institutes, industries, government authorities and other relevant actors. SAFER aims to contribute to the elimination of fatalities and serious injuries in the mobility system through multidisciplinary research, collaboration activities and knowledge exchange, and to make Swedish society, the academia and the industry into world leaders in safe transport. Chalmers University of Technology is our host and about 50 partners are participating in the collaboration.

CONTENT

INTRO-DUCTION

Welcome to our SAFER Stage 5 report, a comprehensive reflection of our traffic safety research journey spanning from April 1st, 2019, to December 31st, 2023.

A STANDOUT ACHIEVEMENT during this stage has been our pre-study program. All in all, we received close to 60 ideas for collaborative research, out of which we financed and executed as many as 34 projects. These initiatives have not only borne fruit for the partners involved and SAFER as a platform, but have also paved the way for follow-up initiatives. A substantial amount of these studies evolved into larger projects, funded by financiers such as e.g. Vinnova.

> In recent years, we've seen increased recognition of traffic safety's crucial role in achieving a sustainable transport system.

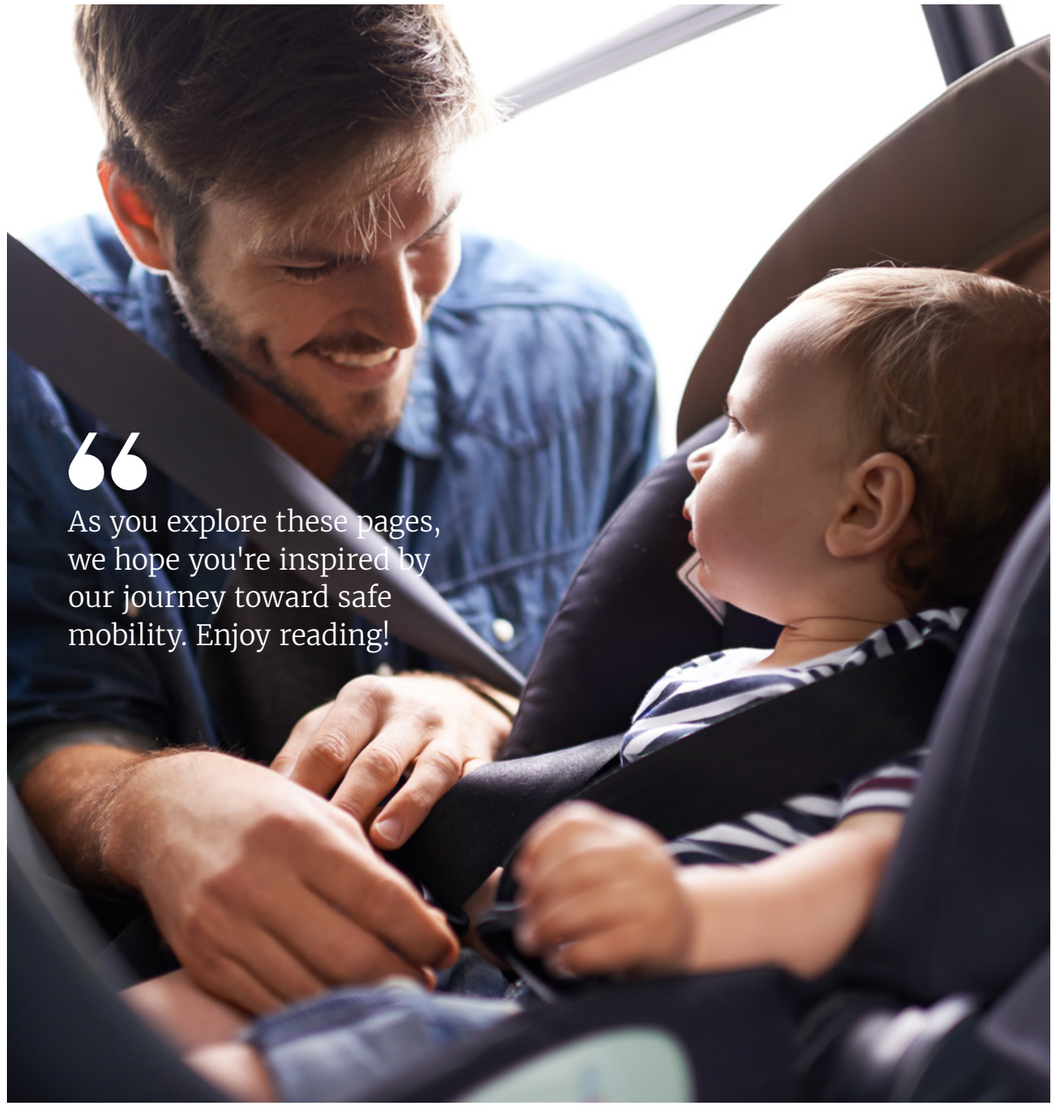
Equally important are the insights and research contributions from our partners. Together, we've made significant progress in areas such as vehicle automation, road user behavior, and modeling human behavior as well as the human body. Additionally, our focus on data collection, analysis, and sharing frameworks has proven particularly valuable for our partners. In total, research insights have been generated from about 170 ongoing projects in SAFER's portfolio.

During this half decade, we have witnessed a growing recognition of the integral role of traffic safety in the transition towards a truly sustainable transport system. As society undergoes a profound transformation, our mission remains steadfast: to ensure that future mobility solutions prioritise safety, ensuring sustainability from all perspectives.

The COVID-19 pandemic introduced exceptional challenges, yet it also provided a unique dimension to our collaboration. Demonstrating resilience and adaptability, we leveraged digital tools to maintain and even enhance our collaborative efforts. This digital spin led to a remarkable 50% increase in participation from partner organisations and also the welcoming of 10 new partners. While digital engagement proved invaluable during these very special times, SAFER remains determined in its belief in the irreplaceable value of face-to-face interactions. As we move forward, we recognise that in-person engagements are paramount for trust-building and nurturing long-term relationships among partners.

Having said that, our dedication to networking remains strong. We have organised numerous events and workshops, including SAFER's appreciated breakfast and lunch sessions, to encourage collaboration and spark new ideas. Overall, we have hosted more than 350 learning and co-creation activities for our partners during these 5 years, promoting regular interactions with researchers and specialists from different disciplines, a focus we will maintain in our next phase.

While traffic fatalities have not decreased as significantly as we hoped over the past decade, a notable achievement has been the recognition of traffic safety on par with other societal challenges. Traffic safety has now been aligned with other pressing global issues, securing its position within the UN's global sustainable development goals. The endorsement of the inaugural UN resolution on road



> As you explore these pages, we hope you're inspired by our journey toward safe mobility. Enjoy reading!

safety provides a robust foundation for our current and future initiatives.

Furthermore, our influence on shaping future research and innovation programs remains profound. Through our co-creation methodology and facilitation know-how, we have generated several project proposals that have secured funding within EU's framework programs. This alignment also underscores SAFER's value proposition, amplifying our partners' voices and reaching out to key societal stakeholders and decision-makers.

As we approached the end of this stage, our focus has increasingly shifted towards setting the strategy and shaping our next phase. In January 2024, we commenced a renewed collaboration agreement with over 40 partners, signalling our collective determination and shared vision to save lives in traffic. Our research agenda remains robust and aligned, positioning us to make significant contributions towards a road transport system safe for *all*.

With this report, we aim to provide you with a comprehensive and inspiring overview of our research findings during this five-year period. We invite you to delve deeper, explore our achievements, and witness the collaborative spirit, innovation, and passion that define SAFER. As you navigate through these pages, we hope you find inspiration in our journey and join us in celebrating the collective steps we have made towards safe mobility. Happy reading!

———

Kindest regards,
SAFER Board and Management Team

WHY SAFER?

ALARMING STATISTICS reveal that 1.19 million lives are lost annually in traffic accidents, with road injuries being the leading cause of death for individuals aged 5–29. The SAFER platform is crucial in addressing this issue. Despite improvements, road accidents remain a significant concern globally, with nine out of ten lives lost occurring in low- and middle-income countries. The increasing number of vulnerable road users, coupled with rising costs, emphasizes the urgent need for collaborative efforts. Europe, recognizing the gravity, aims for near-zero road fatalities by 2050, requiring intensified road safety research and cooperation with stakeholders.

> SAFER's role is to provide the science base for safe products, services, infrastructure as well as policies and legislation.

HOW WE CONTRIBUTE

SAFER Vehicle and Traffic Safety Centre at Chalmers is a collaborative platform for research and knowledge exchange where partners from society, academia and industry acquire and share knowledge to make significant contributions to a safer road transport environment for *all*. SAFER was crafted to facilitate collaborative research and knowledge-building endeavours among the partners, all aimed at achieving Vision Zero and tackling the complex traffic safety challenges of today and tomorrow, far beyond what a single actor can accomplish. The SAFER environment sparks research ideas through its diverse set of networking activities, usually resulting in national, bilateral or European funded research projects feeding back knowledge to the community. SAFER is the go-to hub in Sweden for being up to date on various aspects of road transport safety including research, and it is an excellent networking arena with participation from renowned road transport safety experts and researchers. Strong collaboration across different stakeholders is the required path towards zero fatalities and seriously injuried.

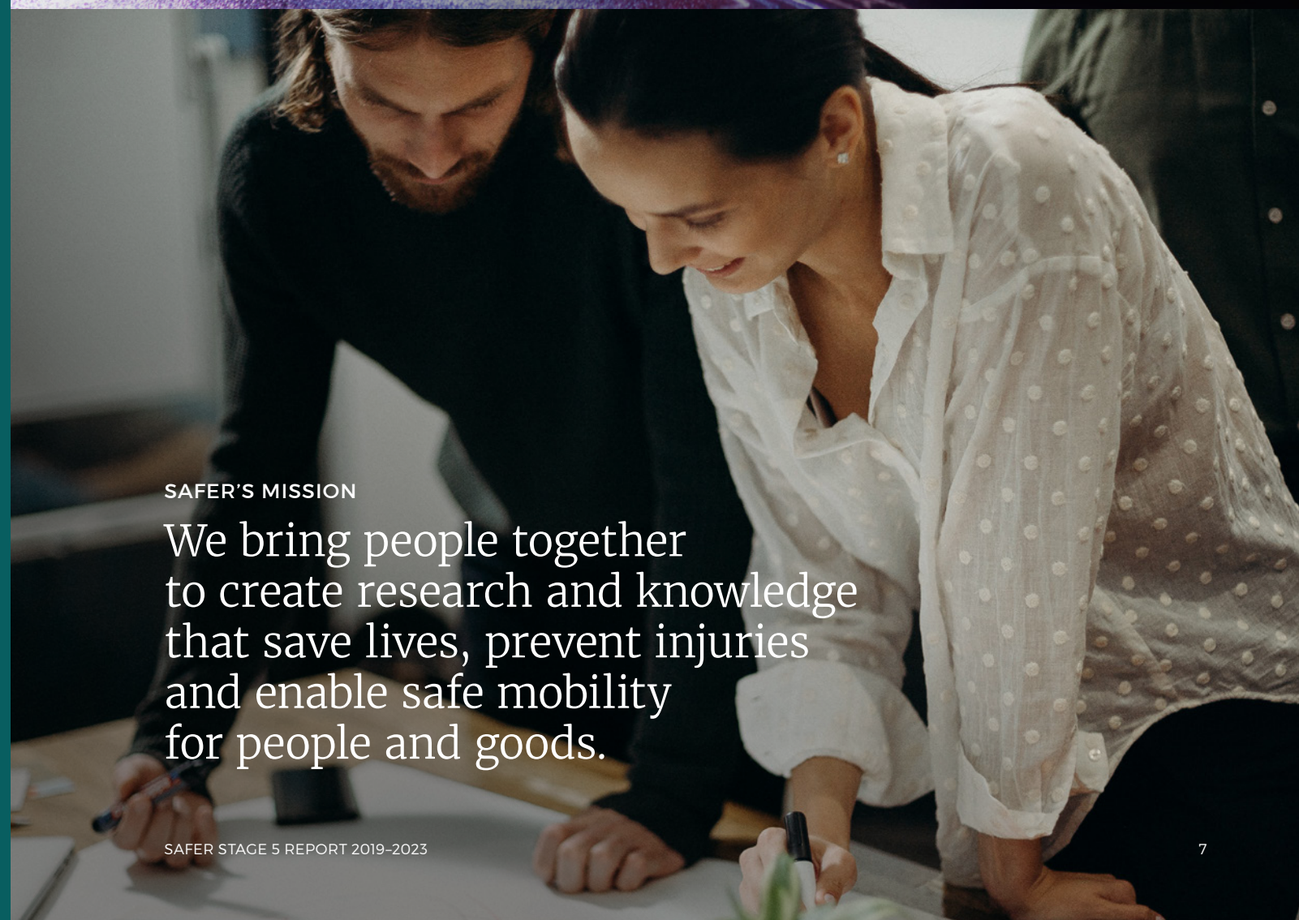
SAFER's collaboration agenda is driven by the partners and their interests, but SAFER is also part of a larger societal project: the design and realisation of smart, sustainable road transport systems in cities and beyond. SAFER's role is to provide the science base for safe products, services, infrastructure as well as policies and legislation and to be a thought leader in safe mobility, offering world-leading knowledge.

PARTNERS

The achievement of secure mobility for people and goods within a sustainable system is only possible through the collective efforts of talented and dedicated individuals united by a clear vision. In the realm of vehicle and traffic safety, the development of knowledge is paramount. By implementing findings from collaborative research, SAFER partners bring about tangible and measurable outcomes in real-world applications. This collaborative effort operates on a unique platform, where partners both access and contribute to a wealth of expertise and research. In SAFER's Stage 5, 35 partners formalised their commitment to collaborative research, and during the ongoing phase 15 new partners with valuable complementary knowledge have joined the collaboration, enhancing the collective pursuit of our common goals. For a complete list of partners during this stage, please refer to page 55.

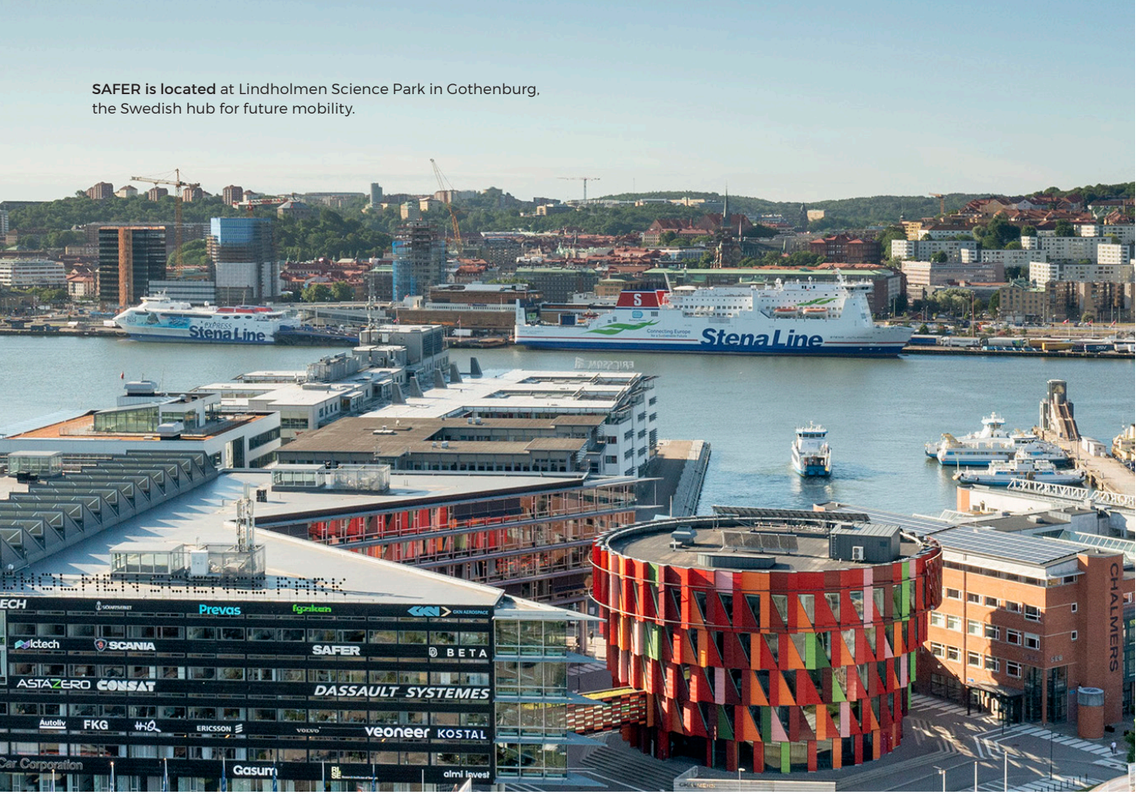
SAFER'S VISION

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.



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

Photo: Lindholmen Science Park

CONNECTED RESEARCH RESOURCES

Strengthening research capabilities for real-world traffic safety

SAFER'S PARTNERS GAIN, through relevant projects, access to an expansive research arena, including valuable resources embedded within our collaborative network. Appropriate projects offer a gateway to a spectrum of connected research resources, supported by a community of experts ready to guide you in leveraging these assets. Central to our strategic vision is the commitment to making research seamless, more impactful, and highly efficient through collaborative partnerships.

SAFER's network provides access to full-scale road traffic safety test environments, cutting-edge simulators, and a state-of-the-art research lab dedicated to active safety and autonomous driving. Complementing these facilities are physical workspaces and a world-class naturalistic driving data platform, collectively contributing to an environment for borderless research. This comprehensive set of resources empowers researchers with opportunities for both real-world and virtual testing and validation.

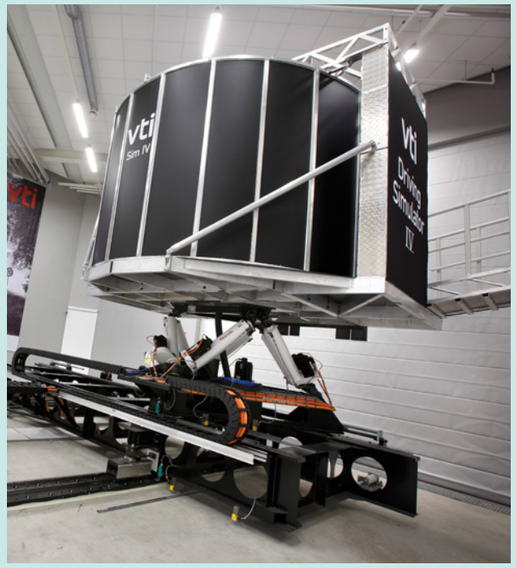
LINDHOLMEN SCIENCE PARK – CATALYSING FUTURE MOBILITY IN SWEDEN

SAFER operates from Lindholmen Science Park, a dynamic hub for cross-border collaboration and Sweden's forefront in future mobility development. With 375+ companies, two universities, and six secondary schools, Lindholmen is a thriving ecosystem, welcoming 25,000 daily visitors. This collaborative and innovative environment is instrumental in SAFER's success, fostering seamless research and collaboration across borders and disciplines.

SAFER NATURALISTIC DRIVING DATA PLATFORM

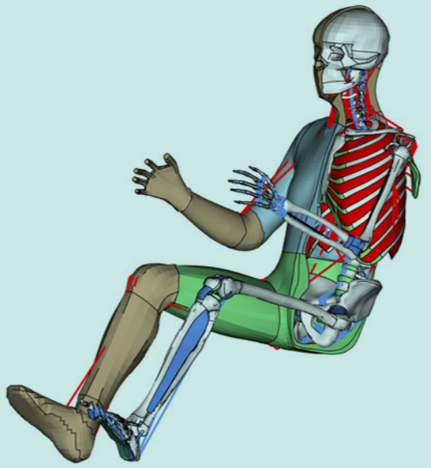
SAFER's Naturalistic Driving Data platform is a secure, world-class repository managing vast datasets from real-world driving scenarios, encompassing around 6.5 million kilometers. In 2019, SAFER secured research funding, leading to a significant platform upgrade completed in 2023. This enhancement incorporates advanced features such as improved eye tracking and body position analysis through machine learning, substantially enhancing the utility of the datasets. The updated platform equips researchers to tackle a broader spectrum of research questions, especially in validating safety systems for future vehicles.

Additionally, SAFER has augmented its research infrastructure with a comprehensive data catalogue, detailing quality-assured datasets and access protocols. The SAFER data portfolio not only supports streamlined traffic safety research but also encourages collaboration, establishing SAFER as an attractive resource for global research communities, read more on page 39.



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

THE SAFER 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.



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, 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. More information about IGLAD can be found at iglad.net

SIMULATORS

The Sim IV driving simulator at VTI, with its advanced motion platform system, has been important for our research efforts in many projects. The simulator offers significant linear movement on both x and y axes, prioritizing motion feedback and wide field of view. It supports simulations for cars, trucks and bicycles. Sim IV, the new Lindholmen mini simulator, inaugurated in 2022, along with the fixed-base simulators in Linköping, all play vital roles in enhancing our research capabilities, including projects like MICA II, CO_2 effects on driver state, EHMI, CTS-project on Cooperative Driving Behaviors, PANACEA and Fit2Drive.

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. The SAFER HBM is 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. On page 35 you can read more about the SAFER HBM and its development during SAFER Stage 5.

STORA HOLM – CLOSENESS AND VERSATILITY IN A TEST TRACK

SAFER's partner, the road safety organisation NTF Väst, provides our researchers with access to a conveniently located traffic training site at Stora Holm, nearby Lindholmen in Gothenburg. This versatile facility offers different driving surfaces, including gravel, asphalt, and slippery terrain, situated in hilly surroundings. The off-road course, set in a natural area, allows for additional practice on transverse slopes, both upward and downward, and features a water-filled ditch.

Beyond its primary function as a training and testing ground, the Stora Holm test track serves as an ideal venue for open-air events and demonstration activities, adding a practical dimension to research events.

ASTAZERO REAL-WORLD PROVING GROUND

Over the past five years, AstaZero, now fully owned by RISE Research Institutes of Sweden since September 2022, has solidified its position as one of the world's most advanced full-scale test environments for safe, sustainable, and connected automated road traffic. The proving ground, continually evolving to support active safety and assisted driving testing, introduced a new Flexible Logistics Zone in December 2022. This redesigned City Area offers adaptability, catering to logistics, parking, parking garages and city environments, complete with infrastructure for optimal testing.

In 2021, AstaZero expanded its operations with the inauguration of the world's longest indoor autonomous vehicle test track, measuring 700 meters in length and 40 meters in width. This indoor track, featuring a central part of 140 meters by 60 meters, accommodates tests with trucks, buses, and ordinary cars. With an internal ceiling height of 4.6 meters, the track enables 24/7 testing, 365 days a year, providing reproducible environments with consistent light and surfaces. The facility's uniqueness extends beyond its physical track to include a perfectly positioned virtual twin and a controllable 5G network. AstaZero remains a leader in defining test methods, participating in global collaborations, and contributing to the development of test methods in various research and customer projects, and will continue to be an important part of SAFER's network also in the upcoming phase.

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

REVERE – RESOURCE FOR VEHICLE RESEARCH

Chalmers' Revere lab, a key resource connected to SAFER, has significantly impacted traffic safety research since its 2015 inception. Transforming into a comprehensive research platform, Revere provides SAFER's partners with facilities for real-world traffic and simulator studies. The lab's involvement in numerous projects, including for example the FFI-funded EVIDENT initiative, demonstrates its commitment to addressing the fidelity gap between virtual simulations and real-world testing. Revere contributed its technical expertise and provided access to flexible vehicle platforms powered by the open-source software stack OpenDLV. Real vehicle experiments, such as those with A-double combinations and HCT vehicles, offer valuable insights into stability and communication protocols.

Revere's global influence is evident in collaborations like the Sweden-India SITIS project, highlighting its positive contribution to international safety efforts. Active participation in the SAFER Open research program and partnerships with Asymptotic to develop open datasets for research highlights Revere's importance for the research community.

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

Figure 1: SAFER's Swedish ecosystem in stage 5

ECOSYSTEM

In SAFER Stage 5, there has been a focus on leveraging the ecosystem and global collaborations. The initiative involves mapping the system, further developing links, and establishing new collaborations.

SAFER, while based in Sweden, embraces a global perspective in its research activities. Actively engaging with universities and traffic safety research communities worldwide, SAFER contributes to shaping the international agenda on traffic safety and encourage sustainable mobility practices. With a commitment to being a multidisciplinary research hub, SAFER serves as a collaborative space for partners across academia, industry, institutes, and the public sector. By developing larger clusters and connecting researchers from diverse fields, SAFER seeks to establish an extended safety research environment, blending its work with research activities funded through various programs.

Here are some examples of new initiatives in Stage 5:

NATIONAL INITIATIVES AND COLLABORATIONS

SAFER collaborates with AI Sweden, a national center launched in 2019, to promote the development and use of artificial intelligence in selected areas, including transport, through the AI Enhanced Mobility program (read more on page 24).

The project portfolio within our research area Care and Rescue was moved to PICTA (Prehospital ICT Arena) at Lindholmen Science Park in 2019. This collaboration enhances the efficiency of research by accessing additional societal actors.

COLLABORATION WITH CYKELCENTRUM

SAFER collaborates with Cykelcentrum, the Swedish Cycling Centre, to contribute to increased cycling safety in Sweden. This collaboration involves sharing knowledge, arranging knowledge-building activities, and inspiring each other to address common research questions.

COLLABORATION WITH K2

A collaboration with K2, Sweden's national center for research and education on public transport, explores the potential for joint activities related to public transport. Workshops and discussions have been held with the aim to resolve goal conflicts and contribute with knowledge about the safety aspects of public transport.

ENGAGEMENT WITH FFI

SAFER has through its partners actively contributed to FFI's updated strategy and roadmap, the governmental vehicle and innovation research program, to address the rapid changes in road transport and the automotive industry.

DRIVE SWEDEN COLLABORATION

SAFER's director is since 2019 a member of Drive Sweden's program office, contributing to project creation, funding, and knowledge building in the development of a sustainable transport system and providing a strong link between the two platforms.

SITIS PARTNERSHIP WITH INDIA

The Sweden-India Transport Innovation and Safety Partnership (SITIS) focus on leveraging the know-how of India and Sweden to accelerate progress in safe and sustainable transport solutions. Projects include collecting naturalistic driving data from buses in India. Read more about our global initiatives for improved traffic safety in developing countries on page 48.

> By developing larger clusters and connecting researchers from diverse fields, SAFER seeks to establish an extended safety research environment, blending its work with research activities funded through various programs.

SAFER IN CORONA TIMES

Navigating challenges, embracing digital tools and emerging stronger

IN THE FACE of an extraordinary global pandemic, the SAFER community demonstrated remarkable resilience and adaptability. The COVID-19 crisis, while posing significant obstacles, catalysed SAFER's evolution into a more digitally understanding and interconnected community.

This stage of SAFER has been extraordinary, with the COVID-19 pandemic forcing us all to redefine our workspaces, processes, and methods of collaboration. SAFER embraced the challenge head-on, recognising the significance of digital tools in maintaining continuity and expanding engagement. Although in-person meetings became a rarity, SAFER proved that distance could not put off the spirit of collaboration.

One of the most profound lessons learnt during this period was the power of equality in collaboration. Everyone, regardless of location or affiliation, found themselves on equal footing in digital meetings. This opened doors for new partners to seamlessly integrate into SAFER's initiatives, contributing fresh perspectives and fostering knowledge exchange.

Perhaps one of the most remarkable achievements during these trying times was the rapid growth of SAFER's network. The digital transition saw a nearly 50% increase in participation by community members from partner organisations. These new connections have endured beyond the pandemic, adding strength to SAFER's ever-expanding network.

Embracing digital tools was a crucial aspect of SAFER's success. We explored platforms like Miro and Mentimeter for brainstorming and engaging digital participation. These tools not only facilitated smoother meetings, but also enhanced the quality of interactions, sparking innovation and creativity.

Moreover, SAFER welcomed as many as 10 new partners into the partnership during the pandemic. These new fresh talent and expertise not only bolstered the research capabilities, but also exemplified of resilience in very special times.

> One of the most profound lessons learned during this period was the power of equality in collaboration.

As the world begins to emerge from the shadows of the pandemic, SAFER finds itself in a unique position. Physical meetings are once again possible, and they are warmly embraced. While digital tools served as a lifeline during the crisis, there is simply no substitute for in-person interactions when it comes to trust-building and long-term relationship development.

In the post-pandemic landscape, the value of face-to-face meetings is irreplaceable. The renewed creativity, the ability to gain diverse perspectives, and the simple joy of reconnecting in person have reignited the sense of togetherness, among SAFER's partners.

In retrospect, SAFER's journey through the pandemic was not just about fighting the viruses but maintain a positive mindset. The partners willingness to adapt, embrace digital tools, and stay true to its mission of promoting traffic safety research exemplifies its strength and resilience. As we look forward, the SAFER community was an example of how innovation and collaboration can flourish even in the most challenging times.

SAFER ROADS FOR A SUSTAINABLE FUTURE

The UN resolution on traffic safety and the integration of the Sustainable Development Goals

IN 2020, the world witnessed a pivotal moment in the pursuit of global sustainability and road safety. The United Nations, recognising the interconnectedness of these two crucial issues, adopted a new resolution, marking a significant step forward in the quest for safer roads and a sustainable future.

This resolution emerged from the 3rd Global Ministerial Conference on Road Safety, held in Sweden, and it has set the stage for a new era of collaboration, research, and innovation. In this feature, we will explore how the recommendations from this conference and the subsequent UN resolution have inspired SAFER, and how it has shaped a different approach to tackling traffic safety while connecting it to the broader global sustainable development goals.

SAFER'S COMMITMENT TO THE UN GOALS

SAFER, as a research consortium, has embraced the UN's sustainable development goals and continually strived to integrate these principles into its work throughout stage 5. While SAFER's primary focus is road safety, we understand that achieving these goals requires a holistic approach that considers interconnected areas e.g. such as health, climate change, equity and spatial planning. By incorporating these perspectives, SAFER aims to generate new ideas, create awareness, formulate research questions, and foster dialogues that transcend traditional boundaries. In doing so, SAFER anticipates not only making a significant contribution to sustainable mobility, but also opening doors to new funding opportunities and collaborations.

THE 3RD GLOBAL UN CONFERENCE ON ROAD SAFETY

In February 2020, Sweden hosted the 3rd Global Ministerial Conference on Road Safety, a important moment for the road safety community. This conference brought together approximately 1,700 delegates from 140 countries, representing a wide spectrum of stakeholders, from government officials to industry leaders, research organisations, and non-governmental organisations.

The key outcome of this conference was The Stockholm Declaration, a strategic agenda that offered recommendations to achieve the global sustainability goals by 2030 and halve the number of traffic fatalities between 2020 and 2030.

This declaration, which put road safety on par with critical global issues like climate change and equity, was a major step forward in road safety advocacy. Importantly, it highlighted that road safety is not a standalone issue but a shared responsibility among various public and private entities. The Stockholm Declaration was subsequently adopted as a UN resolution in August 2020, signifying a giant leap forward in global road safety efforts.

SAFER'S RESPONSE TO THE UN RESOLUTION

For SAFER, the UN resolution represented an unparalleled opportunity to align our research and activities with the global sustainability goals. The consortium saw the chance to contribute to these goals and to be guided by the recommendations outlined in the Stockholm Declaration. SAFER took a series of steps to maximise these opportunities. First, we arranged a seminar about the outcome from the UN conference in May 2020, in which we introduced the Stockholm Declaration and the conference's nine

> The UN new resolution presented SAFER with a unique chance to align research and activities with global sustainability goals.

recommendations to our research community. This served as the first step in understanding how to leverage the UN resolution's potential. Following this event, we launched a series of webinars to dig deeper into the recommendations and explore the strategic implications of the UN resolution. These sessions featured members of the Academic expert group responsible for developing the recommendations. The overarching goal of these initiatives was to enhance awareness and understanding of the opportunities arising from the new UN resolution and to identify research questions and potential projects.

These webinars fostered an environment of knowledge sharing and inspiration, with the objective of embracing the new mindset presented in the Stockholm Declaration. Researchers from SAFER's partners collaborated to identify relevant research questions, assess the current state of knowledge, pinpoint potential gaps, and formulate ideas for interdisciplinary research projects.

NEW RESEARCH TOPICS EMERGED

Throughout the seminar series and webinars, a multitude of new research topics and questions emerged. These ranged from the effectiveness of future road safety technologies to the consideration of environmental and health aspects in conjunction with road safety measures. The focus extended to exploring the transfer of technology, specifically in how protection and preventive safety systems designed for vehicles could be adapted for two-wheelers.

Knowledge transfer was another crucial aspect, examining how existing road safety knowledge can be made accessible worldwide, democratising road safety. Collecting, storing, and sharing data efficiently and effectively was also emphasised, recognising that reliable data is the key to success in road safety initiatives. Furthermore, we explored safety in the context of value chains, holding organisations accountable for their role in traffic casualties in the same way as they are for climate impact.

A crucial outcome when we explored the potential from the UN conference was the recognition that organisations and the private sector can play a key role in improving road safety. A significant takeaway was the *redefinition of responsibility for traffic safety*; shifting the focus from the individual road user to organisations, unlocking vast opportunities for positive change and improvements. By systematically measuring, monitoring, and enhancing organisations road safety impact, their *traffic safety footprint*, within their value chains, they have the potential to contribute significantly to safer roads. This paradigm shift encourages organisations to include traffic safety in their sustainability agenda and to for example prioritise road safety in their transportation procurement processes and follow up and report their traffic safety footprint. For a deeper insight into the projects we have initiated on this topic, please turn to page 38.

The global UN conference in February 2020 marked a pivotal moment in global traffic safety efforts. The resulting world's first UN resolution on the subject opened up new opportunities for our ongoing work.

MAIN ACHIEVEMENTS

OVER THE PAST HALF-DECADE, we have significantly advanced our understanding of a safe traffic environment through partners' research. Our collective expertise has grown, propelling us into the next phase with enriched knowledge. The most impactful achievements and outcomes vary among partners. Below, you will find ten examples that we take pride in contributing to:

1. RESEARCH TARGET FULFILLMENT: Achieved nearly all collaborative research targets, advancing our shared agenda for safe road transport.

2. AI ADVANCEMENT: Elevated traffic safety research by integrating and exploring AI tools, notably through the projects AI Aware and AI Enhanced Mobility, financed by Drive Sweden.

3. KNOWLEDGE DEVELOPMENT IN AUTOMATION FOR ROAD SAFETY: SAFER's competence network for Automotive safety assurance network has contributed to influencing future safety standards in automation. Key contributions include L3Pilot, a major EU project affiliated with SAFER, showcasing methods and challenges in automated driving.

4. KNOWLEDGE TRANSFER: Our research insights have disseminated in our network and beyond, reaching stakeholders through over 350 collaborative knowledge building activities. Ongoing strategic knowledge transfer projects in counties with high traffic mortality are underway with India, Africa and China.

5. CONSORTIUM SUCCESS: Established strong consortia, resulting in successful EU applications such as the ongoing Roadview and AfroSafe projects.

6. TRAFFIC SAFETY FOOTPRINT: Pioneered the Traffic Safety Footprint approach, presented at the UN conference on road safety in 2020 and gaining insights from the SAFER Traffic safety footprint Think Tank.

7. NETWORKING EXCELLENCE: Hosted impactful events, fostering collaborations and innovative ideas. Recognised for creating valuable connections and facilitating high-level seminars and workshops, including SAFER's influential breakfast and lunch seminars that inspire ideas among attendees.

8. INFLUENCE THE GLOBAL TRAFFIC SAFETY AGENDA: Positioned SAFER at the forefront of global traffic safety discussions through contributions to, for example, ERTRAC and the CCAM partnership.

9. DATA EXPERTISE: Plays central roles in EU projects like HiDRIVE and FAME, focusing on data collection, analysis, and sharing frameworks.

10. SAFER HUMAN BODY MODEL EVOLUTION: Successfully developed and applied the SAFER Human Body Model across numerous research projects.

INSIGHTS FROM SAFER STAGE 5

Here are seven key reflections from SAFER Stage 5 that we now carry forward into the next phase, focusing on transformative change to create added value for our partners:

1. PROACTIVE FACILITATION: The complexity of creating safe and sustainable transportation systems is ever increasing and we need to focus even more on proactive facilitation.

2. ACCELERATED TRANSFORMATION: The shift to sustainable transportation must accelerate, with a strong emphasis on traffic safety to ensure that new solutions are safe. As a collaborative platform, we should prioritise cooperation beyond traditional boundaries, operating within an ecosystem.

3. EXPERTISE INTEGRATION: In the light of above, we need to involve more expertise in our knowledge-building process and increase the agility. Thus, we are transitioning from our previous fixed-member reference groups to dynamic working groups, enabling broader engagement, contributions, and deeper exploration of research questions.

4. KNOWLEDGE TRANSFER: It is evident that the value of our collective knowledge is a crucial aspect of our value proposition. Therefore, it remains imperative to integrate partners' research in SAFER's project portfolio to further increase the knowledge transfer between relevant actors.

5. NETWORK ENHANCEMENT: The value of SAFER's network remains central. Digital formats developed during the pandemic have opened new possibilities. We will prioritise enhancing meeting formats to create valuable opportunities for people to convene and co-create. This will primarily be done through regular research days with engaging topics and result days focussing on the outcomes of the projects.

6. BRAND LEVERAGE: Partners recognise the potential to benefit from SAFER's brand and communication platform more effectively. This involves utilizing it strategically to engage with targeted audiences, promote required research funding, and influence road safety agendas at national and international levels.

7. FUNDING OPPORTUNITIES: SAFER's pre-study program has excelled, fostering high-level multidisciplinary research, and facilitating vital collaborations. Given its success, we are extending and enhancing funding opportunities in the next stage, recognising the vital role of seed funding, while maintaining a lean process. Also, this will provide an additional tool for the working groups to use.

KEY PERFORMANCE INDICATORS

	2019	2020	2021	2022	2023	IN TOTAL STAGE 5
Total number of ongoing projects[1]	52	70	81	86	76	169
New projects[1]	12	38	24	32	25	131
Finalised projects[1]	21	20	30	36	35	142
Number of SAFER partners per project[2]	No.	No.	No.	No.	No.	No.
Publication volume	59	78	87	103	89	416
Number of seminars and other knowledge sharing activities[3]	49	74	79	82	72	356
Number of visits by external stakeholders[4]	7	N/A	5	3	4	19
Visibility / references in conferences[5]	18	15	33	21	26	113
Number of connections to other research centres[6]	25	25	27	27	25	27
Gender balance in SAFER Board and management team (women/men)	11/12	11/12	10/12	13/10	13/10	N/A
Partners Level 1	7	7	7	7	7	N/A
Partners Level 2	18	18	18	19	19	N/A
Partners Level 3	12	12	19	21	22	N/A
Partner satisfaction index[7]	–	4,45	4,75	4,75	4,40	N/A

1. Read more about our project portfolio on page 18 and all the projects are listed in appendix 3.
2. See figure 4 on page 19.
3. See complete list of activities in appendix 4.
4. Traffic office The city of Oslo, Lab France, Slovakian government, ANTT traffic administration in Brazil.
5. See complete list in appendix 5.
6. See figure 1 och page 11.
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.

RESEARCH PORTFOLIO

IN SAFER STAGE 5, our research is concentrated in four key areas, representing world-class, multidisciplinary exploration. Our solid objective is singular yet profound: save lives, prevent injuries and enable safe mobility. These research domains serve as an expansive forum where our partners converge, actively identifying pivotal issues that catalyse innovative research initiatives aligned with 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.

> SAFER provides a dynamic platform characterised by scientific excellence and resource accessibility.

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 PROJECT PORTFOLIO

SAFER's Project Portfolio serves as the anchor of collaborative efforts, encompassing a variety of projects aligned with our joint strategic research agenda. Crafted through collective endeavors within Research Areas and among partners, Stage 5 has focused on strengthening the SAFER pre-study program and establishing a robust project foundation through diverse funding sources.
The distribution of projects among the four Research Areas is illustrated in Figure X, providing clarity on our research focus. Projects are categorised based on alignment with specific areas or the exploration of broader, cross-functional questions.

Within this framework, SAFER provides a dynamic platform characterised by scientific excellence and resource accessibility. Our knowledge repository spans research findings, publications, databases, models, methods, and demonstrators since 2006, offering a comprehensive view of vehicle and traffic safety developments. Efficient portfolio management is a key aspect, with the project portfolio serving as the foundation for SAFER's collaborative initiatives. Joint efforts among partners contribute to the curation and expansion of this vital resource.

Project initiation and management have primarily occured within the Research Areas, acting as a central forum for discussions and recommendations. Each Research Area, comprising representatives from level 1 and 2 SAFER partners, has played a crucial role in shaping a comprehensive and diverse project portfolio.

Stage 5 achievements include the addition of 32 SAFER-funded pre-studies, 2 SAFER-funded strategic tasks, and 97 externally funded projects to the portfolio, demonstrating the vitality and growth of our collaborative research efforts.

As SAFER embarks on its 19th operational year, the commitment to excellence and impactful research continues to be the driving force behind our collective pursuit of advancing vehicle and traffic safety. About 40 projects are included in the portfolio when we enter SAFER Stage 6.

> Based on the research portfolio, it is evident that collaboration projects provide a significant leveraging factor for our partners.

Figure 2
Number of projects in SAFER's project portfolio. Cross functional activities and projects are not included in the diagram.

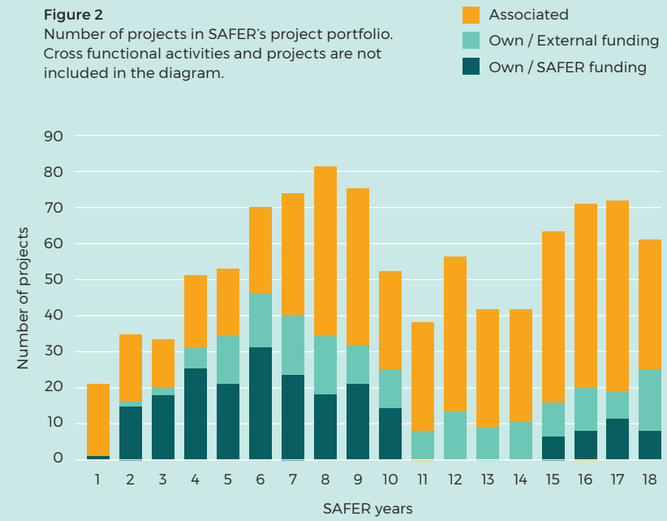


Figure 3
Ongoing projects during stage 5. The distribution of projects between the research areas.

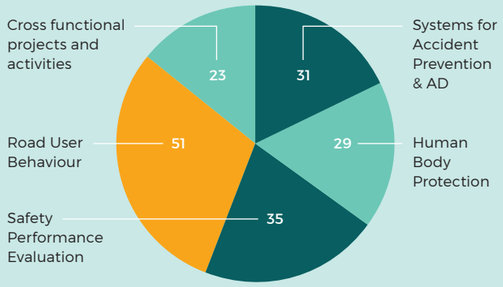


Figure 4
The number of partners in SAFER's projects during stage 5.

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 Stage 5 sums up to about 4.000 MSEK in total and 1.200 MSEK for the 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 programmes. Also, the leveraging factor of collaboration projects is clear, especially when accessing the knowledge and financing power on the European arena.

THE SAFER PRE-STUDY PROGRAM

SAFER'S PRE-STUDY PROGRAM was launched in October 2019 to offer research funding for pre-studies and seed-projects. The aim was to boost strategic knowledge creation by bringing partners together and building new competences that would lead SAFER forward and contribute to the continued development of our unique collaboration platform. The originally planned budget of 600KSEK per year was exceeded and 32 pre-studies have been funded during Stage 5 with a total funding of 3 165 KSEK. At least 50% in-kind was required and the overall budget for the program during Stage 5 added up to 7 MSEK. 54 proposals have been submitted with the encouraging approval rate of 63% led to an increased interest of partners and high-quality proposals.

25 pre-studies have been finalised during Stage 5. New research areas have been explored, collaboration partners found, workshops organised, competences acquired, knowledge distributed, and reports written, all available on SAFER's website. Funding for larger projects has been secured, as for example the FFI project "I2Connect" or the Skyltfonden project "Here I go". Master theses and PhD work have been based on some of the pre-studies and results have led to publications both in scientific journals and at conferences. The pre-study created a very good collaboration, not least with industry partners. SAFER has been a key basis for knowledge, interaction, and key research areas together with industries and other academic areas. All that is making SAFER's pre-study program a success story with well spent efforts.

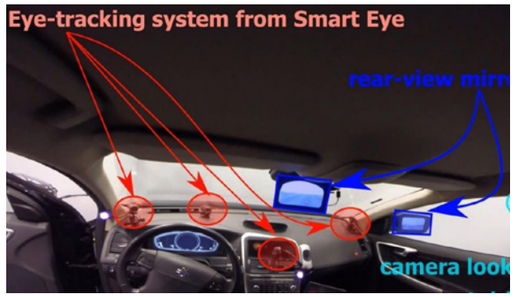
2023 was no excemption; we've received diverse, highly relevant, and very interesting proposals. Eight out of 13 submitted proposals have been granted and are briefly described on the following pages. One pre-study has already been successfully finalised and seven are joining into Stage 6.

In Stage 6 the initiative will develop into the Idea Exploration program, which remains an important tool for SAFER and will take the center stage in fostering new ideas that have the potential to make our roads safer. This program will see further development, driving research activities aimed at saving lives in traffic. It encompasses for example pre-studies on emerging topics, the generation of knowledge, the development of proposals for national funding, and the completion of research publications.

RURAL CYCLING IN FOCUS

PARTNERS: VTI, IF INSURANCE

The goal of the present project is two-fold. First, an overview of the Swedish rural road crash situation for car-to-pedestrian and car-to-cyclist situations will be provided based on the If-crash-database. Second, a portable sensor for logging data from a bicycle point of view will be improved. A current prototype exists and has been used to collect pilot data. In addition to measurements related to overtaking, it should also be able to log effect and acceleration, such that it can be used for multiple purposes, including micro-simulation of cycling behaviour depending on various factors (e. g. hilliness, road surface).



EMERGENCY VEHICLE APPROACHING SYSTEM

PARTNERS: VTI, UNIVERSITY OF GOTHENBURG

In this simulator experiment, 75 participants will be approached by an emergency vehicle two times while driving on a highway. Eye-tracking in combination with measurements of vehicles' speed and placement will allow for a thorough examination of the effects of EVA warnings. In previous studies, only measures of vehicle position and speed have been used as measurements of EVA's effect. Through eye-tracking it will be possible to explore how drivers' glance behavior changes when receiving an EVA warning. This pre-study prepares for a naturalistic study in a real traffic environment.

RISKY SCENARIO IDENTIFICATION

PARTNERS: CHALMERS UNIVERSITY, RISE, VOLVO GROUP, (ALKIT COMMUNICATIONS)

The goal of this pre-study is to determine whether perceived risk, measured by both objective metrics (e.g., jerk changes) and subjective evaluation by a large number of human drivers, could be predicted from vehicle trajectory and basic features obtained using computer vision. We aim to identify possible critical scenarios, evaluate the real driving conditions of AVs, and discover potential unsafe scenarios by using deep learning. An automatic system will be built to find out the relationship between the perceived risk score and the objects extracted from traffic scenes to improve the accuracy and efficiency of identifying critically risky scenarios. Finally, the overall framework can be used to improve the evaluation of implemented safety systems performance of ADAS and AVs in different driving circumstances.

VIDEO-BASED DRIVER CONDITION MONITORING FOR SAFE DRIVING (VIDCOM)

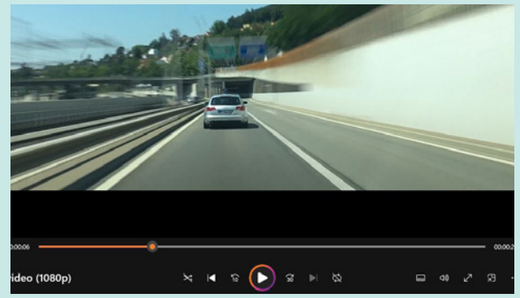
PARTNERS: CHALMERS UNIVERSITY, ASTAZERO, SMART EYE

The vision behind ViDCoM is dedicated to advancing road safety by focusing on the critical factor of driver condition and behavior. Through innovative applications of computer vision and signal processing, the pre-study ViDCoM aims to prepare activities and an interest group of industrial stakeholders and academic experts for systematically studying the feasibility of developing an intelligent solution for real-time monitoring of driver health, including vital signs like heart rate, respiration rate, blood pressure, and blood oxygen saturation. By continuously assessing the driver's health, the vision is to provide means to potentially reduce the number of road accidents caused by driver health issues.

HUMAN FACTORS, RISKS AND OPTIMAL PERFORMANCE IN CCAM

PARTNERS: HALMSTAD UNIVERSITY, VTI, RISE

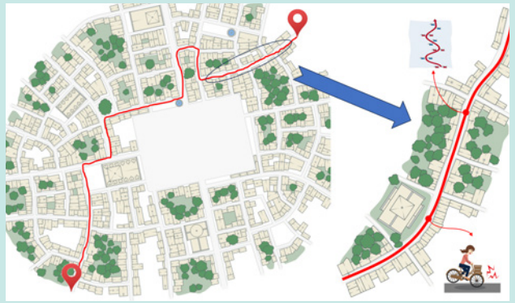
The purpose for the project is to further progress in Cooperative, Connected, and Automated Mobility (CCAM) technologies deploying and thus addressing Vision Zero mission. While it is expected that CAVs become pervasive, multimodal road users (MRUs), such as pedestrians, bicycles, non-connected legacy cars might obstruct the convergence towards an optimal performance. The expected outcomes would put the spotlight on potential challenges related to Multimodal Road Users and their influence the CCAM ecosystem and provide the groundwork for future collaborations with the industry, aiming at larger project applications within the scope of SAFER's long-term vision.



EDR-V FEASIBILITY

PARTNERS: CHALMERS UNIVERSITY, AUTOLIV

The purpose of this study is to assess the feasibility of using already collected data from Event Data Recorders with video (EDR-V; also called DashCams). EDR-Vs are devices installed in vehicles (consumer or commercial) to record information in the event of crash or near crash. This information includes vehicle kinematics, GPS, video of the scene and of the driver. The goal is to, after the project is completed, have gotten enough insights into EDR-V and its possibilities, constraints, and limitations to decide if we can/should/want to pursue a larger project on EDR-V. If we decide that EDR-V research is feasible and deemed to have good cost/benefit potential, the project should also outline a draft proposal for next steps.



SAFETY PERFORMANCES OF INSTRUMENTED MICRO-MOBILITY MODES BY LEVERAGING MICROSCOPIC DRIVING BEHAVIOR DATA

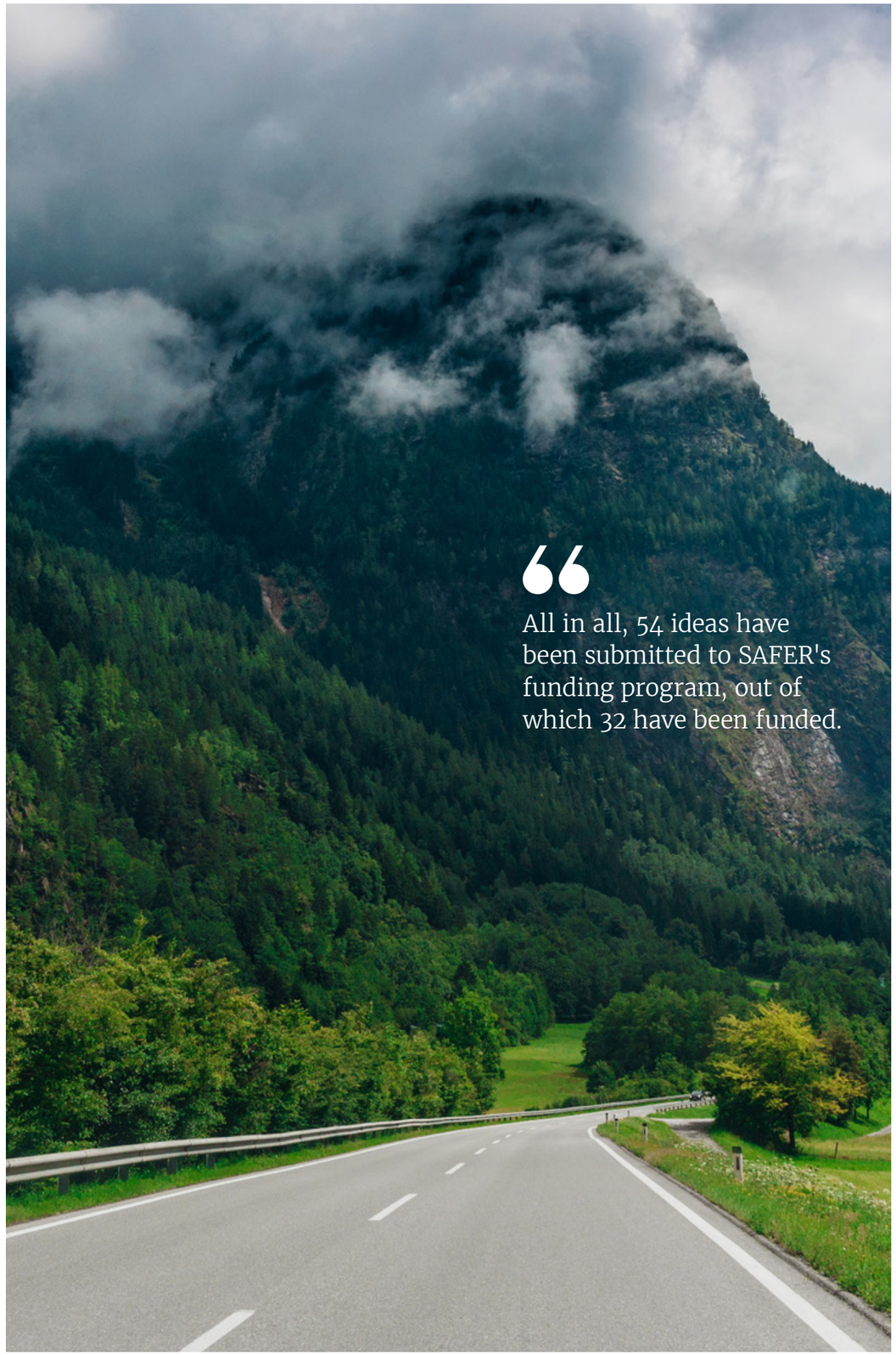
PARTNERS: VTI, HALMSTAD UNIVERSITY, VOI

Shared micro-mobility services offer a sustainable alternative to cars for short trips in cities. It is imperative from the perspective of all stakeholders to develop new methods and/or digital solutions to improve the safety performance of the users. One way to monitor the safety performance is by analyzing the accident statistics, however, there are clear challenges associated with the comprehensiveness and extent of accident database. Alternative measures, e.g., monitoring near misses using different surrogate safety metrics, have gained popularity in the recent years but there are still open challenges with extraction of such metrics and use them to derive the overall safety performances, especially on route-level.

REMOTE OPERATOR STATE MONITORING FOR TRAFFIC SAFETY (REMOSAFE)

PARTNERS: RISE, SMART EYE, EINRIDE, ASTAZERO, (CDE)

The purpose of the project is to gain an understanding about the needs, feasibility and development of a remote operator monitoring system (RMS) adapted from a state-of-the-art driver monitoring system. The project closely ties to traffic safety in future transportation systems. The operators of future automated vehicle fleets will have a key role in foreseeing and mitigating negative impacts of automated vehicles in traffic. They will also have a pivotal role in reactive safety, managing accidents and incidents. For remote operators to make fast and correct decisions when needed, operator fatigue, cognitive state and situational awareness are important aspects of traffic safety, which is what will be addressed by RMS.



HARNESSING AI FOR ENHANCED TRAFFIC SAFETY: A SAFER JOURNEY

IN 2020, SAFER EMBARKED on a strategic endeavor to unlock the potential of artificial intelligence (AI) as a driving force in traffic safety research. Recognising the transformative capabilities of AI, we were determined to harness this innovative tool to not only improve traffic safety but also elevate the quality and efficiency of our research. This journey began with the formation of a stakeholder group for AI in June 2020, with a remarkable 75% participation rate from our partners.

A series of six workshops and the active involvement of approximately 130 researchers over this period enabled us to expand our collective knowledge about AI's role in research. Through these workshops, we pinpointed three key areas where AI could enhance our research and contribution to a safer transport system, and we decided to continue to work with these strategic topics.

1. IDENTIFY AND ASSESS EXTERNAL OBJECTS AND SAFETY CONDITIONS: AI could assist in recognising and analysing external elements in the traffic environment, such as pedestrians, vehicles, and road conditions, ultimately contributing to safer roads.

2. DETECT RISKS IN THE TRAFFIC ENVIRONMENT BY COMBINING DATA: Leveraging AI to synthesise and analyse diverse datasets from various sources in the traffic environment, could unveil hidden risks, enabling us to proactively address potential safety concerns.

3. DETECTION AND CLASSIFICATION OF DRIVER STATE AND DRIVING PATTERNS: AI can play a pivotal role in monitoring driver behavior and patterns, leading to improved understanding and mitigation of risks associated with human factors.

In 2021 a strategic initiative within Drive Sweden and AI Sweden was born; *AI Enhanced Mobility* (during the first phase this project was called AI Driven Mobility). AI Enhanced Mobility represents a crucial catalyst in accelerating AI solutions within the mobility sector. The program strived to foster new collaborations, expand AI knowledge within mobility, and synergise with existing initiatives and resources. The project's aim has been to accumulate experience, knowledge, and collaborative opportunities within applied AI for sustainable mobility systems of the future. About 25 SAFER partners have been actively involved in this project, demonstrating the significant interest and dedication from our community.

SAFER was entrusted with leading the focus group on traffic safety within this strategic project, focusing on bridging the knowledge gap between societal needs owners and AI experts. This not only granted us access to valuable AI knowledge, but also paved the way for new funding opportunities and collaborations. Over the three-year project duration, we hosted co-creation workshops where AI experts, traffic safety researchers, concerned community stakeholders seeking solutions, and industry partners with product development challenges came together. The workshop-based co-creation methodology proved highly effective, fostering trust among project members and enabling the formation of interdisciplinary teams that do not traditionally collaborate. Thanks to our strategic initiative in 2020, SAFER now hosts several pre-studies and ongoing projects, with more ideas continually emerging. These projects span a broad spectrum of topics, including automated safety classification of the road environment, AI-supported risk reduction using large datasets, and AI applications in driver evaluations. The SAFER Data catalogue plays a key role in supporting these initiatives by providing a platform for researchers to access and share relevant data. Read more about the SAFER Data catalogue on page 39.

The focus group for AI in traffic safety, active from 2021 until the end of SAFER Stage 5, has been dedicated to identifying funding opportunities, conducting pre-studies, launching larger projects, building and sustaining our network and collaborating with other relevant initiatives. This strategic investment reflects our dedication to progress and continued excellence in traffic safety research, as we collectively embrace the transformative power of AI.

> SAFER's collaborative work concludes: AI holds significant potential for improving traffic safety.

PROJECT EXAMPLES

Here are some project examples that have emerged from our workshop series in the AI Enhanced Mobility program and in other stakeholder dialogues between SAFER partners, all with the aim of enhancing traffic safety and mobility, using AI as a tool:

1. SINTIA (SAFE INCLUSIVE TRAFFIC INFRASTRUCTURE): data and AI for decision making): This project focused on creating safer traffic infrastructure to promote active mobility like walking and cycling. It aimed to use AI and data to make informed decisions regarding traffic infrastructure changes that enhance safety for vulnerable road users.

2. INTENTION RECOGNITION OF VULNERABLE ROAD USERS: In collaboration with multiple stakeholders, this project aimed to understand and predict the intentions of pedestrians, cyclists, and scooter users around bus stops using real-world data. The goal has been to enhance road safety through intention recognition, benefiting both human drivers and automated vehicles.

3. IMPROVE TRAFFIC SAFETY THROUGH ADVANCED AND AUTOMATIC DRIVING EVALUATIONS USING AI AND EYE TRACKING: This project seeked to revolutionise the way driving evaluations are conducted. By utilizing AI and eye tracking, the project team automated and improved the accuracy of practical driving tests, thus enhancing traffic safety.

4. AI AWARE: This project explored the application of AI in creating predictive awareness for traffic control. The researchers identified and predicted potential hazards in the traffic system, such as flash floods and accidents, through the fusion of various data sources and AI algorithms, ultimately preventing accidents and disturbances.

5. MIDAS – ANONYMISING DATA COLLECTION FOR TRAFFIC SAFETY: The MIDAS project addressed data privacy concerns by developing machine learning algorithms that anonymize video data collected in real traffic environments. The project result enables researchers to analyse traffic data while complying with GDPR, promoting safe and sustainable transport system research.

6. LARA (DISTRIBUTED LEARNING SYSTEMS FOR ACCIDENT RISK ASSESSMENT): The project group used distributed AI to assess and predict accident risks in real-time by integrating vehicle sensors and data from various sources. This approach eliminated the need for a central point of coordination, enhancing road safety through comprehensive risk assessment.

7. AI FOR ROAD SIDE OBJECT DETECTION: This pre-study investigated data processing pipelines for roadside object detection, aiming to reduce single-vehicle accidents by improving the detection and management of hazardous roadside objects. The project explored sensor options, target objects, and algorithm designs to contribute to Sweden's Vision Zero road safety initiative.

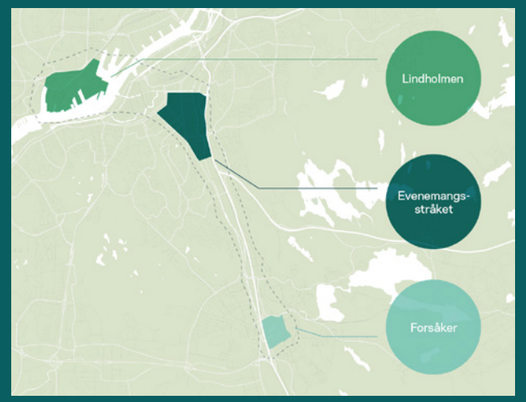
TRAFFIC SAFETY NEEDS FOR A SUSTAINABLE TRANSPORT SYSTEM

IN 2035, ENVISION A SUSTAINABLE and safe urban traffic environment designed for humans. Achieving this transformation requires collaborative efforts and in the autumn of 2022, nearly 30 stakeholders engaged in a co-creation process to pinpoint essential traffic safety research aligned with the city's vision.

Gothenburg faces growth challenges with 120,000 new jobs by 2035 and a doubling of tourists by 2030. To address increasing transport needs while meeting climate goals, the Gothenburg Green City Zone aims to lead in achieving emission-free status by 2030, emphasising road safety as integral to sustainability. This initiative encompasses Lindholmen, the central Event district, and Forsåker in Mölndal–three distinct areas forming a live test environment for future transport.

SAFER's project within this initiative identified future traffic safety research needs through workshops involving industry, academia, research institutes, and society. Results contributed valuable knowledge for regional competitiveness and a more sustainable future. Areas needing understanding included shared spaces for diverse transport types, flexible space usage, dynamic geofencing, digital queues, one-way lanes, fast cycle routes, and infrastructure for varying speeds on cycle tracks.

Participants contributed to create projects ideas exploring road safety challenges in mobility hubs, microsimulation of cyclists and electric scooters, and the positive experience of mobility. The collaborative process yielded an inspiring list of project ideas, emphasising the shared vision of a future, sustainable transport system. This significant initiative contributed to valuable input to the research agenda for SAFER Stage 6.



Three areas in the Gothenburg Green City Zone will be used for large scale testing of sustainable products and services.

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.

RESULTS FROM THE RESEARCH AREAS

ROAD USER BEHAVIOUR

THE ROAD USER BEHAVIOR (RUB) research area has its starting point in the question: How do people behave in traffic and how can they be stimulated to safe behavior? In an era where traffic complexity is increasing as quickly as technology is evolving, answering this question becomes vital. Taking a broad multidisciplinary approach, the RUB research at SAFER has in stage 5 focused 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 behaviors, as well as exploring safety implications of new mobility means such as electric scooters.

The RUB research area was formally created in early 2017, and since then it has hosted over 50 projects. These projects have been of both national and international character and have typically involved several SAFER partners from industry, society, academia, and research institutes. These projects cover a wide variety of topics and have delivered valuable results over the years. The work in the RUB research area in stage 5 has been guided by five research targets, and a summary of the outcomes is presented below.

To start with, the results have extended our understanding of how new technologies such as driver and passenger monitoring systems can be used to gain a deeper knowledge of driver and passenger state and behavior. This, in turn, will help stakeholders design new or improve existing safety systems in vehicles. Studies on driver impairments have also extended our understanding of how short-term driver impairments such as fatigue, intoxication, and inattention affect driving performance and how these states can be detected and counteracted. A future application of driver monitoring includes determining drivers' fitness to take over the driving task in partly automated vehicles.

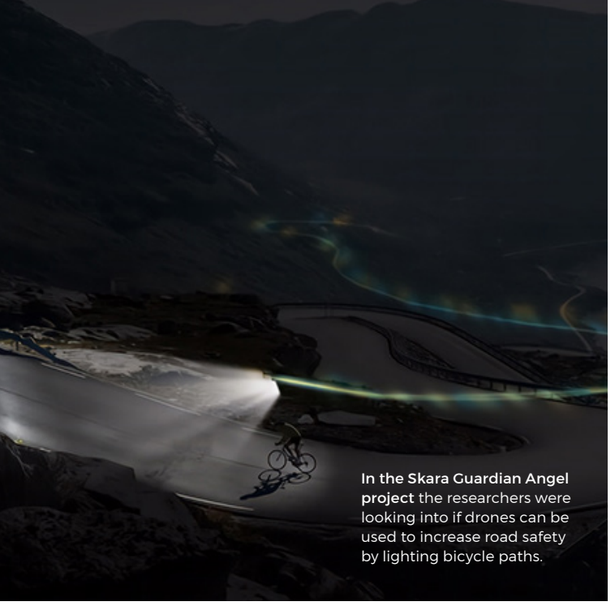
A significant contribution has also been made in the field of interaction principles; for example, it has been demonstrated how nudging can be used as a means to stimulate safer behaviors, both when it comes to drivers and pedestrians and bicyclists. Several studies on interactions between automated vehicles and other road users in their vicinity have been carried out. For example, it has been demonstrated how an external HMI can support the interaction between automated vehicles and vulnerable road users (VRU) at zebra crossings and bus stops. This has extended our knowledge of evaluation methodologies and tools, e.g., VR, as well as deepened our understanding of how to support interactions between different road users in future road environments with mixed traffic. In addition, our researchers have also developed a novel bicycle simulator that enables a more realistic bicycling experience. Our projects addressing the safety of new electric vehicles for personal mobility (ePVMs) have advanced the understanding of their impact on infrastructure and traffic safety, about mechanisms causing e-PMV crashes, and about public opinion on the safety concerns and ease-of-use of e-PMVs. The results can support the design of policy instruments and guide technological development of e-PVMs, to ensure a safe utilization of these vehicles. The project portfolio has also hosted projects addressing a rather neglected topic in the research community – human factors in remote operation of automated vehicles.

OVERVIEW AND OUTCOME OF RESEARCH TARGETS:

1. **WE CAN STUDY ROAD USER BEHAVIOR IN THEIR DOOR-TO-DOOR TRAVELS.**
   Various aspects of road user behavior have been studied in many of the RUB projects. The AHA-II project specifically addressed future mobility services that target the transport of people and goods from door-to-door in urban areas. A practical methodology was created through which city planners, industry partners, and university stakeholders can collaborate to create effective and aligned mobility solutions.

2. **WE CAN MONITOR THE DRIVER STATE AND POSITION DURING THE WHOLE TRIP IN-VEHICLE IN COOPERATION WITH HUMAN BODY PROTECTION.**
   Several technologies for driver monitoring have been evaluated for different purposes, including detection of driver impairments and monitoring of driver position and engagement in non-driving related activities in partially automated vehicles. Some of these technologies are mature and on the market, whereas new technologies will require further research to determine their usefulness for monitoring drivers and other vehicle occupants. The DRAMA project has developed a system that can recognise individual and interaction activities of drivers and passengers using input data from multiple cameras mounted in the cabin of a vehicle. Insights from the RE-ENGAGE project were that there are both behavioral and experiential benefits of adapting the interaction with the driver based on the driver's activities.

3. **WE CAN DIAGNOSE A FIT DRIVER BASED ON MONITORING DATA.**
   Monitoring systems for the detection of driver impairments such as fatigue and distraction have been available for some time, and these have been further refined and tested in new use cases in stage 5. The first steps



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

have also been taken towards real-time monitoring of alcohol intoxication and sudden sickness in drivers. Further research is needed to ensure reliable fitness to drive monitoring in real-life driving. The Fit2Drive project provided further insights into the detrimental effects of alcohol intoxication on driver attention, safety margins in driving, and engagement in NDRT. Improved driver fatigue detection and novel measures for driver intoxication detection were also developed using driver monitoring cameras.

4. **WE CAN ENSURE A SAFE INTERACTION BETWEEN AUTOMATED VEHICLE AND VULNERABLE ROAD USERS IN COOPERATION WITH SYSTEMS FOR ACCIDENT PREVENTION AND AUTOMATED DRIVING.**
Remote operations of heavy vehicles and interaction with autonomous vehicles in transport hubs have been studied in the HAVOC and In the Hub projects. These projects provided insights into the design of safe remote operations. Projects including GLAD, eHMI, and Drive-2theFuture have found that the use of external HMI (eHMI) such as light strips and sounds communicating awareness and intent of automated vehicles are useful to facilitate the interaction between automated vehicles and VRUs. A pre-study on safety culture in automation was conducted and resulted in continued larger scale projects on the topic (SCAV). The SCAV project is still ongoing and will deliver results in 2024.

5. **WE HAVE DEVELOPED SEVERAL NUDGE-BASED SOLUTIONS AND EVALUATED THEM.**
The MeBeSafe project showed that various nudging principles directed at drivers and cyclists can help improve traffic safety. Examples were the use of commonplace infrastructure measures such as lines on the street and signaling lights for nudging speeding road users to slow down, apps with nudges to increase the use of ACC for safe distance between cars, and surprise rewards as a nudge to make tired drivers take a break. More information about the MeBeSafe project on the next page.

> The results have broadened our understanding of how new technologies, such as monitoring systems, offer deeper insights into states and behaviors.

6. **WE CAN DEFINE AND MEASURE SEVERAL USER EXPERIENCE INDICATORS TO CONTRIBUTE TO SAFETY.**
Many of the projects have measured various aspects of user experience through careful selection and testing of various user experience (UX) indicators, using both previously validated instruments and new indicators developed within the projects. Different use cases require different UX indicators to capture safety-critical situations and behaviors. A framework for the evaluation of holistic fitness-to-drive and driver coaching solutions was developed within the PANACEA project with an emphasis on users' acceptance, trust, and perceived safety. Furthermore, SAFER's partners are in the FAME project aiming to develop a framework and knowledge base for CCAM testing in Europe, including guidelines for the evaluation of user experiences. There is a plethora of UX indicators available and further work within this area could involve the ranking of UX indicators for traffic safety research.

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

MEBESAFE: SAFER ROADS THROUGH SUBCONSCIOUS NUDGING AND SOFT MEASURES

MEBESAFE STANDS OUT as one of SAFER's most triumphant projects during Stage 5. This €7.1 million EU initiative, spanning between 2017-2021, focused on employing nudging and other soft measures to enhance traffic safety. The project's success is attributed to its easily implementable research findings, drawing considerable attention for their applicability in urban settings. MeBeSafe looked into the concept of nudging, inspired by the Nobel Prize-winning work of Richard Thaler in 2017, aiming to influence subconscious decision-making for safer traffic behavior.

Traditional road safety approaches often rely on information or symbols that demand conscious interpretation, potentially slowing down the decision-making process. MeBeSafe takes a different route by communicating road safety on a subconscious level, drawing inspiration from the rising popularity of nudging in behavioral science. The project team established eight meticulously developed soft measures, each addressing specific aspects of road safety, from aiding cyclists at intersections to encouraging responsible driving behaviors.

One measure involves creating an illusion for cyclists approaching accident-prone intersections, achieved by strategically arranged flat stripes. This visual deception prompts cyclists to reduce their speed, resulting in a significant increase in compliance. Similarly, a clever lighting arrangement on motorway exits induces an illusion of speed for drivers, effectively reducing speeding incidents by 40%.

MeBeSafe also introduces in-vehicle nudges, leveraging adaptive cruise control to increase distances between cars.

By using a nudging approach, road users will instead be encouraged to make a safe choice without even thinking of it.

One approach utilizes circles on a screen that behave more orderly with increased ACC use, appealing to individuals who appreciate order. Another involves a list showcasing drivers using ACC the most, leading to substantial adoption increases.

The project extends its impact to truck drivers, developing coaching apps that utilize driving data to provide insights without employer disclosure. The results indicate the potential for substantial savings in societal costs and, more importantly, the prevention of numerous accidents and injuries.

MeBeSafe also incorporateed a reward scheme for tired drivers, encouraging breaks by promising secret rewards. This resulted in a remarkable 87% increase in drivers taking breaks when drowsy.

The project's profound impact is quantified through a comprehensive assessment using a vast German accident database. The results suggest that MeBeSafe has the potential to save between 150–500 lives and prevent 21,000–65,000 injuries annually in the EU. With the most likely adoption scenario, MeBeSafe could save 366 lives, avoid 40,000 injuries, and save 3 billion euros in societal costs per year.

For more detailed information about MeBeSafe, visit http://mebesafe.eu

HUMAN BODY PROTECTION

SAFER PARTNERS IN THE HUMAN BODY PROTECTION field have a world leading position in applied biomechanics research and application; exemplified by child safety and whiplash injury research, development of crash test dummies and human body models. SAFER Stage 5 has enabled the continuity of this position.

> SAFER's Human Body Protection research area focus on understanding traffic-related injury mechanisms, biomechanical responses, and protective principles.

During SAFER Stage 5 the HUMAN BODY PROTECTION research area has dealt with traffic-related injury mechanisms, biomechanical responses and consequences, and the principles for protection including safety system usage. This area aligned with the work of partners in the development and evaluation of countermeasures to protect the body, to prevent injuries or at least to mitigate them. There continues to be a focus for this research on emerging challenges in transportation, as we build the knowledge-base and enablers for future human body protection evaluations. In addition, through our links with the Structures and Materials Competence Network, the Stage 5 achievements include research to develop new simulation approaches for the development and assessment of novel, lightweight, crashworthy structures.

At the end of SAFER Stage 5, the Human Body Protection Research Area progress can be described with respect to the objectives set at the beginning of the Stage. We have seen research activities tackling all of the targets, as summarised briefly, below:

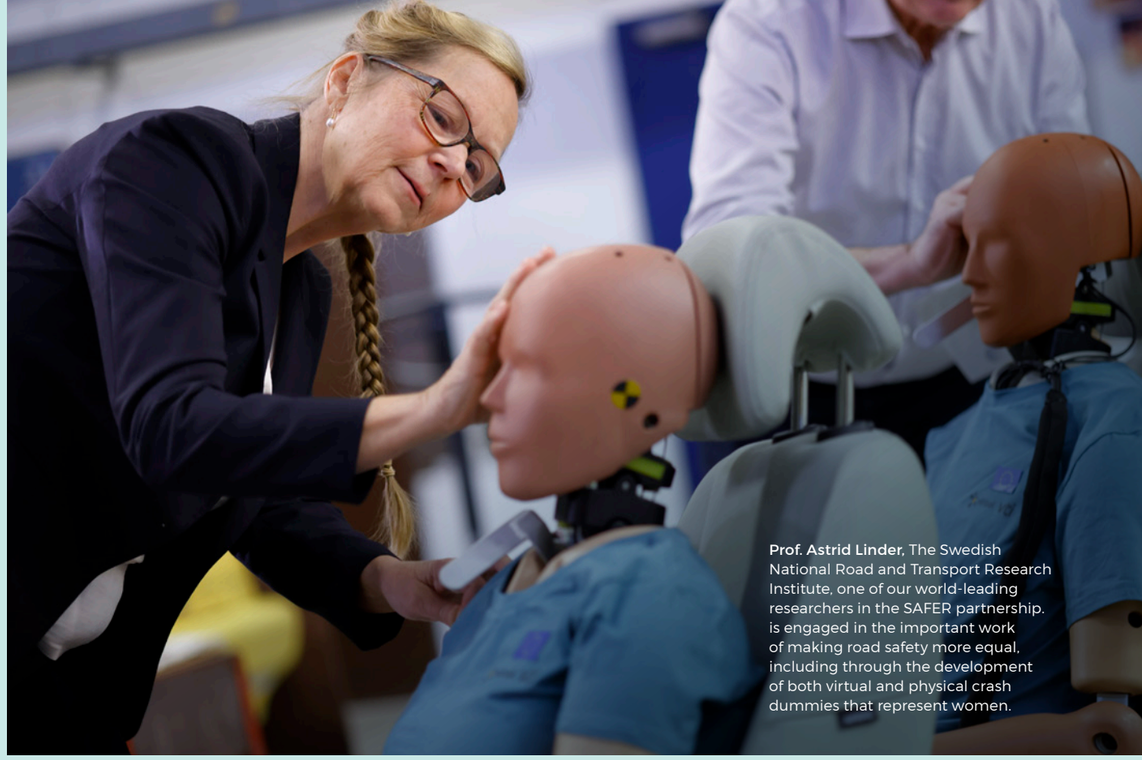
Automation in the driving task and future market demands give rise to opportunities for the car's seats to be placed in other ways, such as rotated or reclined. Given this desired flexibility in seating position, and to ensure that people travel safely in various vehicle configurations, more research was needed. The project "Assessment of Passenger Safety in Future Cars", that concluded in 2020, helped address these challenges.

At the end of SAFER Stage 5 we conclude that a reclined seating position is one of the most popular expectations among end users of future shared mobility options. It seems that in highly automated vehicles people want to recline more. Lap belt geometry was seen to deteriorate when the seat back reached an angle over 30 degrees. This means that the majority of occupants would, in their relaxed position, have a lap belt geometry that could increase the risk for submarining. An experimental setup has been developed to evaluate this. With this and our subsequent project work, principles for effective countermeasures have been shown to be effective for upright and reclined seating during frontal impacts (i.e. seat track and lap belt load limiting).

Future cars will likely also (to a higher degree) encompass new kinds of car ownership and mobility, e.g. car sharing pools. These new ways of gaining access to a car and travelling will increase the need for easy-to-use child restraints, since they will be moved around more often and will be used in many different cars. The need for a booster cushion for shared mobility was promoted and the concept for a rear-facing car seat for future travel developed. Car-based countermeasures such as seatbelt pretensioning, have been demonstrated to be effective, also when using reclined boosters. Therefore, Human Body Protection has addressed child safety through this project activity and, importantly, in organising the biennial child occupant protection seminar.

Two paths have been paved with the Human Body Models used within the Human Body Protection group. The first is to provide broad access for research via open-source tools and the second is to concentrate on the SAFER HBM as a model ready for industrial applications.

The project VIRTUAL: Open Access Virtual Testing Protocols for Enhanced Road User Safety, has provided virtual testing procedures and open access tools to assess the safety improvements for all road users. This EU project further developed the Human Body Models VIVA+ 50F (average female, as originally developed in Vinnova-funded projects) and 50M (average male) and the equivalent physical models for low severity rear impact testing, the Seat Evaluation Tools, SET 50F and 50M. The list of open-access tools and scripts generated within the project is extensive, and they are hosted on the Open VT Organisation (ovto.org) platform. As an open-source tool, the VIVA+ models are available for any research applications.



Prof. Astrid Linder, The Swedish National Road and Transport Research Institute, one of our world-leading researchers in the SAFER partnership, is engaged in the important work of making road safety more equal, including through the development of both virtual and physical crash dummies that represent women.

Whilst VIRTUAL concerns open-source models, the FFI-funded projects Active Human Body Models (HBM) Step 4 and Step 5 were devised to develop the SAFER HBM further. In step 5, a mid-female sized SAFER HBM was developed and validated in maneuvers. The series of Active Human Body Model Projects have updated the SAFER HBM to be a tool founded in state-of-the-art research on occupant muscle responses and active musculature for pre-crash movements. The resulting active Human Body Model simulations can now cover whole sequences of braking and impact for a range of pre-crash events.

Stage 4 in the series of Injury HBM projects finalised during 2023. It included mainly developments of the pelvis and the lumbar spine models and their capabilities to predict injury risks. A statistical shape model of the pelvis bone was developed based on CT scans and a novel detailed morphable pelvis model to SAFER HBM was developed.

Elderly occupants have been shown to exhibit differences in preferred posture to young, this is explained through body composition, BMI and different awareness of seat belt usage and discomfort. The implications of varying age, BMI and size have been investigated through morphing of Human Body Models.

Sitting posture and belt position whilst travelling in a car have been studied with respect to restraint system interaction. Approaches have been developed in the EU Horizon 2020 research project OSCCAR (Future Occupant Safety for Crashes in Cars) to consider both the pre- and in-crash phases together. The project 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 called 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.

The development of the SAFER human body model and knowledge building in the field of biomechanics and human body protection continued through the project Car Passenger Protection - To the Next Level. Human scaling methods have been developed and the sensitivity of rib fracture risk predictions to individual differences has been studied.

The associated project "Application for Automated Design & Optimization of Vehicle Ergonomics (ADOPT!VE)" aims to develop a methodology for advanced vehicle ergonomics analyses within simulation tools. The process looks at simulations of virtual driving routines, performed with a family of manikins, and generates subsequent objective ergonomics evaluations as the output. These accurate posture prediction models are leading the way in demonstrating the importance of having families of human models rather than single size/point evaluations.

A study on belt-use in pregnancy showed low levels of correct use. The project results led to information material being made available to pregnant women for distribution via the health care system. Further investigations are ongoing with respect to additional devices which are on the commercial market to improve comfort for pregnant belt-wearers.

Johan Iraeus, Chalmers University and Lotta Jakobsson, Volvo Cars, received the SAFER 15 year anniversary award as representatives from the cluster of HBM-projects at the prize giving ceremony in September 2021.

The identification and prediction of injuries with long-term consequences was the title of another recent project. This project focussed on necessary injury assessment tools and methods. This included the use of the SAFER Human Body Model (HBM) in various simulations to predict the risk of long-term consequences for the head or upper extremities (arms). As well as simulations with the SAFER HBM and related model improvements, a novel instrumented crash test dummy forearm was developed. This project showcased how, with a focus on long-term consequences from traffic crashes, SAFER partners can develop new methods and assessment tools to enable innovative safety concepts to be proposed and evaluated.

The growing focus on sustainability emphasizes the importance of low-weight materials in vehicles, and the challenges associated with simulating those in crashes. Within the area of traffic safety related composite research, SAFER and its partners are currently one of the world-leading groups focusing on developing modelling and simulation tools for composite structures in crashes.

The composite modelling developments in the FFI-Crash2 project move us incrementally closer to robust, accurate and efficient predictions of composite material responses under loads typically seen in crash events. Use of novel finite element modelling approaches are now enabling dynamic analysis of failure in laminated composites. One such model received extra validation and moved further towards application via the CompCrash2 project. A model to look at strain rate effects in unidirectional plies of 3D-woven composites was also established in the ICONIC project.

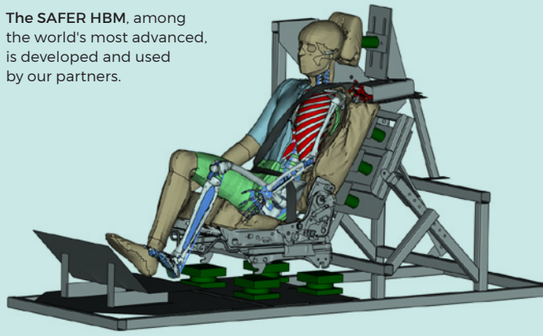
In 2022 another FFI-funded project was associated to the group, UTMOST, the modelling of biocomposites in occupant safety analyses. This project reflects the increasing use of biocomposites in place of traditional plastics and composites. The goal is to deliver a methodology for crash analysis, which is predictive and effective for industrial use.

Two challenging anatomical models were also tackled in Stage 5, firstly through the development of a method to study nerve cell physiology in-vitro and the relationship of pressure transients in the central nervous system, dorsal nerve root ganglia deformations and pain (whip-lash), and secondly through the design of tests that could characterise the strain rate sensitivity of soft (adipose – fatty) tissues via pre-study investigations and a PhD on the topic.

In the FFI-funded, SAFER associated project, Motorcycle rider model for injury prediction the aim is to deliver updates to the SAFER HBM validating it for prediction of motorcycle rider kinematics in the most common crashes. SAFER cycling was a pre-study to pose research questions around our ability to detect bicyclists visually and requirements on shoulder protection systems for common bicycle falls. These have led to new projects being started (e.g. to improve the shoulder of the SAFER-HBM for the purpose of detecting shoulder injuries in bicycle crashes). Pedestrian research has used the HBM tools - predominantly the VIVA+, as in the VINNOVA-MOST Project and VIRTUAL for example. Therefore, we continue to apply tools and knowledge outside of the vehicle as well as inside.

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. Therefore to the successes of Stage 5 we add evolved challenges to continue this research into the future.

SAFER HUMAN BODY MODEL DEVELOPMENTS AND MILESTONES



The SAFER HBM, among the world's most advanced, is developed and used by our partners.

SAFER IS A FOCAL competence platform, promoting collaboration and serving as a hub for external partnerships for research on impact biomechanics Human Body Models (HBMs). At the heart of SAFER's vision for this research area, a number of partners work on the creation of a versatile and scalable human body model, the SAFER HBM, able to represent a diversity of road users such as occupants and vulnerable road users, in high-g to low-g events and including active musculature. The ultimate goal for the tool is to provide a virtual human substitute that replicates real-world injury outcomes in any impact situation.

Research related to the SAFER HBM research involves multiple projects aimed at refining the existing model to improve its performance. The cluster of projects carried out during this phase of SAFER has notably expedited the industrial implementation process, offering the SAFER HBM partners access to a cutting-edge HBM.
Some key developments and milestones during SAFER Stage 5 include:

1. PROJECT MILESTONE: SAFER HBM VERSION 10

– Achieved in year 2020 as part of Injury-HBM step 4 project with contributions from several other projects.
– Notable model updates were a population average male pelvis, new soft tissue mesh with softer materials for the torso, and new distal upper and lower extremities.

2. TARGETS ACHIEVED DURING THIS PHASE:

– Improved omnidirectional injury prediction capabilities, such as further improved prediction for rib fracture and brain injury.
– Model validation to simulate a variety of impact scenarios.
– Scalability by morphing to a diverse population of occupants.
– Demonstrations of whole-sequence crash simulation capability, addressing the challenges posed by increased vehicle automation.

3. CONDUCTED PROJECTS DURING SAFER STAGE 5:

Active HBM for virtual occupant response, step 4 (2018–2021) and step 5 (2021–2023)
– Funded by FFI, involving the partners Autoliv, Chalmers, Volvo Cars and Dynamore Nordic.
– Developments included whole-sequence occupant kinematics prediction, the first morphed active average female HBM, and evaluation of muscle activation influence on injury risk.

Pelvis and spine injury predicting models for women and men in a variety of sitting postures in future autonomous cars (Injury-HBM step 4) (2019–2023)
– Funded by FFI, with the partners Autoliv, Chalmers, Volvo Cars and Sahlgrenska University Hospital .
– Noteworthy developments encompass a population-based pelvis model, a new spine model prepared for tissue-level injury prediction, improved numerical robustness, and far-side validation.

Assessment of passenger safety in future cars (2017–2020) and Car passenger safety – to the next level (2020–2024)
– Partners were Autoliv, Chalmers, and Volvo Cars. The projects were funded by FFI.
– Achievements involve the capability to morph SAFER HBM to population-based shape models and improved rib fracture prediction.

Taking SAFER HBM to the global arena; focusing the cervical and thoracic spine (2022–2024)
– Research activities, financed by FFI, are focused on the cervical and thoracic spine, aiming to prepare the model for potential access beyond the current partners.
– The partners working together are Autoliv, Chalmers, Sahlgrenska University Hospital and Volvo Cars.

4. AWARD WINNING CLUSTER OF PROJECTS

In 2021, the SAFER HBM cluster of projects was honored with SAFER's prestigious 15-year anniversary prize for being the most groundbreaking project in the research and competence center's history. The award was bestowed during the 15-year anniversary celebrations.

5. PUBLICATION OUTPUT

A total of 29 publications have been released during this period, showcasing the array of knowledge generated and its applicability in numerous future projects and applications aimed at predicting and preventing injuries and fatalities in traffic. Welcome to explore more about these findings in the SAFER knowledge library!

SAFETY PERFORMANCE EVALUATION

THE RESEARCH AREA of Safety Performance Evaluation (SPE) has been essential to all other research activities at SAFER and is a cornerstone for future safety research. SAFER has utilized this research area to guide forthcoming research activities. 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 standardization of methods, recording, and sharing of data have all been crucial tasks. SPE can be considered complementary to all SAFER research areas and is integrated into many SAFER research projects on new safety strategies. Results of SPE studies are critical for ensuring the utility of new safety systems and providing confidence in their market introduction.

The SPE research area has given 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 gained international recognition due to strategic choices and activities throughout SAFER's history. The available datasets cover over 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 with the collected data and analysis requirements. These activities have enabled 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.

WELL POSITIONED FOR THE FUTURE

The introduction of advanced driver assistance systems has increased the need to understand their usage and performance in real-world traffic. Understanding how these systems should be improved further is crucial. The need to comprehend technologies for accident prevention aligns with understanding the complex system of factors behind crashes. This interest has strengthened the focus on Field Operational Tests (FOT) and Naturalistic Driving Studies (NDS) – areas to which SAFER is deeply committed and will continue developing spearhead competence and research leadership. These activities foster new research collaborations, providing opportunities for accessing larger amounts of data and gaining new research insights.

> The findings from the Safety Performance Evaluation team's studies are essential for ensuring the effectiveness of new safety systems.

Data collection is expensive and typically limited to specific regions. International collaboration facilitates research on socio-geographical differences, as exemplified by positive developments in strategic collaboration with India. Ongoing projects aim to upgrade SAFER's databases, enabling more extensive use, such as validating safety systems in future vehicles tracking driver attention and drowsiness. The reference group's engagement during stage 5 has been steady, focusing on exploring how large amounts of data could be used in real-time to enhance traffic safety.

Several inspiring workshops have been conducted, addressing topics like the use of traffic simulations for safety benefit assessment of autonomous driving systems and exploring differences and similarities between safety performance indicators for humans and automated driving systems. This dialogue has generated new project ideas, including a SAFER pre-study, (DISC).

Algorithms and technology for efficient real-time traffic data collection are other interesting areas of research. Additionally, connecting research to global sustainable development goals, understanding new security challenges related to Intelligent Transportation Systems (ITS) and connectivity, and addressing questions like "How safe is good enough?" are crucial for the entire research platform. SAFER, with its multidisciplinary research, is well-positioned to tackle new challenges in accident prevention, leveraging its profound expertise in road traffic data analysis.

OVERVIEW AND OUTCOME OF RESEARCH TARGETS

One research target has been to identify safety gaps, such as long-term injury types. Fundamental work has been done to review the Swedish in-depth accident database STRADA, determining what needs inclusion to identify safety gaps. Contributing factors have been researched, as seen in the project Traffic Accidents and Risk Factors Among Elderly. Research collaborations around the iGLAD in-depth database have been explored, along with efforts to identify critical use cases, like driving a heavy truck in fog among vulnerable road users.

Projects such as FOT-E have developed field operational tests data collection methods in this regard. Other projects mapping into this research target include Hövding data for risk assessment, AI AWARE, and Vulnerable Road Users – E-scooter target. To gain global insights into how infrastructure and traffic situations look, projects like SITIS and AfroSAFE have provided valuable input. Additionally, the Roadview EU-project focuses on bad weather conditions.

Another research target involves identifying new critical load cases, such as multiple impact car crashes, mainly related to injury prevention. Ongoing research explores methodologies for identifying new critical load cases in later stages (e.g., FOT-E, AI AWARE), connecting with the Human Body Protection area. Evaluation of implemented safety systems' performance, i.e., safety benefit analysis, has seen SAFER partners involved in projects like the European project L3Pilot, see page 40.

The L3Pilot project demonstrated SAFER's strong position in NDS data analysis, focusing on evaluating over 20 self-driving features and understanding drivers' attitudes toward self-driving cars. SAFER led the analysis of naturalistic driving data in this critical project. Furthermore, predicting safety benefits of new safety systems has been a research target for SPE, with ongoing projects like V4SAFETY aiming to provide a safety assessment framework for various safety measures.

Projects such as OSCCAR and VIRTUAL are developing virtual prediction approaches for the entire sequence of events from normal driving to crashes, their consequences, and countermeasure assessment. This connects to the research target of predicting future safety-critical scenarios, including automation. Steps taken in projects like L3Pilot and HIDRIVE contribute to advancements in this field.

The final research target for the SPE research area is determining the required safety level for automated drive. SAFER's involvement in projects like Headstart and SUNRISE, with a focus on test and verification, has contributed to advancing the research frontier. In summary, all research targets for Safety Performance Evaluation have been addressed during SAFER stage 5, with either research results readily available or activities initiated, including projects extending beyond SAFER stage 5, ending in December 2023.

ORGANISATIONAL RESPONSIBILITY FOR ROAD SAFETY

THE UN CONFERENCE on road safety in 2020 emphasised a potential shift in responsibility for road safety from individual users to organisations, encouraging them to measure, monitor, and enhance their traffic safety impact within value chains. SAFER actively embraced this approach, conducting projects to explore opportunities and support organisations in integrating traffic safety into sustainability agendas and procurement processes. The concept of traffic safety footprint, introduced at the global ministerial conference, became a key focus for SAFER, aligning road safety with sustainability goals. The Stockholm Declaration resulted in a UN resolution, urging organisations to incorporate traffic safety into their corporate responsibility agendas, fostering systematic measurement, follow-up, and implementation of effective measures to improve overall safety in the mobility system.

The concept of traffic safety footprint was introduced at the 2020 UN conference, crucial and offering opportunities.

PROJECT EXAMPLES

- **A SAFER THINK TANK FOR TRAFFIC SAFETY FOOTPRINT**, funded by SAFER with partners from Autoliv, VTI, Volvo Group, the Swedish Transport Administration and Folksam has made great progress in mapping suitable activities and research questions that could be addressed to accelerate implementation.

- **IN TRAFFIC SAFETY FOOTPRINT I AND II**, researchers have developed tailored indicators for organisations to assess and monitor their influence on traffic safety, empowering them to proactively implement strategic actions based on the findings.

- **FOLLOW-UP OF ROAD SAFETY REQUIREMENT IN PROCUREMENT OF FREIGHT TRANSPORT**: In the pursuit of enhancing road safety in procurement processes for freight transport, the project team hypothesis was that a significant number of lives could be safeguarded if companies and organisations optimally integrate road safety requirements. Researchers from Volvo Group, VTI and DuWill explored the feasibility of improving road safety through the development of a methodology specifically designed for monitoring and enforcing road safety requirements in freight transport procurement.

Requiring high traffic safety standards in procurement can save lives, as observed by researchers in SAFER-associated projects.

EMPOWERING RESEARCH: INTRODUCING THE SAFER DATA CATALOGUE

IN SEPTEMBER 2022, SAFER marked a significant milestone with the introduction of a new asset for the research community: The SAFER Data Catalogue!

Access to a diverse array of datasets within SAFER's network is crucial for research efficiency, offering new insights into ongoing and historical projects, and promoting the creation of entirely novel initiatives through data-driven exploration. To streamline this process and make essential data readily available, we introduced the SAFER Data Catalogue. This platform is designed to provide detailed descriptions of relevant datasets within our network, ensuring that SAFER remains an instrumental resource for our partners and an attractive hub for global research groups.

The SAFER Data Catalogue is a important addition, encapsulating an array of relevant datasets available through SAFER partners. The inaugural edition, launched in 2022, included metadata descriptions for over 15 datasets and at the end of Stage 5, the number is doubled. These datasets encompass a broad spectrum, ranging from field operational tests with a focus on vehicles or locations to real-time data featured in the Swedish National Access Point (NAP), and comprehensive accident databases.

The official launch event for the catalogue was a cause for celebration, and Erik Svanberg, the project leader behind this initiative, presented the project in festive forms. Attendees were given the insights into the catalogue's structure and content. Three of our partners, The Swedish road administration, Viscando and RISE, also had the opportunity to highlight their contributions and the value they derived from participating in the catalogue.

Incorporating the SAFER Data Catalogue aligns with our vision to create a valuable asset and furnish our SAFER partners with essential information about accessible datasets for future research and collaborative projects. It's important to note that we're not offering the datasets themselves, but primarily delivering comprehensive information regarding the dataset's content and instructions on how to access it.

In September 2022 the SAFER Data catalogue was officially launched in festive forms.

The datasets available to our partners are hosted within our collaboration tool Webforum, declared by the partners who provide the data. These partners also hold the responsibility for data accuracy and validity. The development and utilization of the data catalogue will persist as an integral component of SAFER's research in the next stage. Future updates and expansions of the catalogue will be rolled out continuously, ensuring that the SAFER Data Catalogue remains a dynamic and central resource in our journey to save lives on the roads.

FROM DATA TO DESIGN: L3PILOT INSIGHTS FOR SAFE AUTOMATED DRIVING

HOW DO WE MAKE SURE that the human is a reliable fallback and can promptly, safely, and efficiently take back the driving task from automated driving? That has been the key question for over 30 stakeholders from academia and industry in Europe's first comprehensive pilot test of automated driving on public roads. The result is believed to help speed up and harmonize the development of automated driving systems in the future. The European research project L3Pilot, led by Volkswagen and co-funded by the European Commission, has run from 2017 to 2021 with stakeholders from the whole value chain: car manufacturers, suppliers, academia, research institutes, infrastructure and governmental agencies, user groups and the insurance sector. The four-year project successfully ended with performing its final event in conjunction with the ITS World Congress in Hamburg 2021.

Present at the ITS World Congress were Chalmers researchers from Vehicle Safety at the department of Mechanics and Maritime Studies – Marco Dozza, Linda Pipkorn, Pierluigi Olleja, along with SAFER representative Erik Svanberg – to show-case their research findings, which once started with the quest to find out how to optimise safety in automated driving:

"We all want full automation, that is, a vehicle that picks us up and takes us places without us having to think about driving. But tech is not there yet and there will be a transition phase with partial automation. That means humans and vehicles need to help each other and take turns in the driving task. The most relevant scenario is when a vehicle needs help from the human to sort out a critical situation that may lead to a crash. In such case, the research question is "how do we make sure that the human is a reliable fallback and can promptly, safely, and efficiently take back the driving task?" In our research, we tackled this question by exposing drivers to critical situations, where they need to take over control, and see how they do it. In this way, we can design vehicles that help the driver to efficiently coming back to the driving task rather than setting unreasonable expectations on human beings," says Marco Dozza, professor at Vehicle Safety at the department of Mechanics and Maritime Sciences at Chalmers.

Linda Pipkorn, PhD student at Chalmers University, has been leading some of the test studies in the L3Pilot project.

EUROPE'S FIRST COMPREHENSIVE PILOT TEST ON PUBLIC ROADS

The project was the first comprehensive pilot test of automated driving on public roads in Europe, which makes it unique in its kind. Fourteen partners focused on testing automated driving functions in normal motorway driving, traffic jams, urban driving and parking. The pilots, which was conducted from April 2019 until February 2021, involved six countries besides Sweden: Belgium, Germany, France, Italy, Luxemburg and the United Kingdom and included crossborder activities.

The project equipped 70 vehicles and the test fleet comprised 13 different vehicle brands, from passenger cars to a SUV. More than 400,000 kilometers were driven on motorways including 200,000 kilometers in an automated mode and 200,000 km in a manual mode as a baseline for comparison of the user experience and evaluation of the impacts. More than 24,000 km were travelled in the automated mode in urban traffic. With the aim to put the focus on the user experience of automated driving functions, over 1,000 persons participated in piloting and complementary virtual environment tests.

> L3Pilot paved the way for real-life driving tests with automated series vehicles and leading to further projects in the field.

"We're proud about the high number of advanced studies, with a real vehicle on test track and public roads, that we managed to perform within this project, especially given the pandemic. All of these studies advanced our understanding of how drivers behave – how they act and where they look – when transitioning from automated driving to manual in response to take-over requests," says Linda Pipkorn, PhD student at Chalmers at that time.

UNIQUE DATA COLLECTION TO ENHANCE SAFETY IN AUTOMATED DRIVING

The four-year project has also involved a considerable collection of valuable data based on the research findings on how pilot participants reacted when going from automated to manual driving in real traffic scenarios. The data will in the next step enable virtual testing to further enhance safety in automated driving.

"We found out that, in real traffic, drivers are able to transition control from automation to manual in response to a take-over request. The transition should be considered as a process of actions – look to instrument cluster, putting hands on wheel, look forward, deactivate automation - that requires a certain amount of time: up to 10 s in real traffic. Our research also showed that, in real traffic, drivers' visual attention towards the forward road return to similar levels as in manual driving 15 s after a take-over request. In response to take-over requests, drivers may look away from the road towards the instrument cluster rather than to the road. This means that, designing safe automated driving functions requires take-over requests to be issued in all situations that require driver input. In addition, it is important for the automated driving function to be responsible for safe driving at least up to the moment of the automation deactivation but preferably also some time after," says Linda Pipkorn.

As a part of the L3 pilot project, Linda Pipkorn carried out a study on a public road in Gothenburg together with Volvo Cars, aiming to find out how the drivers' gaze behavior changed when going from driving with automation to driving manually again.

"It turned out that, paradoxically, a take-over request, i.e., the signal from the car that the driver needs to take control can contribute to the drivers looking away from the road rather than looking at the road, which from a traffic safety point of view is not optimal," Linda explains.

L3PILOT FACTS

L3Pilot was an Innovation Action, co-funded by the European Union under the Horizon 2020 programme with the contract number 723051. 34 organizations were committed to scientifically test and assess the impact of automated driving systems on driver comfort, safety and traffic efficiency as part of the project.

Web: www.l3pilot.eu
Duration: September 2017 – October 2021
Total budget: €68 million
Funding: €36 million
Coordinator: Volkswagen AG

HI-DRIVE FACTS

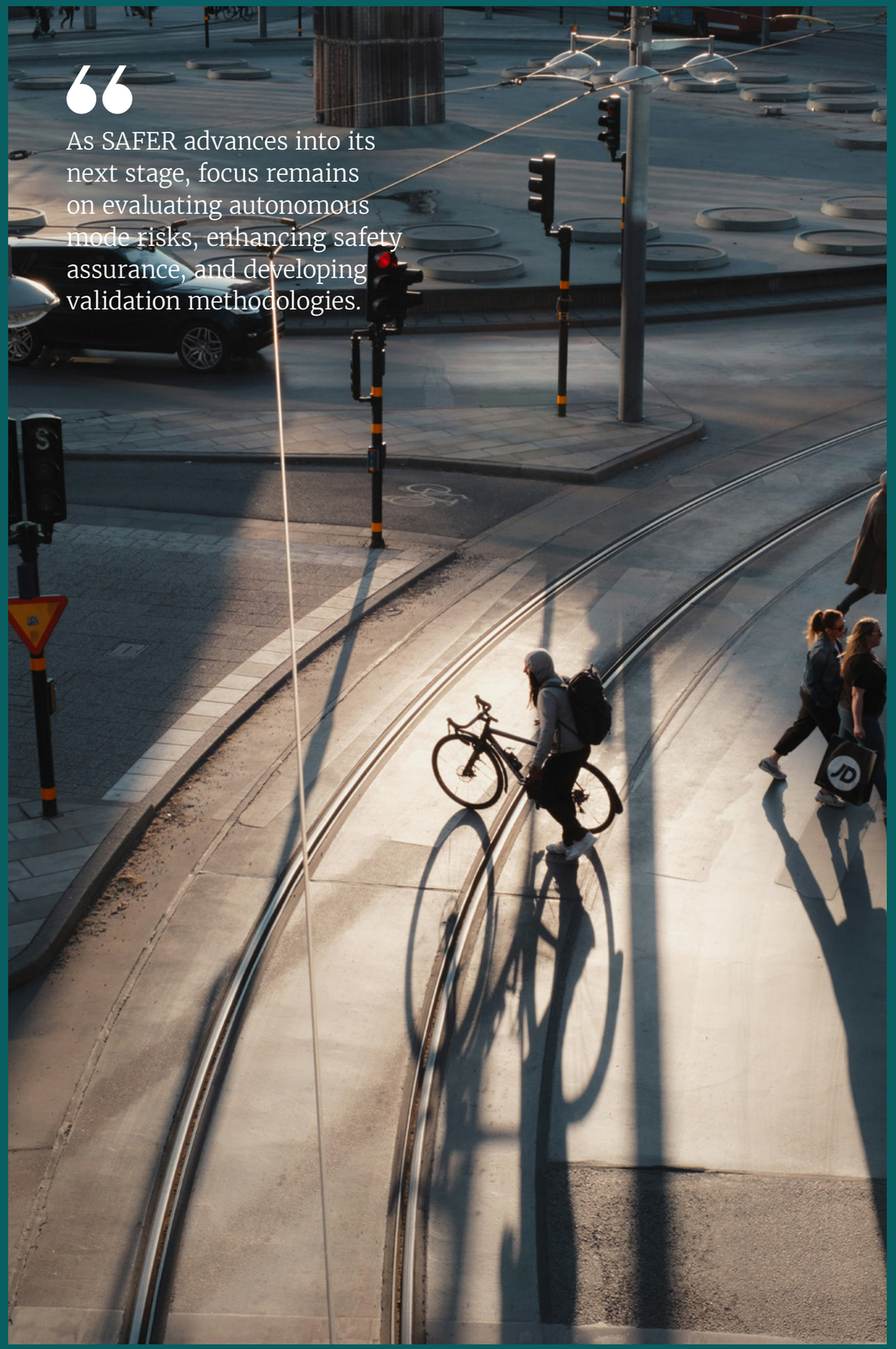
Hi-Drive is co-funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 101006664. 40 OEMs, automotive suppliers, research institutes, associations, traffic engineering, deployment organisations and mobility clubs are involved in the research activities.

Web: https://www.hi-drive.eu
Duration: July 2021 – July 2025
Total budget: €60 million
Funding: €36 million
Coordinator: Volkswagen AG

UPSCALED TESTS IN HI-DRIVE

L3Pilot paved the way for scaled-up driving tests with automated series vehicles in real-life traffic. Together with 40 partners – OEM:s, automotive suppliers, research institutes, traffic engineering and deployment companies – Chalmers researchers started working on the project Hi-Drive in July 2021 to address crucial challenges hindering the progress of vehicle automation. Building on the insights gained from the L3Pilot project, Hi-Drive focuses on advancing automated driving technologies by testing robust high automation functions in diverse traffic environments. Key objectives include investigating communication and positioning technologies, building trust in the transport system, addressing data complexity, and ensuring reliability and cybersecurity. The project extends operational design domains through "Enablers" and involves testing nearly 30 use cases across urban traffic and motorways. With a systemic approach to testing and evaluation, Hi-Drive assesses impacts on individual driver-vehicle behavior, interaction with road users, and vehicle behavior. The project, supported by SAFER partners Chalmers University of Technology, Volvo Cars, and Volvo Group, as well as a strong European network, is expected to provide valuable insights into the societal benefits and challenges of automated driving.

The €37.5 million Euro budget, funded by the European Union, underscores the project's commitment to advancing safety performance evaluation in the realm of automated driving.



> As SAFER advances into its next stage, focus remains on evaluating autonomous mode risks, enhancing safety assurance, and developing validation methodologies.

SYSTEMS FOR ACCIDENT PREVENTION AND AUTOMATED DRIVING

THE QUEST FOR implementing self-driving vehicles on public roads presents substantial challenges, requiring collaborative efforts from various stakeholders. The Systems for Accident Prevention and Automated Driving reference group, including the competence network for Safety Assurance, has been at the forefront of addressing these challenges over the past half-decade.

In 2019, SAFER outlined three primary research challenges connected to this research area:

- understanding the role of the driver,
- designing sufficiently safe technology, and
- scaling applicability from specific scenarios to universal implementation.

The organisation emphasised the importance of collaboration and explored advancements in AI application in road safety (read more about these efforts in page 24). Key projects, such as ESPLANADE, SEBRA, REALSIM FOR AD, and SWEDEN4PLATOONING, focused on developing methodologies for autonomous vehicle safety, radar-based bicycle safety systems, simulation tools, and platooning technologies.

The subsequent year saw the culmination of the ESPLANADE project, which delved into demonstrating the safety of autonomous road vehicles. SEBRA focused on radar-based safety systems for bicycles, while REALSIM FOR AD provided tools for simulation based on extensive real-life driving data. SWEDEN4PLATOONING successfully demonstrated interoperable platooning with automated longitudinal control. The HEADSTART project tackled testing and validation procedures for automated road transport.

In 2021, SAFER continued its efforts to enhance expertise in systems for accident prevention and automated driving. Notable, the Automotive Safety Assurance competence network and facilitated discussions on methods and nomenclature. Projects like VALU3S and ASSERTED aimed to evaluate validation methodologies and assure safety for rapid deployment of autonomous driving, respectively.

As of 2022, the challenges in automated driving persist, with particular attention to overall safety and determining when a self-driving vehicle is safe enough for public roads. The trucking industry has taken a lead in addressing the driver shortage through hub-to-hub operations. Research has also focused on improving sensor robustness in adverse weather conditions and incorporating wireless connectivity for connected safety.

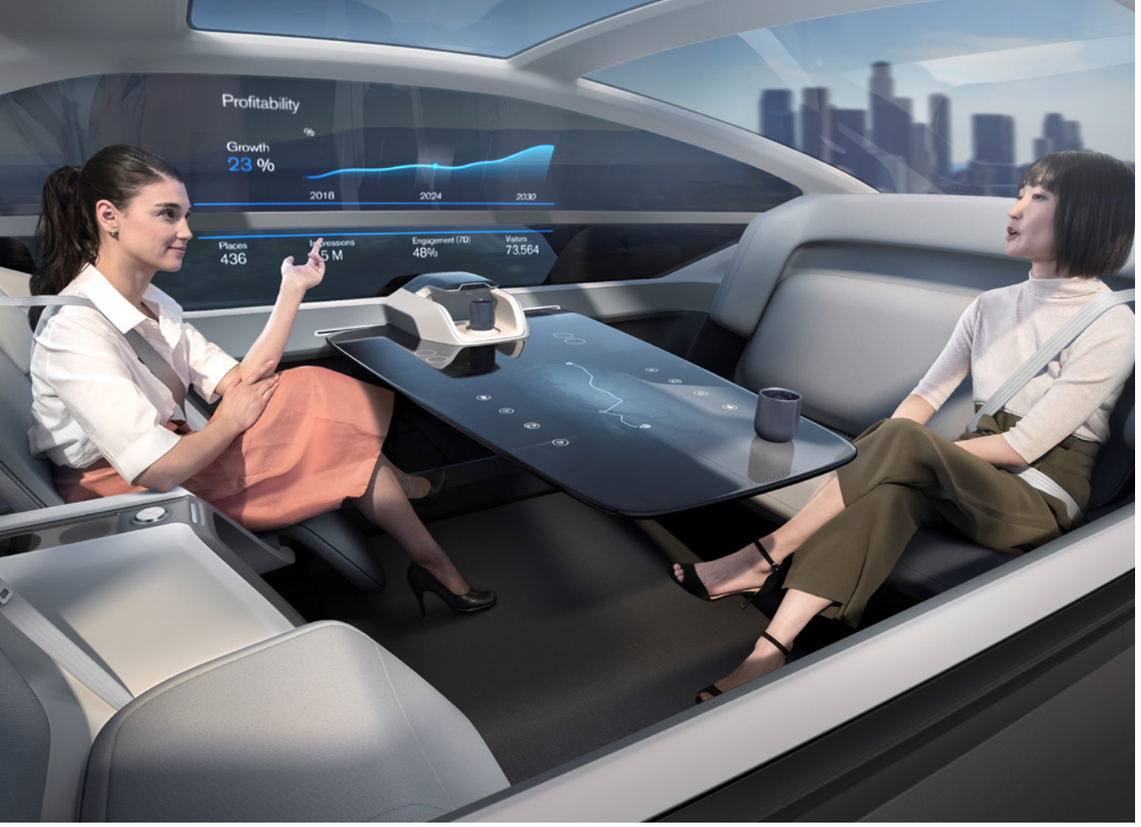
> Ensuring the safety of automation has been a central question for us in Stage 5.

Several ongoing projects highlight SAFER's commitment to cutting-edge research. SEVVOS and AI-SEE explore simulation and emulation of water spray for validating optical sensors, contributing to adverse weather testing. EVIDENT investigates virtual validation and verification for ADAS and AD features, aiming to reduce testing time and costs. ROADVIEW, led by Halmstad University, addresses robust automated driving in extreme weather, integrating collaborative perception and digital twins.

As SAFER advances into its next stage, the focus remains on evaluating risks in autonomous mode, enhancing safety assurance, and developing methodologies for validation and verification. The organisation continues to lead in shaping the future of systems for accident prevention and automated driving, with a robust network of collaborations and a commitment to innovation.

OVERVIEW AND OUTCOME OF RESEARCH TARGETS:

1. **We can evaluate different ways to act in the traffic situation and decide upon how to progress safe and efficiently:**
   In SAFER's pursuit of evaluating different strategies for safe and efficient traffic interaction, this research target proved ambitious for Stage 5. Recognising that a comprehensive evaluation requires a well-designed and verifiable Automated Driving System (ADS), the research area team encountered challenges that slowed down the deployment of automated vehicles on public roads. Notably, issues surrounding the verification and valida-



tion of ADSs emerged, leading to a more cautious approach. The envisioned expansive Operational Design Domain (ODD) for ADS features, initially anticipated to cover diverse scenarios, has evolved into more specific applications, such as automated valet parking and autobahn driving in congested traffic under specific conditions.

Despite challenges, this research target remains a focal point, acknowledged for reevaluation in SAFER Stage 6. Concluded projects, SWEDEN4PLATOONING and AUTOFREIGHT, exemplify SAFER's commitment to addressing these complex issues. AUTOFREIGHT's initial ambitious goals for self-driving trucks were recalibrated in AUTOFREIGHT II, focusing on using High Capacity Transport (HCT) trucks to pull two containers, optimising transport between the harbor in Gothenburg and Viared in Borås. Projects like SAFETYNET FOR TRUCKS and SALIENCE4CAV contribute valuable insights, particularly in tactical decision-making with safety guarantees, showcasing SAFER's dedication to advancing the field of automated driving.

2. **We have developed a methodology to verify and validate assisted and automated systems in cooperation with international researchers in this area.**
SAFER has successfully achieved the target of developing a comprehensive methodology for the verification and validation of assisted and automated systems. This accomplishment is highlighted by collaborative efforts with international researchers, fostering a rich exchange of ideas and best practices. Ongoing projects such as VALU3S, SALIENCE4CAV, and ASSERTED exemplify SAFER's commitment to refining and implementing this methodology.

The VALU3S project, aiming to evaluate state-of-the-art verification and validation methods, has positioned SAFER partners as a leader in advancing techniques for ensuring the safety, cybersecurity, and privacy of automated systems. SALIENCE4CAV has contributed valuable insights, particularly in tactical decision-making, enhancing the reliability of automated systems. The ASSERTED project, focusing on assuring safety for the rapid and continuous deployment of autonomous driving, showcases dedication to real-world application of verification and validation methodologies.

In addition to ongoing projects, the researchers involved have successfully concluded projects such as REALSIM FOR AD, HEADSTART and ESPLANADE. These projects have not only contributed to the development of the methodology, but have also provided tangible outcomes and lessons that contribute to the continuous refinement of verification and validation practices.

Moreover, SAFER's engagement in the ISO5083-work underlines its commitment to setting industry standards and participating in global initiatives. This active involvement in international standardisation efforts further strengthens SAFER's position as a key contributor to shaping the future of assisted and automated systems.

3. **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.**
The research target of developing prediction models for human cognition and behavior in the areas of driver engagement, transitions between manual and automatic driving, and interaction between human and ADAS has been primarily addressed within the Road User Behavior reference group.

Although ADAS is recognised as a significant contributor to road safety, it has not been as prominently featured at SAFER during this stage compared to the earlier phases. This shift may be attributed to the initial hype and focus on automated driving during the lead-up to phase 5. Additionally, the nature of pre-competitive research might be more relevant for technologies that have not yet reached their productivity plateau in the innovation hype curve. Consequently, while there is ongoing research in ADAS, its execution might now be more competitive or internal to partner organisations.

Increased activities in projects to further address the targeted areas of human cognition, driver engagement, and interaction with ADAS features are recommended for SAFER's next stage. This indicates an awareness of the evolving landscape and a call for enhanced efforts in these specific domains in SAFER's upcoming research agenda.

Top: One of the key issues investigated in the project ESPLANADE is how the communication between the car and the driver will be set up in an autonomous vehicle, for example, by clarifying who is responsible for conveying the vehicle in different situations.

The SEBRA project investigated the possibilities to equip a bicycle with active safety systems.

> A notable finding from SAFER's Automotive safety assurance competence network is the suggestion to describe sensing performance using a dynamic capability statistic.

The ENSEMBLE public demonstration event, held in Spain in September 2021, showcased the collaborative efforts of six prominent European truck manufacturers, among them SAFER partners Scania and Volvo. The project focused on the development and demonstration of cutting-edge platooning technology, marking a significant advancement in the field of trucking innovation.

4. **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.**
   The research target of obtaining knowledge essential for the development of new perception components enabling high-performance, reliable information about the vehicle environment and the driver/riders in the vehicle has encountered challenges due to the complexity of assisted and automated driving features. The development of perception components encompasses a broad spectrum, including how sensors perceive the environment in adverse weather conditions and the acquisition of reliable and accurately annotated data for training machine learning algorithms, particularly for cameras. The integration of different sensors into a cohesive world representation poses a significant challenge.

Throughout SAFER stage 5, the development of perception components has been marked by confidentiality, with much of the research and technical advancements occurring in startup companies. A notable finding from the SAFER competence network Safety Assurance is the suggestion to describe sensing performance using a dynamic capability statistic. This approach advocates for reporting where the required performance level can be met dynamically, allowing the feature to adapt to varying conditions rather than presenting a performance that remains indifferent to factors such as weather conditions until deemed insufficient.

It is emphasised that further exploration and development are needed to reach this research target. The need for more activities in projects like ENSAMBLE and SWEDEN4PLATOONING is highlighted, indicating a recognition of the importance of continued research and activities in this domain, which is expected to be addressed in SAFER Stage 6.

KNOWLEDGE DISSEMINATION & RESEARCH OUTREACH

DRIVING GLOBAL IMPACT: SAFER'S INITIATIVES IN DEVELOPING COUNTRIES

ONE OF THE KEY conclusions from the Global Ministerial Conference on Road Safety 2020 centered around knowledge transfer; how we can more systematically and effectively assist countries that need it most in strengthening their road safety. Our research at SAFER can make a significant difference in this regard. During this phase, our primary focus has been on three geographical areas: India, Africa, and China.

SAFERAFRICA

After three years, the SaferAfrica project concluded successfully in 2019. It aimed to enhance road safety policies, management, capacity building, and interventions. The key innovation is the Dialogue Platform, connecting stakeholders from Africa and Europe to advise on road safety actions. The Platform continues to develop recommendations post-project closure. A transferability tool assesses implementation barriers, and new knowledge on risk factors and policy needs was generated. The African Road Safety Observatory (www.africanroadsafetyobservatory.org) provides accessible information, including country fact sheets and capacity reviews. SAFER partners contributed to the African Road Safety Action plan review, analysed WHO accident data, and participated in developing a road safety e-learning course available through the Road Safety Observatory.

AFROSAFE

Initiated in 2022, AfroSAFE aims to elevate knowledge on road safety in low- and middle-income African countries. Despite hosting only 4% of the global motor vehicle fleet, African roads account for over 10% of global traffic fatalities, with rates more than four times higher than the European average. AfroSAFE adopts the safe system-approach, emphasizing safe speeds, tolerance for human errors, and the responsibility of transport system designers to create forgiving road environments.

Funded by Horizon Europe Research and Innovation, its key objectives include propagating the safe system in African road safety, emphasising knowledge transfer, and focusing on vulnerable road users. Prioritising pedestrians and cyclists, the project aims to positively impact public health, gender equality, sustainability, and city livability. Additionally, AfroSAFE aims to build local expertise through a 'train-the-trainer' approach, promote long-term change for sustainable road safety improvements tailored to African conditions. Lund University, VTI, Volvo Group, Autoliv and Chalmers Industriteknik are partners in this project. The project idea was generated during a workshop at SAFER in 2021.

CHINA SWEDEN RESEARCH CENTRE FOR TRAFFIC SAFETY

The CTS platform, a collaboration between Swedish partners Chalmers, Autoliv, Volvo Cars, Volvo Group, and VTI, and Chinese partners Tongji University, RIOH Institute, Tsinghua University, and Geely Automotive Research, has been driving impactful traffic safety research and activities for advancing road safety in China since its inception in 2012. Although faced with challenges due to the pandemic, the program celebrated its 10-year anniversary in 2022, reflecting a decade of positive contributions. Plans to showcase research highlights and the partnership's value are underway, emphasising the enduring commitment to enhancing traffic safety. Over the past 12 years, the center has grown to include ten partners, with numerous projects successfully executed, including the project Virtual evaluation tools for pedestrian integrated safety. This collaborative project aimed to enhance vulnerable road user protection in European and Asian traffic conditions by developing integrated safety systems, focusing on injury mitigation and passive safety. Swedish partners contributed with open source computational mechanics tools for model development and injury assessment, while Chinese partners focused on integrated system development to address emerging challenges in road safety for pedestrians, cyclists, and new personal mobility devices.

SITIS

The SITIS initiative (Sweden-India Transport Innovation and Safety Partnership) was launched in February 2020 during the UN's global conference on road safety. The collaboration aims to leverage the expertise of India and Sweden to accelerate the implementation of safe and sustainable transport solutions and policies in India. The first project focuses on collecting naturalistic driving data from buses in India, specifically two long-distance coaches in a connected corridor near Bangalore. The data covers various aspects such as drivers, vehicles, passengers, infrastructure, and surroundings to address research questions related to traffic system analysis, weather conditions, driver behavior, and emergency response systems. The collaboration also involves sharing Sweden's Vision Zero and expertise in building a successful structure for implementing traffic safety measures. In 2022, the SITIS team met in India to discuss project success and future endeavors, including meetings with funding agencies from both countries. Key SAFER partners in this initiative include Autoliv, Volvo Group, Chalmers University of Technology, RISE Research Institutes of Sweden, VTI (Swedish National Road and Transport Research Institute) and the Swedish Transport Administration.

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.

CONTRIBUTE TO THE GLOBAL ROAD SAFETY AGENDA

IN THE PURSUIT of advancing global traffic safety, SAFER has strategically collaborated with key organisations to influence and shape the traffic safety agenda within the Horizon Europe Framework programme. Through active engagement with entities like ERTRAC, EARPA, EUCAR, ECTRI, and CLEPA, SAFER has not only prioritized its collective research agenda but also played a pivotal role in initiatives like the formation of the CCAM partnership and the revision of the ERTRAC Road Safety Roadmap. These endeavors have positioned SAFER at the forefront, facilitating meaningful dialogues with the European Commission and ensuring that critical safety issues are addressed in future research calls.

2023 has been yet another year where the joint efforts of SAFER partners have paid off in terms of consolidated contributions and comments to relevant roadmaps and other strategy documents, primarily on the European arena. Some specific examples include the update of the ERTRAC (the European Road Transport Advisory Council) Road Safety Roadmap with a specific focus on the needs for calls during 2025. Three priority areas were defined and agreed upon among a subset of ERTRAC partners: Safe Human-Technology Interaction in the Coming Decade, Safety of Bicyclists and Users of other Micro-mobility Devices, and Safety of Users of Small Electric Vehicles. The document was delivered to the commission in December 2023.

Also, during this year, an update of the CCAM (Connected, Cooperative Automated Mobility) Strategic Research and Innovation Agenda was done, also looking towards the final years of the Horizon Europe program. Swedish partners are well-represented in the core team of the CCAM partnership, and through the support from the DriveSweden project HEUDRIS, we have been able to coordinate and consolidate the Swedish input to the SRIA. At the General Assembly meeting of the CCAM partnership in December 2023, two additional persons representing SAFER partners were elected to the core team of the partnership: Anna Larsson, RISE, as co-leader of Cluster 7 – coordination, and Hamid Zarghampour, the Swedish transport administration, as vice-chair of the administration board.

SCIENCE OUTREACH

SAFER's five-year mission: Shaping the future of road safety through knowledge dissemination and outreach.

OVER THE PAST FIVE YEARS, SAFER has continued the mission to disseminate research findings, promote knowledge exchange, and actively engage with partners and society. Our commitment to knowledge dissemination and science outreach has been instrumental in advancing road safety initiatives, setting up collaborations, and contributing to our collective goal of achieving zero traffic fatalities. In this chapter, we will summarise the journey SAFER has undertaken and highlight some of the most impactful activities.

EFFECTIVE DISSEMINATION CHANNELS

SAFER serves as a platform for the dissemination of research findings, allowing all our partners to amplify their voices and reach relevant stakeholders, including key decision-makers and financiers, both nationally and internationally. To achieve this, we leverage our communication expertise and established channels, including our website, project tools, and various communication channels, to ensure the widespread distribution of research results. These efforts not only increase the visibility of our work but also support new research funding, propelling our joint research agenda.

HIGHLIGHTS FROM THE JOURNEY

Over the years, SAFER has organised and participated in a multitude of events, totaling a remarkable 356 gatherings. These activities have played a pivotal role in sharing knowledge and research findings with our partners and the wider community. The seminars, networking events, and inspirational workshops have been vital in creating visibility, sharing current research topics, and facilitating networking opportunities.

INTERNATIONAL KNOWLEDGE SHARING

SAFER has actively engaged in international events, debates, and panels, strengthening our global presence and influence in the field of road safety. Our proactive approach has resulted in SAFER being approached for collaborations, expert opinions, and speaking engagements at conferences and seminars. Our expertise has resonated with organisations seeking to enhance road safety, making us a trusted partner on the international stage.

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

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

For example, SAFER co-chaired a workshop on Road Safety Research & Innovation in Brussels in November, 2019 and moderated a session on Sustainable Road Safety in November 2022, discussing medium-term trends and needs for future research and innovation at the TRA Conference (Transport Research Arena) in Lisbon.

HOST OF LEADING CONFERENCES

SAFER has had the privilege of hosting several leading international conferences, for example the International conference on Driver Distraction and Inattention in 2022, the Scandinavian conference on system and software safety in 2021, 2022 and 2023 as well as the International Conference and Transport and Traffic Psychology in 2022. These events have drawn researchers and experts from around the world, providing them with a platform to exchange knowledge and insights. SAFER's role in organising these conferences has further cemented our position as a hub for cutting-edge research and knowledge exchange.

CONTRIBUTING TO AGENDA 2030

SAFER has worked diligently to integrate road safety into the broader framework of the United Nations' Sustainable Development Goals. Our activities have focused on how road safety can contribute to a safer and more sustainable transport system. We have organised seminars about the recommendations from the UN conference in 2020 and for example also panel dialogues to explore the concept of traffic safety footprints, inspiring participants to work collaboratively toward a safer and more sustainable future.

BORDERLESS RESEARCH FOR ROAD SAFETY

One particularly significant event was SAFER's "Borderless Research to Save Lives," which took place in Stockholm in February 2020. This event attracted over 150 delegates from approximately 40 countries and was listed as a pre-event in the conference program of the Global Ministerial Conference on Road Safety. The purpose of this event was to demonstrate the power of collaboration and knowledge sharing in addressing road safety, using Vision Zero as a guiding philosophy.

The event featured inspirational lectures from academia, industry, research institutes, and the European Commission. These speakers emphasised the efficiency and effectiveness of working together toward a common vision. Following the lectures, attendees engaged in a networking dinner, where SAFER's collaborative research projects were presented. The event aimed to highlight SAFER's commitment to the UN Global Sustainable Development Goals, Sweden's Vision Zero strategy, and the global significance of road safety.

During the exhibition, guests had the opportunity to interact with SAFER's experts across various research areas, gaining insights into knowledge dissemination, collaborative efforts like the China Sweden Research Centre for Traffic Safety, and SaferAfrica. Discussions regarding future policies, legislation, and regulations were also held, underscoring the profound interest in SAFER's research and its potential to influence traffic safety worldwide.

In summary, SAFER's five-year mission has been a remarkable journey of knowledge dissemination, international outreach, and impactful events. Our efforts have not only elevated road safety to the forefront of the global agenda but have also solidified SAFER as a leader in the field. As we continue to shape the future of road safety, we look forward to new challenges and opportunities that will further our mission and make our roads safer for everyone. See the complete list of organised events in appendix 4.

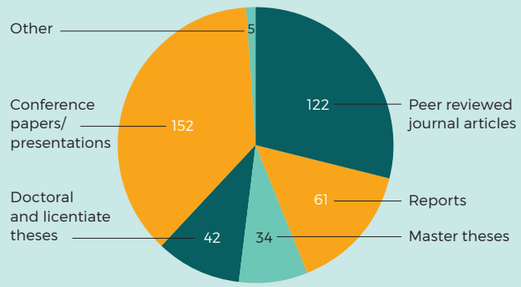
More than 150 UN delegate participated in SAFER's event Borderless research to save lives – an experience on how Vision Zero can be addressed by collaboration – in conjunction to the global ministerial conference in Stockholm 2020.

In June 2023, Peter Kronberg from Autoliv and Malin Levin from SAFER's operational team joined Liv och Trafikpodden to share the results and dialogue from the global Vision Zero conference held in Stockholm.

TRAFFIC SAFETY PODCAST

The SAFER Traffic Safety Podcast, "Liv och Trafikpodden," serves as a comprehensive knowledge-sharing platform focused on road safety. Presented in collaboration with NTF Väst, the podcast features interviews and discussions covering for example research at SAFER, successful practices, and traffic policies. The primary objective of the podcast is to simplify complex subjects and reach out with knowledge to a diverse audience. The podcast's format is designed for easy consumption, ensuring accessibility to a wide range of listeners. For a valuable exploration of these topics and more, take advantage of the opportunity to listen to the episodes on livochtrafikpodden.se.

Figure 5
Number of SAFER publications during SAFER Stage 5



PUBLICATION VOLUME

SAFER's research projects have produced more than 400 publications during SAFER Stage 5, including peer reviewed journal articles (29%), conference papers and posters (37%), reports (15%), master theses (8%) and doctoral and licentiate theses (10%). Publications which are still listed as "in preparation/in press" will be made available in the near future (e.g. accepted papers of conferences that have not yet been held) are not included. In addition, these numbers also exclude publications from research conducted within SAFER but not belonging to a specific project (e.g. some PhD and post-doc research). A certain degree of underreporting should also be considered. 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.

OUR SAFER DOCTORS

We are proud to share that no fewer than 39 students have successfully completed their licentiate or doctoral theses within the SAFER environment during this stage! A SAFER Doctor actively contributes to one of our projects in the portfolio and is either employed or affiliated with one of SAFER's partners. These students are integral contributors and are invited to our collaborative activities and actively participate in various co-creation events.

The students are a crucial asset to our collaborative platform and also provide added value to our partners by serving as a valuable recruitment pool. Each SAFER Doctor is honored with a golden SAFER hat at their dissertation and has been given the opportunity to showcase their research within the network.

We strive to make the students' time at SAFER as enriching, enjoyable, and conducive to building valuable networks with other traffic safety researchers in Sweden. See the complete list of doctorial and licentiate students in appendix 6.

Fredrick Ekman, Chalmers University of Technology, defended his doctoral thesis "User trust here and now but not necessarily there and then – A Design Perspective on Appropriate Trust in Automated Vehicles" in Februay 2023.

Emma Nilsson, Chalmers University and Volvo Crars, defended her doctoral thesis "Effects on cognitive tasks on car drivers' behaviours and physiological responses" in September 2022.

APPENDICES

APPENDIX 1: SAFER PARTNERS IN STAGE 5

The following partners have been engaged during SAFER Stage 5:

PARTNER LEVEL 1 & 2

- Aptiv AB
- AstaZero AB
- Autoliv Development AB
- BETA CAE Nordic AB
- Chalmers Industriteknik (as of March 2022)
- Chalmers University
- China Europe Vehicle Technology AB (CEVT)
- Combitech
- Folksam
- Halmstad University
- If Insurance
- Institute of Transport Economics – Norwegian Centre for Transport Research (TØI)
- Jönköping University
- National Electric Vehicle Sweden AB (NEVS) (until dec 2022)
- 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)

- 4S (July 2020 – dec 2021)
- Agreat (as of May 2021)
- Afry
- ASTUS AB (as of March 2021)
- Asymptotic (as of July 2020)
- Bookman Visibility (as of August 2022)
- City of Gothenburg
- Consenz (as of May 2021)
- Cycleurope AB
- DuWill (as of March 2021)
- HiMinds (until dec 2020)
- Hövding (as of March 2021)
- Knightec (as of May 2021)
- Malmeken AB
- Nationalföreningen för trafiksäkerhetens främjande (NTF Väst)
- Pionate AB (as of April 2022)
- QRTECH (as of May 2022)
- Svanberg & Svanberg AB
- Swedish Transport Agency
- Tier Mobility (May 2021 – Dec 2022)
- Trivector
- Viscando (as of March 2021)
- Voi (as of August 2021)

APPENDIX 2: SAFER PRE-STUDIES IN STAGE 5

PROJECT	PROJECT MANAGER	START	END	PARTNERS	RESEARCH AREA
SMART-LOOP – DESIGN OF MULTI-MODAL HUMAN-MACHINE-INTERACTION SYSTEM FOR KEEPING THE DRIVER IN-THE-LOOP IN AUTOMATED DRIVING SYSTEMS	Pinar Boyraz Baykas	2020-01-01	2020-12-31	Chalmers, VTI	RUB
HUMAN FACTORS RELATED TO REMOTE CONTROL OF AUTOMATED HEAVY VEHICLES	Linda Meiby	2020-01-15	2020-04-30	Scania, RISE	RUB
SAFER CYCLING	Magnus Larsson	2020-05-04	2021-04-01	VTI, Folksam, Chalmers, Sahlgrenska Academy, Vätterrrundan (extern)	HBP
SAFETY CULTURE FOR AUTOMATION IN TRANSPORT COMPANIES	Christina Stave	2020-03-01	2021-03-31	VTI, Volvo Group, TØI	RUB
THE ROLE OF ROAD DESIGN	Debora Lombardi	2020-04-15	2020-09-15	GU, VTI	RUB
MULTIMODAL DATA FOR ROAD USER BEHAVIOR ANALYSIS TO SUPPORT SAFE DRIVING PATTERNS	Yacine Atif	2021-01-01	2021-09-30	University of Skövde, Smart Eye	RUB
TASK FORCE – HYGIENE PROCEDURES IN TEST WITH RESEARCH PERSONS	Arne Nåbo	2020-09-01	2020-12-31	VTI, Autoliv, RISE, Scania, Volvo Group	RUB
VIRTUAL REALITY INTERACTIONS WITH AUTONOMOUS VEHICLES	Carmelo D'agostino	2021-02-01	2021-08-31	Lund University, VTI, Volvo Group, Autoliv, Swedish Transport Administration	RUB
CHANGING POINT OF VIEW: EXPLORING THE IMPACT OF EMBODIED COGNITION ON AD DESIGN	Henrik Svensson	2021-04-01	2022-06-10	University of Skövde, Folksam, Autoliv, VCC, Volvo Group	RUB

PROJECT	PROJECT MANAGER	START	END	PARTNERS	RESEARCH AREA
HÖVDING DATA FOR RISK ESTIMATION	Viveca Wallqvist	2021-04-05	2022-12-31	RISE, Hövding	SPE
COOPERATIVE AUTOMATED DRIVING USE CASES FOR V2X COMMUNICATION	Stephanie Milena Alvarez Fernandez	2021-05-01	2021-06-30	Halmstad University, Zenseact, Viscando	SAP
REPORT ON THE SAFETY AND TRAFFIC FLOW IMPACT OF MIXED TRAFFIC CONDITION	Jiali Fu	2021-03-01	2021-12-31	VTI, Chalmers	SPE
EXPERIMENTAL CHARACTERIZATION OF SOFT (ADIPOSE) TISSUE RATE-DEPENDENT RESPONSE	Håkan Johansson	2021-06-01	2021-12-31	Chalmers, Autoliv	HBP
DRONE LIGHTING SYSTEMS: WILL IT TAKE OFF	Henrik Svensson	2021-08-01	2022-08-01	University of Jönköping, University of Skövde, RISE, Municipality of Skara (extern)	RUB
OPENBIKE-CD	Magnus Larsson	2022-01-02	2022-03-31	VTI, Viscando, Folksam, Scania, Vätterrrundan (extern), Trafikia (extern), Statens Vegvesen (extern)	RUB
TRUSTWORTHY AI FROM A TRAFFIC SAFETY PERSPECTIVE	Else-Marie Malmek	2022-01-10	2022-08-31	Zenseact, VCC, Malmeken, REVERE, Blackbird Law (extern)	SAP
HOW WE ROLL	My Weidel	2022-04-10	2022-12-31	VTI, IF, Trivector	RUB
GENERATING SYNTHETIC SCENARIOS TO TEST AN AI-ENABLED TRAFFIC MEASUREMENT SYSTEM	Markus Borg	2022-04-01	2022-08-31	RISE, Lund University, Viscando	SPE
DRIVER INTERACTION WITH AUTOMATED VEHICLES IN REAL MOTORWAY TRAFFIC	Thomas Streubel	2022-03-30	2022-08-30	VCC, Chalmers	SPE
THINK TANK TRAFFIC SAFETY FOOTPRINT	Tania Dukic Willstrand	2022-04-01	2023-03-31	Volvo Group, Autoliv, Folksam, Swedish Transport Administration, VTI	SPE
SYNCOPE	Ke Lu	2022-09-01	2023-02-28	Chalmers, Autoliv, VTI, VCC, Trafikverket, VGR	RUB
DISC – Driver interaction with Safety Scales and Scoring Systems based on different use case scenarios	Paul Hemeren	2022-11-30	2023-09-30	University of Skövde, Autoliv, Smart Eye, Viscando	RUB
SAFE MICROMOBILITY	Marco Dozza	2023-01-01	2023-06-30	Chalmers, Autoliv, Folksam, Swedish Transport Administration, Gothenburg City, NTF Väst	RUB
DARTER: Digital twins for Accessible Real Testing grounds for automotive Engineers and Researchers	Beatriz Cabrero-Daniel	2022-12-01	2023-06-30	University of Gothenburg, AstaZero, Computer Vision Center (extern)	SPE
RURAL CYCLING IN FOCUS	Katja Kircher	2023-04-01	2024-02-29	VTI, IF	RUB
EMERGENCY VEHICLE APPROACHING SYSTEM	Kajsa Emanuelsson	2023-04-01	2023-10-31	VTI, GU	RUB
RISKY SCENARIO IDENTIFICATION	Ruo Jia	2023-05-01	2023-12-31	Chalmers, RISE, Volvo Group, Alkit Communications (extern)	SPE
HUMAN FACTORS, RISKS AND OPTIMAL PERFORMANCE IN CCAM	Elena Haller	2023-09-01	2024-08-01	Halmstad University, VTI, RISE	SAP
VIDCOM – Video-based Driver Condition Monitoring for Safe Driving	Tayssir Bouraffa	2023-09-01	2024-03-31	Chalmers, AstaZero, Smart Eye	SPE
EDR-V FEASIBILITY (EDRVf)	Jonas Bärgman	2024-01-01	2024-09-30	Chalmers, Autoliv	SPE
SAFETY PERFORMANCES OF INSTRUMENTED MICRO-MOBILITY MODES BY LEVERAGING MICROSCOPIC DRIVING BEHAVIOR DATA	Kinjal Bhattacharyya	2024-01-01	2024-06-30	VTI, Halmstad University, VOI	RUB
REMOSAFE: REMOte operator state monitoring for traffic SAFEty	Jonas Andersson	2024-01-15	2024-06-30	RISE, Smart Eye, Einride, AstaZero, CDE (extern)	RUB

APPENDIX 3: SAFER'S PROJECT PORTFOLIO IN STAGE 5

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
Human Body Protection					
COMPCRASH 2 – Reliable crash modeling of fiber composites for lightweight vehicles	Robin Olsson	2016-05-01	2019-08-31	Energi-myndigheten	RISE, VCC, Volvo Group, Chalmers, Gestamp
SURVEY CRASH TEST DUMMIES	Mats Svensson	2019-06-01	2019-11-30	Swedish Transport Agency	Chalmers (CIT)
ADIPOSE TISSUE	Håkan Johansson	2014-01-01	2019-12-31	The Swedish Research Council	Chalmers
Female whiplash injury mechanisms, FusakoSato/JARI	Mats Svensson	2016-01-01	2019-12-31	JARI	JARI, Chalmers
WHIPLASH IN VITRO MODEL – In Vitro Model of Whiplash Trauma in Dorsal Root Ganglia – A Pilot Study	Mats Svensson	2019-01-01	2019-12-31	Chalmers AoA	Chalmers, GU (Sahlgrenska)
ViVA II – Virtual Vehicle Safety Assessment Step 2: Open Source Digital Human Body Models and Crash Testing	Astrid Linder	2017-04-01	2020-03-31	VINNOVA	VTI, Chalmers, Folksam och VCC
DUCTILE COMPOSITE – Fiber composites with ductile properties	Martin Fagerström	2016-12-06	2020-06-30	Energi-myndigheten	Chalmers, KTH, Biteam, VCC
FFI-CRASH 2 – Modelling crash behaviour in future lightweight composite vehicles	Martin Fagerström	2017-01-01	2020-06-30	FFI	Chalmers, RISE, Gestamp, VCC, Volvo Group, ÅF, Escenda, FS Dynamics, NEVS, DynaMore, MSC Software
ASSESSMENT OF PASSENGER SAFETY IN FUTURE CARS	Lotta Jakobsson	2017-06-15	2020-09-30	FFI	VCC, Autoliv, Chalmers
ICONIC – Improving the crashworthiness of composite transportation structures	Robin Olsson	2016-10-01	2020-09-30	EU H2020	RISE, other EU partners
LONG TERM CONSEQUENCES – Identification and Prediction of Injuries with Long Term Consequences	Bengt Pipkorn	2017-10-09	2020-10-02	FFI	Autoliv, VCC, KTH, POC, MIPS
OSCCAR – Future Occupant Safety for Crashes in Cars	Johan Davidsson	2018-06-01	2021-11-30	EU H2020	VCC, Autoliv, Chalmers, other EU/ international partners
A-HBM 4 – Active human body models for virtual occupant response, step 4	Linus Wågström	2018-04-01	2021-12-31	FFI	Autoliv, Chalmers, VCC, DYNAmore Nordic
DUCTILE FIBER REINFORCED COMPOSITES	Martin Fagerström	2016-12-06	2021-12-31	Energi-myndigheten	Chalmers, KTH, VCC, Biteam
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
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	2023-06-30	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
CAR PASSENGER PROTECTION – To the Next Level / Passenger Safety, part 2	Lotta Jakobsson	2020-11-01	2024-06-15	FFI, TSAF	VCC, Autoliv, Chalmers
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
BELT USE BY PREGNANT WOMEN II – Mapping of comfort products and testing how these work in the event of a crash	Anna Carlsson	2021-01-01	2023-12-31	Skyltfonden	CIT, Folksam

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
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
BELT USE BY PREGNANT WOMEN IV – Simulation	Anna Carlsson	2023-07-01	2024-06-30	Skyltfonden	Chalmers Industriteknik, Folksam, Chalmers, Autoliv
BELT USE BY PREGNANT WOMEN III – Who owns the issue?	Anna Carlsson	2022-01-01	2024-12-31	Skyltfonden	CIT, Folksam, BOID
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
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
HBM SHOULDER – Advanced Tool for the Development and Evaluation of Protection Systems for Bicyclists	Bengt Pipkorn	2023-06-01	2026-05-31	Swedish Transport Administration	Autoliv, VCC, Chalmers, Folksam
Road User Behaviour					
Open Research project: TRUBADUR – Truck drivers braking and glance behaviour during interaction with VRUs	Giulio Bianchi Piccinini	2019-01-15	2019-06-30	Open Research at AstaZero Program	Chalmers
SÄMO – Safe mobility on a bicycle for sustainable aging	Helena Selander	2019-03-01	2019-09-30	Skyltfonden	Chalmers, Cycleurope, VTI, TriVector, NTF
HARMONISE – Safe interaction with different levels of automation	Emma Johansson	2017-01-01	2019-12-31	FFI	Volvo Group, VCC, RISE
DRAMA – Driver and passenger activity mapping	Cristofer Englund	2018-03-01	2020-02-29	FFI	Smart Eye, RISE
ADAS&ME – Adaptive ADAS to support incapacitated drivers Mitigate Effectively risks through tailor made HMI under automation	Anna Anund	2016-09-01	2020-03-31	EU H2020	VTI, Autoliv, Smart Eye, other EU partners
MEBESAFE – Measures for Behaving Safely in Traffic	MariAnne Karlsson	2017-05-01	2020-10-31	EU H2020	SAFER JRU (Chalmers, Swedish Transport Administration), VCC, other EU Partner
BRAVE – BRidging gaps for the adoption of Automated Vehicles	Ingrid Skogsmo	2017-06-01	2021-02-28	EU H2020	VTI, other EU/ international partners
QUADRAE – Quantitative Driver Behaviour Modelling	Thomas Broberg	2016-01-01	2021-07-31	FFI	VCC, Volvo Group, Autoliv, VTI, Chalmers
EU-COORDINATION DRIVE SWEDEN	Ingrid Skogsmo	2020-11-01	2021-08-31	VINNOVA, Drive Sweden program	VTI, SAFER/Chalmers, Volvo Group, Autoliv, RISE, Scania
SCALE-UP – Crowdsourcing for scaling up evaluation of external interfaces on automated vehicles	Azra Habibovic	2019-03-01	2021-08-31	FFI	RISE, VCC
CHARACTERIZING AND CLASSIFYING NEW E-VEHICLES FOR PERSONAL MOBILITY	Marco Dozza	2019-08-01	2021-10-01	Skyltfonden (STA)	Chalmers
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
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
GLAD – Goods delivery under the Last-mile with Autonomous Driving vehicles	Mikael Söderman	2020-06-01	2022-09-30	Swedish Transport Administration	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

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
ENHANCED ADAS – Improving drivers' experience, acceptance and trust in assistance systems	Jonas Andersson	2020-10-15	2022-10-15	FFI	RISE, Aptiv, Smart Eye
DRIVE2THEFUTURE	Anna Anund	2019-05-01	2022-11-30	EU H2020	VTI, TØI, other EU/ international partners
FIT2DRIVE	Katja Kircher	2020-04-01	2022-12-31	FFI	VTI, Smart Eye
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
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
RE-ENGAGE – Driver re-engagement in autonomous driving by means of HMI adapted to human activity	Jonas Andersson	2020-10-01	2023-06-30	FFI	RISE, VCC, Smart Eye
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
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	2023-12-31	FFI	RISE, University of Skövde, Jönköping University, Skara Municipality
QUADRIS – Improved quantitative driver behavior models and safety assessment methods for ADAS and AD	Mikael Ljung Aust	2021-04-01	2024-03-31	FFI	VCC, Chalmers, AB Volvo, Autoliv, VTI
SCAV – Safety culture & automated vehicles	Johanna Larsson	2022-04-01	2024-03-31	FFI	VTI, RISE, Toyota, Combitech, Volvo Group, TØI
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
CARDIO – Detection of sudden cardiovascular sickness in drivers, a feasibility study	Anna Sjörs Dahlman	2023-09-01	2024-08-31	Skyltfonden	Chalmers, VTI
MEGABITS – Mobilizing Europe's Green Ambition through Bicycles and Intelligent Transport Systems		2023-05-01	2025-04-30	North Sea Interreg	Chalmers, 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
SCREENS II – Safe chauffeurs in safe and healthy multimodal driver information environments	Kjell Brunnström	2023-09-01	2026-08-31	FFI	Optea, RISE, Scania, Smart Eye, VCC, Volvo Group
Safety Performance Evaluation					
UDRIVE Data User Group	John-Fredrik Grönvall	2017-07-01	2021-02-28	Consortium financed	Chalmers, DLR, IFSTTAR, LAB, SWOV, University of Leeds
AI ROAD SIDE – Recommendation for methodology on AI-based Road-side object identification	John-Fredrik Grönvall	2021-05-10	2021-09-30	Chalmers AOA Transport	Swedish Transport Administration, Chalmers, Asymptotic, VCC
ARCADE – Aligning Research and innovation for Connected and Automated Driving in Europe (CARTRE2)	John-Fredrik Grönvall	2018-10-01	2021-09-30	EU H2020	SAFER, Chalmers, Volvo Group
VRU - E-SCOOTER "TARGET"	Fredrik Åkeson	2020-10-01	2021-09-30	FFI	AstaZero
L3PILOT – Piloting Automated Driving on European Roads	John-Fredrik Grönvall	2017-09-01	2021-10-31	EU H2020	SAFER JRU, VCC, Autoliv, other EU Partner

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
AI AWARE – AI Powered Awareness for Traffic Safety	"Johan Amoruso-Wennerby Martin Ivarson"	2020-11-01	2021-12-31	FFI	VCC, Gothenburg City, Swedish Transport Administration, Zenseact, LSP, Carmenta, Ericsson, HERE Technology
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
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
SAFER DATA PORTFOLIO	John-Fredrik Grönvall	2020-11-01	2022-12-31	SAFER Core	Chalmers, Svanberg&Svanberg
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
FOT-E – Field Operational Test-Feature Extraction from Video	John-Fredrik Grönvall	2019-11-01	2023-03-31	FFI	Chalmers, Autoliv, Smart Eye
MIDAS – anonyMIsing DAta collection for traffic Safety	Cristofer Englund	2020-04-01	2023-03-31	FFI	RISE, Halmstad University, Viscando, Berge Consulting
FOLLOW-UP OF ROAD SAFETY REQUIREMENTS WHEN PROCURING FREIGHT TRANSPORT	Tania Dukic Willstrand	2022-01-20	2023-05-31	Skyltfonden	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	2023-12-31	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)
TRAFFIC SAFETY FOOTPRINT II – Development of the Traffic Safety Footprint concept to enable a broad application in the private and public sector	Carlos Viktorsson	2023-08-15	2024-05-31	Skyltfonden	Lund University, Chalmers/SAFER, Sweco
SUPPORT COGNITIVE ABILITIES FOR PREDICTIVE PROCESSING THROUGH DRIVER MONITORING	Paul Hemeren	2023-11-01	2024-10-31	VINNOVA	University of Skövde, Smart Eye
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
VIASAFETY – Road Traffic Safety for Electric Micro Vehicles	John-Fredrik Grönvall	2023-07-01	2025-06-30	VINNOVA, Drive Sweden program	SAFER (Chalmers), CLOSER, Ciklio, Vialumina, Vianova
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
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
V4SAFETY – Vehicles and VRU Virtual eValuation of Road Safety	Jonas Bärgman	2022-10-01	2025-09-30	EU Horizon Europe	Chalmers, VCC, other European partners
I2CONNECT – Intelligent, interactive and connected next generation real time driver assistance system	Paul Hemeren	2023-12-01	2026-05-31	FFI	Skövde University, Scania, Smart Eye, Viscando
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					
COPPLAR – Campusshuttle Cooperative Perception And Planning Platform	Lars Hammar-strand	2016-01-01	2019-06-30	FFI	Chalmers, GU, VCC, Autoliv, AstaZero
Open Research project: ACTIVE SAFETY FOR BICYCLES USING RADAR TO PREVENT AND REDUCE THE IMPACT IN CAR-AND-BICYCLE COLLISIONS	Jonas Andersson	2019-02-01	2019-06-30	Open Research at AstaZero Program	RISE, Aptiv
C2VC – Complete Combination Vehicle Control with automated reconfiguration	Leo Laine	2017-03-01	2019-07-31	VINNOVA	Volvo Group, Chalmers
Open Research project: VALIDATION OF OPTIMAL MOTION PLANNING FOR AUTOMATED URBAN DRIVING	Matthijs Klomp	2019-02-01	2019-08-20	Open Research at AstaZero Program	VCC, Virtual Vehicle Research Center (Graz)
SEBRA – SEnsor for Bicycle's impRoved Awareness	Jonas Andersson	2018-06-01	2019-12-31	VINNOVA	RISE, Aptiv, LIRI AB
ESPLANADE	Fredrik Warg	2017-01-01	2020-03-31	FFI	Aptiv, Comentor, KTH, Qamcom, RISE, Semcon, Systemite, Veoneer, VCC, Volvo Group, Zenseact
IDOLLY – Use of i-dolly for local distribution of container trailers to logistics terminals from a dry port	Fredrik von Corswant	2017-10-26	2020-08-31	FFI	Volvo Group, Chalmers, VBG, Ellos, Kerry Logistics, Speed Group, Borås Stad
REALSIM – Realistic simulation of vehicles for safer, more robust and less expensive development of automated vehicles.	Monica Ringvik	2017-11-01	2020-10-31	VINNOVA	AstaZero, Chalmers, Data Intelligence, Wiretronic, Volvo Group
Sweden4Platooning	Stefan Bergquist	2017-01-01	2020-12-31	FFI	Scania, Volvo Group, KTH, RISE, Schenker AB, and Swedish Transport Administration
Open Research project: TRACTION ADAPTIVE MOTION PLANNING FOR CRITICAL SITUATIONS	Lars Svensson	2020-01-20	2021-02-20	Open Research at AstaZero Program	KTH, Revere
Open Research project: VALIDATION OF AUTONOMOUS HIGHWAY DRIVING ALGORITHM AT ASTA ZERO	Johan Karlsson	2020-08-01	2021-03-31	Open Research at AstaZero Program	Chalmers, Revere
HEADSTART – Harmonised European Solutions for Testing Automated Road Transport	Jonas Sjöberg	2019-01-01	2021-12-31	EU H2020	SAFER JRU, RISE, Chalmers, Volvo Group, Veoneer, other EU/ international partners
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
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
SAFETYNET FOR TRUCKS	Stefan Koychev	2018-10-01	2022-03-31	FFI	Volvo Group, Chalmers
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
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	2023-12-31	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

PROJECT	PROJECT LEADER	START	END	FUNDER	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	2024-04-30	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	2024-06-30	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 Projects					
Pre-study for a SWEDEN/INDIA Multi-stakeholder Innovation and Safety Program	Peter Kronberg	2019-03-06	2020-03-31	VINNOVA	Chalmers, RISE, VTI
TSIH – Trafc safety in Horizon 2020	Magnus Granström	2019-04-01	2020-12-31	"VINNOVA, Drive Sweden program"	Chalmers, Autoliv, VCC, Volvo Group, VTI
KNOWLEDGE DISSEMINATION AND IMPLEMENTATION OF THE STOCKHOLM DECLARATION'S 9 RECOMMENDATIONS	Malin Levin	2021-01-01	2021-06-30	Skyltfonden (STA)	SAFER
TSIH Continuation EU-coordination Drive Sweden	Ingrid Skogsmo	2020-11-01	2021-08-31	VINNOVA, Drive Sweden program	VTI, SAFER/Chalmers, Volvo Group, Autoliv, RISE, Scania
YOUNG MOBILITY	Malin Levin	2021-01-01	2021-11-30	NTF	NTF, SAFER, Halmstad municipality
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
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
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

PROJECT	PROJECT LEADER	START	END	FUNDER	PARTNERS
GOTHENBURG GREEN CITY ZONE – Traffic safety research needs, utilizing the Gothenburg Green City Zone Initiative	Malin Levin	2022-08-23	2023-03-31	Swedish Transport Administration	Autoliv, Business Region Göteborg, Chalmers, City of Gothenburg, Cycleurope, DHL, GU, 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, VCC, Volvo Group, VTI, Zenseact
INTENTION RECOGNITION OF VULNERABLE ROAD USERS	Sepideh Pashami	2022-12-15	2023-04-30	VINNOVA, Drive Sweden program	RISE, Volvo Group, Viscando, Univrses and Electricity
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, CIT, Swedish Transport Administration, Tyréns Sverige, VGR,
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
HEUDRIS – Horizon, EUrope och DrIve Sweden	Ingrid Skogsmo	2022-05-01	2023-12-31	VINNOVA	VTI, Autoliv, Chalmers, RISE, Volvo Group
SINTIA – Safe inclusive traffic infrastructure: data and AI for decision making	Yury Tarakanov	2023-04-01	2023-12-31	VINNOVA, Drive Sweden program	Jönköping municipality, Jönköping University and Viscando
LARA – Predictive Capabilities in the Mobility Environment	Gunnar Mathiasson	2023-10-15	2023-12-31	VINNOVA, Drive Sweden program	University of Skövde, Smart Eye, VCC
SHAPE-IT – Supporting the interaction of Humans and Automated vehicles: Preparing for the Environment of Tomorrow	Jonas Bärgman	2019-10-01	2024-03-31	EU H2020	Chalmers, GU, TU Delft, TU Munich, University of Leeds, and University of Ulm, other associated partners
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
IGLAD Phase 5 – Initiative for the global harmonisation of accident data	Ines Heinig	2014-01-01	2025-12-31	Consortium financed	SAFER/Chalmers, Autoliv, VCC, Volvo Group, Asymptotic, other EU/ international 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), CIT, 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
SUPERSAFE – SUrrogate measures for SAFE autonomous and connected mobility	Carmelo D'Agostino	2023-01-01	31-12-2020	EU Horizon Europe	Lund University

APPENDIX 4: COLLABORATIVE KNOWLEDGE SHARING AND PROJECT CREATION ACTIVITIES

Concluded SAFER seminars, conferences, workshops and other events during year 18 include (for a complete list, please turn to the annual reports for 2019, 2020, 2021 and 2022):

- SAFER lunch webinar: Improving safety for bus passengers using wheelchairs and mobility scooters: Effectiveness of restraint and containment systems, January 12, 2023
- Workshop: How can AI be used as a tool to improve traffic safety – 11 ideas were pitched within the AI Enhanced Mobility program, January 13, 2023
- Workshop: How will a safe transport system look like in the future according to the Safe System Principle?, January 26, 2023
- SAFER Thursday lunch seminar: Presentation of the Swedish Electromobility Centre and collaboration opportunities, January 26, 2023
- SAFER Thursday lunch seminar: EuroNCAP's roadmap, February 2, 2023
- SAFER Update webinar about ongoing activities within the partnership, February 7, 2023
- SAFER Research area day, February 7, 2023
- SAFER Partner TØI - collaboration interests and available competences, February 7, 2023
- SAFER Thursday lunch seminar: Project HEAT (Heat stress in outdoor Environments - Planning the city of the older Adults Today and in a future warmer climate), February 9, 2023
- REDO - final event, February 10, 2023
- E-scooter rider safety: Lessons and cautionary tales from North America, February 23, 2023
- SAFER lunch seminar: How we roll – main results from the SAFER Pre-study, February 23, 2023
- Alexander Rasch doctorial defence: "Drivers overtaking cyclists and pedestrians: Modeling road-user behavior for traffic safety", Feb 24, 2023
- Fredrick Ekman doctoral defense: "User trust here and now but not necessarily there and then - A Design Perspective on Appropriate Trust in Automated Vehicles", February 28, 2023
- SAFER lunch seminar: Emergency services – A report from the recently opened national development centre, Christian Carlsson, The Swedish rescue service, March 2, 2023
- SAFER lunch seminar: Mode Confusion in automated driving, March 9, 2023
- Xiaomi Yang's licentiate seminar "The use of computational driver behavior models in crash avoidance systems and virtual simulations with optimal subsampling", March 9, 2023
- SAFER Shareholders meeting - annual partner event, March 10, 2023
- SAFER Research & Project Day, March 10, 2023
- SAFER seminar: The effects and outcome of the SAFER partnership in 2022, March 10, 2023
- SAFER lunch seminar: Einride, our new SAFER Partner, March 16, 2023
- SAFER lunch seminar: Suicide in the transport system, March 30, 2023
- Mica II final event, April 2, 2023
- SAFER seminar with NTF Väst: Trafiksäkerhet i den hållbara staden – möjligheter, och utmaningar, April 4, 2023
- SAFER lunch seminar: Shape-IT project, April 20, 2023
- SAFER Research area day #2 2023, April 26, 2023
- SAFER Update webinar about ongoing activities within the partnership, April 26, 2023
- SAFER lunch seminar: ISO TS 5083 - Safety for automated driving systems, April 27, 2023
- SAFER lunch seminar: Results from the SAFER Pre-study SYNCOPE, May 4, 2023
- SuperSAFE workshop, May 10, 2023
- SAFER lunch seminar with our new partner Arriver/Qualcomm, May 11, 2022
- SAFER competence network for vehicle dynamics annual conference: Testing, development and verification for vehicle dynamics 2023, May 24, 2023
- Victor Fabricius Licentiate seminar "Exploring road traffic interactions between highly automated vehicles and vulnerable road users", May 24, 2023
- SAFER lunch seminar: Main results from the traffic safety indicators in Sweden 2022 and summary of the Result Conference 2023, May 25, 2023
- External HMIs – in depth discussions on communications and interaction with future vehicles, May 29, 2023
- Karl-Johan Larsson doctoral defence: "Human body model morphing for assessment of crash rub fracture risk for the population of car occupants", June 1, 2023
- Workshop: Surrogate Measures of Safety - when can we start trusting them?, June 1, 2023
- The 8th International Advanced Course on Injury Biomechanics, June 12 - 16, 2023
- SAFER Update webinar about ongoing activities within the partnership, June 13, 2023
- SAFER Research area day #3 2023, June 13, 2023
- SAFER seminar: Upphandling av godstransporter – en möjlighet till ökad säkerhet på vägarna, June 14, 2023
- SHAPE-IT project Final Stakeholder days, June 20 – 21, 2023
- Traffic safety footprint – a new tool for corporate responsibility driving radical change in traffic safety towards 2030 (side event to the Vision Zero event in Stockholm), June 27, 2023
- Side event to the Vision Zero event in Stockholm "Road safety technology exhibition" – co-hosted with Business Sweden, June 27, 2023
- SAFER seminar with Associate professor Ashley Weaver: Redicting risk of Automotive, Spaceflight, and fall Injuries with Human Body Models, August 28, 2023
- SAFER Thursday lunch seminar – Volvo Group Safety Report, Anna Theander, Volvo Group, August 31, 2023
- Workshop about using AI as a tool in traffic safety, September 4, 2023
- SAFER Thursday lunch seminar - Safe Micromobility, paving the way for the MicroSAFETY project, Marco Dozza, Chalmers University, September 7, 2023
- SAFER Thursday lunch seminar – Pre-study DARTER, Beatrize Cabrero-Daniel, Gothenburg University, September 14, 2023
- Research area day #4, September 19, 2023
- SAFER Update with information about upcoming collaboration opportunities within the partnership, September 19, 2023
- SAFER Thursday lunch seminar – Afrosafe, Will Safe System approach be the game changer for Africa?, Aliaksei Laureshyn, Lund University, September 28, 2023
- SAFER Thursday lunch seminar – Enhanced Adas I & II, Daban Rizgary and Niklas Strand, RISE, October 5, 2023
- SAFER Thursday lunch seminar – Re-engage, October 19, 2023
- Jens Henriksson's doctoral defence – "Outlier Detection as a Safety Measure for Safety-Critical Deep Learning", October, 2023
- SAFER Thursday lunch seminar – Outlook Finland, Mia Nyholm, Trafikskyddet Finland, October 26, 2023
- Deep Dive Dialogue: Enhancing road safety in winter conditions, October 30, 2023
- SAFER Thursday lunch seminar – Pre-study DISC, Paul Hemeren, University of Skövde, November 9, 2023
- SAFER Update Networking lunch – Stephane Buffat – LAB France, November 15, 2023
- SAFER Thursday lunch seminar – SITIS Project, John-Fredrik Grönvall, SAFER, Nov 16, 2023
- SAFER Update with information about upcoming collaboration opportunities within the partnership, November 15, 2023
- SAFER Research area day #5, Nov 15, 2023
- The Scandinavian Conference on Systems and Software Safety, November 21-22, 2023
- SAFER Thursday lunch seminar – Cykelcentrum, Jones Karlström, Cykelcentrum, November 23, 2023
- AI AWARE Scale Up - Final Conference arranged by Drive Sweden November 23, 2023
- Community meeting: Insight into SAFER Stage 6, November 24, 2023
- Dialog om relevanta trafiksäkerhetsindikatorer för att mäta organisationers Trafiksäkerhetsavtryck (TSA) – Vilka indikatorer behövs och finns det tillräckligt med data?, November 29, 2023
- SAFER Thursday lunch seminar with Lars Lindblom, Linköping University: Etics and selfdriving vehicles, November 30, 2023
- Melina Makris Licentiate seminar How Does it Feel and How is it measured? Assessing Sitting Comfort and Postures of Rear-Seated Car Passengers in Stationary and Driven Scenarios Over Time!, December 1, 2023
- Final event AI Enhanced Mobility, December 7, 2023
- SAFER Christmas breakfast, December 20, 2023
- SAFER Thursday lunch seminar with Trent Victor, Waymo: Safety Impact of the Waymo Driver on Fatalities and Seriously Injured, December 21, 2023

APPENDIX 5: CONFERENCES

Conferences during year 18 include (for a complete list, please turn to the annual reports for 2019, 2020, 2021 and 2022):

- AAAI 2023 – Spring Symposium, Palo Alto, US, March 2023
- REFSQ 2023 – 29th International Working Conference on Requirement Engineering: Foundation for Software Quality, Barcelona, Spain, April 2023
- ESV 2023 – 27th International Technical Conference on the Enhanced Safety of Vehicles, Yokohama, Japan, April 2023
- DISPLAY WEEK 2023 – International Symposium, Los Angeles, US, May 2023
- EUCAD 2023 – 4th European Conference on Connected and Automated Driving, Brussels, Belgium, May 2023
- ITS Congress 2023 – 15th ITS European Congress, Lisbon, Portugal, May 2023
- KES STS 2023 – 6th KES International Symposium on Smart Transportation Systems, Rome, Italy, June 2023
- IEEE IV 2023 – 35th Intelligent Vehicles Symposium, Anchorage, US, June 2023
- SSIV 2023 – 9th International Workshop on Safety and Security of Intelligent Vehicles, Porto, Portugal, June 2023
- AITest 2023 – 5th IEEE International Conference on Artificial Intelligence Testing, Kallithea, Greece, July 2023
- AHFE 2023 – 4th International Conference on Applied Human Factors and Ergonomics, San Francisco, USA, July 2023
- HCI International 2023 – 25th International conference on human-computer interaction, Copenhagen, Denmark, July 2023
- IAVSD 2023 – 28th International Symposium on Dynamics of Vehicles on Roads and Tracks, Ottawa, Canada, August 2023
- RO-MAN 2023 – 32nd IEEE International Conference on Robot and Human Interactive Communication, Busan, South Korea, August 2023
- AutoSens Brussels, September 2023
- IRCOBI 2023 – International Research Council on the Biomechanics of Injury Europe Conference, Cambridge, United Kingdom, September 2023
- SEAA 2023 – 49th Euromicro Conference on Software Engineering and Advanced Applications, Durres, Albania, September 2023
- ITSC 2023 – 26th IEEE International Conference on Intelligent Transportation Systems, Bilbao, Spain, September 2023
- 6GNet 2023 – 2nd edition of the International Conference on 6G Networking, Paris, France, October 2023
- VTC2023-Fall – IEEE 98th Vehicular Technology Conference, Hong Kong, October 2023
- ITS World Congress 2023 – 29th Congress, Driving Towards Intelligent Society, Suzhou, China, October 2023
- POLIS 2023 – Annual Conference, Leuven, Belgium, November 2023
- CAR 2 CAR Forum 2023 – 17th International conference, Gothenburg, Sweden, November 2023
- ICSC 2023 – 11th International Cycling Safety Conference, The Hague, Netherlands, November 2023
- IBRC 2023 –18th Symposiumof Injury Biomechanics, Ohio, US, 2023
- 3rd International Conference on Digital Data Processing, University of Bedfordshire, Luton, UK, December 2023

APPENDIX 6: THESES

Doctoral Theses

- Physically based constitutive models for crash of composites: Sérgio Costa, RISE Research institutes of Sweden and Chalmers University of Technology, September 6, 2019.
- Simulation of Occupant Kinematics using Active Human Body Models: Christian Kleinbach, University of Stuttgart, Institute of Engineering and Computational Mechanics, October 23, 2019.
- Driver interaction with vulnerable road users: Modelling driver behaviour in crossing scenarios: Christian-Nils Åkerberg Boda, Crash Analysis and Prevention, Vehicle Safety, Mechanics and Maritime Sciences, Chalmers University, December 18, 2019.
- Methods for efficient modelling of progressive failure in laminated fibre-reinforced composites: Johannes Främby, Chalmers University of technology, January 17, 2020.
- Material modeling of adipose tissue for traffic injury prevention: A finite element study of parameters influencing lap belt to pelvis interaction: Hosein Naseri, Chalmers University of technology, April 7, 2020.
- Traffic Safety potential and effectiveness of lane keeping support: Simon Sternlund, Swedish Transport Administration and Chalmers University of Technology, June 15, 2020.
- Postural and Muscular Responses of Car Occupants under Pre-Crash Conditions, Ghazaleh Ghaffari, Injury Prevention, division of Vehicle Safety/Mechanics and Maritime Sciences, Chalmers University of Technology, August 27, 2021.
- 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.
- Drivers overtaking cyclists and pedestrians: Modeling road-user behavior for traffic safety On Statistical Methods for Safety Validation of Automated Vehicles: Alexander Rasch, Chalmers University, February 24, 2023.
- User trust here and now but not necessarily there and then – A Design Perspective on Appropriate Trust in Automated Vehicles: Fredrick Ekman, Chalmers University, February 28, 2023.
- Human Body Model Morphing for Assessment of Crash Rib Fracture Risk for the Population of Car Occupants: Karl-Johan Larsson, Autoliv & Chalmers University, June 1, 2023.
- Computational driver behavior models for vehicle safety applications: Malin Svärd, Volvo Cars & Chalmers University, June 8, 2023.
- Passenger kinematics in evasive maneuvers – advancing active human body modeling and understanding variability in passenger kinematics during evasive maneuvers: Emma Larsson, Chalmers University, August 29, 2023.
- Outlier Detection as a Safety Measure for Safety-Critical Deep Learning: Jens Henriksson, Semcon & Chalmers University, October 20, 2023.

Licentiate Theses

- Benefit estimation of active safety for cyclist-crash avoidance: Jordanka Kovaceva, Crash Analysis and Prevention, Vehicle Safety, Mechanics and Maritime Sciences, Chalmers University, December 13, 2019.
- Towards an Improved Safety Benefit Assessment for Heavy Trucks – Introduction of a framework for the combination of different data sources: Ron Schindler, Chalmers University of Technology, March 6, 2020.
- An Average Female Head-Neck Finite Element Model with Reflexive Neck Muscles: I Putu Alit Putra, Chalmers University of Technology, April 28, 2020.
- Modelling 3D-woven composites on the macroscale: predicting damage initiation and inelastic phenomena: Carolyn Oddy, Chalmers University of Technology, April 29, 2020.
- The automation effect: Investigating factors that influence the driver response process to a safety-relevant event during assisted driving and after unsupervised automation: Linda Pipkorn, Chalmers University of Technology, June 2, 2020.
- Evaluation of Morphed Human Body Models for Diverse Occupant Safety Analysis: Karl-Johan Larsson, Chalmers University of Technology, June 10, 2020.
- Car crashes with two-wheelers in China: Proposal and assessment of C-NCAP automated emergency braking test scenarios: Bo Sui, Chalmers University of Technology, Dec 15, 2020.
- Strain rate dependent material model for polymer composites. Vivekendra Singh, Industrial and Materials Science, Material and Computational Mechanics, Chalmers University of Technology, January 20, 2021.
- Towards a human body model for

prediction of vehicle occupant kinematics in omni-directional pre-crash events. Emma Larsson, Division of Vehicle Safety at the Department of Mechanics and Maritime Sciences at Chalmers University, March 31, 2021.

- Pre-Crash and In-Crash Car Occupant Safety Assessment. Alexandros Leledakis, Division of Vehicle Safety at the Department of Mechanics and Maritime Sciences, Chalmers University and Volvo Cars, April 15, 2021.
- Making overtaking cyclists safer: Driver intention models in threat assessment and decision-making of advanced driver assistance system. Prateek Thalya, Vehicle Safety/Mechanics and Maritime Sciences, Chalmers University, April 23, 2021.
- 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.
- The use of computational driver behavior models in crash avoidance systems and virtual simulations with optimal subsampling. Xiaomi Yang, Vehicle Safety/Mechanics and Maritime Sciences, Chalmers University, March 9, 2023.
- Exploring road traffic interactions between highly automated vehicles and vulnerable road users. Victor Fabricius, Halmstad University & RISE, May 24, 2023.
- Human Motion Predictions for Automotive Ergonomics Design. Estela Pérez Luque, School of Engineering Science at Skövde University, June 20, 2023.
- Computational interaction models for automated vehicles and cyclists. Ali Mohammadi, Vehicle Safety/Mechanics and Maritime Sciences, Chalmers University, October 13, 2023.
- How Does it Feel and How is it measured? Assessing Sitting Comfort and Postures of Rear-Seated Car Passengers in Stationary and Driven Scenarios Over Time!: Melina Makris, Department of Industrial and Materials Science Division of Design and Human Factors at Chalmers University, Dec 1, 2023.

SAFER is a 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.

SAFER

Lindholmspiren 3A
SE-417 56 Gothenburg
Sweden
+46 31-772 21 06
safer@chalmers.se

SOCIAL MEDIA AND WEB

LinkedIn: linkedin.com/company/safer-vehicle-and-traffic-safety-centre

Web: www.saferresearch.com

SAFER
VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS