ANNUAL REPORT

OPERATIVE YEAR # 11
APRIL 1ST, 2016 – MARCH 31ST, 2017

SAFER
VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

SAFER Vehicle and Traffic Safety Centre at Chalmers is a competence centre where 25 partners from the Swedish automotive industry, academia and authorities cooperate to make a centre of excellence within the field of vehicle and traffic safety.

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

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

SAFER conducts borderless research to save lives!

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1. DIRECTOR'S PAGE

This year #11 started with a birthday party – SAFER celebrated 10 years with balloons, cake and the presentation of achievements expressed through 17 success stories. The partners had decided to sign up for a stage four, but what would the prerequisites look like? Would SAFER be granted another five years of Vinnova funding? And if not – how would the new SAFER function? Now we know – after a year of transition SAFER is full of energy and drive towards the vision. The partners show a strong commitment and the region of Västra Götaland has decided to support with co-funding of the core operations. SAFER board and management have carefully assessed what creates value with SAFER and set up a corresponding strategy and an organization to carry it out.

In spite of management attention to SAFER existential questions the life at SAFER has carried on unabated with interesting seminars, project results, project applications, new grants, several important conferences and dissertations. It is impressive and gratifying with all the research and innovation that is taking place within the broad community of SAFER. I hope you will read this report and get the same joyful feeling.

Traffic safety is more important than ever – the liveable, attractive cities and the connected, automated, sustainable transport systems need to integrate the aspects of traffic safety in their design and implementation. This goes for all system levels and system components as well. It will require more deep knowledge and excellent research **and** more collaboration with new stakeholders and new disciplines. SAFER is well prepared for this, having practiced collaborative research and innovation with a large group of diverse partners for more than ten years. There has been a lot of learning of what actually works. Valuable infrastructures are in place - such as Revere and tools and data for large databases. Links are established with international research environments.

I am confident that SAFER - with the people and partners involved - is well positioned to make a crucial and strong contribution to the future challenges, continuing to build a world-class vehicle and traffic safety research hub and support the partners' successful growth and reputation!

April 2017,
Anna Nilsson-Ehle, Director

2. CHAIR'S PAGE

Sustainable transport and traffic safety are now developing at an unprecedentedly rapid rate. Technology has developed in leaps and bounds, and there is no doubt that automation and digitalization will play a key part in efforts to continue reducing the number of injuries and fatalities in traffic accidents. Being part of this development and being the chair of the SAFER Vehicle and Traffic Safety Centre – Sweden's hub of traffic safety research – is incredibly inspiring.

SAFER's 11th year of operations has been both exciting and challenging. During the year we have focused strongly on developing and launching SAFER's new strategy, which I think we have done very successfully; you can read more about it on page 6. On the board of directors we have also had to be creative and find new solutions to enable us to continue delivering top-class traffic safety research despite reduced funding. We welcome Region Västra Götaland as a new financier and look forward to continuing to conduct high quality multidisciplinary research projects. Our new financier also gives us the opportunity to run pre/pilot studies to ensure that the research is going in the right direction. We have also during the year developed more efficient working methods and simplified our organisation, and our infrastructure has grown strong. The fact that our researchers can now be given access to Revere, our research lab in the field of automation and autonomous vehicles, and AstaZero, the world's only test track of its kind for active safety systems, will make our platform even more attractive and enable additional projects to be realised. I am also pleased that the Swedish Government has relaunched Vision Zero, an intensified initiative for increased transport safety in all modes of transport. Just like at our SAFER centre, vulnerable road users constitute a priority area for Vision Zero. It is also positive that traffic safety finally became integrated in the sustainable development goal.

I am convinced that SAFER's role as a hub for world-leading traffic safety research is more important than ever. Working with several areas in parallel using an interdisciplinary approach is a successful way of achieving sustainable solutions. The network and competence under the umbrella of SAFER form a unique combination in this field. Together we will be able to continue to deliver knowledge, competence and research findings that will enable people and goods to be transported safely and sustainably. I am proud to have been entrusted with the task of continuing to lead the board of SAFER into the future.

I would like to conclude by also warmly thanking our director, Anna Nilsson-Ehle, for her fantastic work in building up and running SAFER since its launch in 2006. Anna is now retiring, and we are aiming for a new director to take up the position in the autumn.

Kind regards,
Karin Svensson, Board Chair

3. VISION, MISSION, WANTED POSITIONS AND STRATEGY

Vision

Excellent inter-disciplinary research, innovation and collaboration to secure close to zero accidents and injuries in traffic and enable Sweden to hold global leadership in traffic safety.

Traffic safety will be a key factor for implementing a sustainable, connected automated traffic system.

Mission – Enhance traffic safety

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

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

Be a base for international collaborations
- Be a well renowned and attractive international centre of excellence.

Figure 1: SAFER's misson.

Wanted Positions

Since 2012 SAFER has aimed at a wanted position 2016 consisting of five statements:

1. Visible and measurable results in practice.
2. Hub for Swedish traffic safety research.
3. Acknowledged as a world leader in traffic safety.
4. A broad set of partners and collaborations in order to ensure the strategy and explore new needs and countermeasures.
5. A balanced project portfolio and a long term financing of the core operations.

The assessment of results is sorted under the chapter 9. Contribution to targets year 11, page 21.

Strategy

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

SAFER consists of three different conceptual parts – *SAFER Core*, the *SAFER Research* and project portfolio *and SAFER Assignments and investigations.* SAFER Core is the name for the driving function of SAFER with its secretariat including communication and support systems, research areas and their reference groups, the infrastructures, networks and the physical working environment.

The strategy, decided by the board in late 2016, is based on four corner stones that give the direction and focus to SAFER: *Create identity and influence, Act as a thought leader, Create and share knowledge for innovation and Shared infrastructures.*
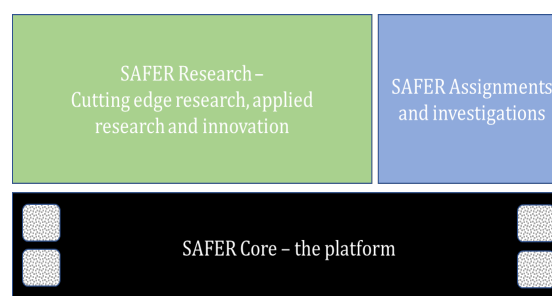

Figure 2: SAFER's three conceptual parts and four corner stones.

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

1. Create identity and influence

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

WANTED POSITION

Visible and measurable results in practice

2. Act as a thought leader

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

WANTED POSITION

Hub for Swedish traffic safety research

3. Create and share knowledge for innovation

The basic task for the research areas and the reference groups is to transform and share knowledge and to create a strong academic base. New knowledge and relevant facts should be made available and visualized. Furthermore, networks should be created and maintained to the benefit of all partners. SAFER should be promoting project generation and coordination and act as a catalyst for joint projects.

By creating strong connections to world class research environments, and nurturing an international reputation for outstanding collaboration between industry, society and academy, it is possible to influence the international research agenda.

4. Shared infrastructures

Shared infrastructure is a hallmark for SAFER. Databases of real world data including their collection, storage and analysis tools are strong assets and SAFER will further develop business models to maintain them.

Revere – Resource for Vehicle Research – the full scale laboratory is increasingly important for the safety research in the domain of automated driving and a connected transport system. The collaboration and support to AstaZero gives high value. The physical environment, SAFER's office environment, with working desks, meeting and analysis rooms, creative work spaces, instruments and bikes are another asset.

WANTED POSITION

A broad set of partners and collaborations in order to ensure the strategy and explore new needs and countermeasures.

WANTED POSITION

Acknowledged as a world leader in traffic safety

4. VALUES AND IDENTITY

SAFER is guided by its vision, strategy and values. The essence and ultimate purpose of SAFER is to create a setting where "World class expertise in traffic safety collaborates to save lives". SAFER values shall be reflected in the work environment and express open minds, respect for each other, cooperative spirit, high aspirations, curiosity and joy. Creativity is a hallmark and thrives on diversity in all aspects and borderless networks seeking and attracting expertise where it is to be found. SAFER, in collaboration with researchers on management of open innovation, has identified five guiding principles for success of a multidisciplinary research platform:

1. **Presence of participants equals influence**
   SAFER has physical space (1200 sqm, work places and meeting rooms), individuals have a high degree of presence, and SAFER arranges several activities additional to the project work.

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

3. **Multiple identities create an extended action net**

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

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

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

5. ORGANISATION AND MANAGEMENT OF THE CENTRE

Partners
There have been 19 partners and 6 members (associated partners) during year 11.

Board
The executive board of SAFER consists of representatives from the large partners. Year 11 the board has consisted of ten members. There have been eight board meetings during year 11, including one meeting dedicated to strategy in August 2016.

Members of the Board year 11:
- **Autoliv**: Ola Boström (2016) / Cecilia Sunnevång
- **Chalmers**: Per Lövsund, Sinisa Krajnovic (2 members)
- **RISE**: Jan Jacobson
- **Swedish Transport Administration**: Maria Krafft
- **University of Gothenburg**: Jan Smith
- **Volvo Car Corporation**: Malin Ekholm
- **Volvo Group**: Magnus Rilbe
- **VTI**: Jan Andersson (2016) / Jonas Jansson
- **Independent chairperson**: Karin Svensson

Vinnova has had the possibility to send an observer, Eric Wallgren.

Management
SAFER's daily operation and strategic development is led by a Management group. The Management group meets on a bi-weekly basis. During year 11 the old structure with two management teams has been simplified. The extended management team, consisting of the small management team, the competence area leaders and key functions, is partly integrated in the new management team and partly replaced by a dedicated meeting/workshop twice a year with the competence area leaders.

SAFER PARTNERS

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

Members (associated partners)
Malmeken AB
Mälardalen University
Trivector
University of Borås
University of Skövde
ÅF

Two additional bridging functions have been added to the management; a *Chalmers profile director traffic safety* and The Swedish transport administration's *Vision Zero Academy* (VZA). The Profile director is the profile leader at Chalmers Transport Area of Advance (Styrkeområde Transport) and is responsible for the link to the Area of Advance, where SAFER is the core of the traffic safety profile. The profile leader has a role to develop SAFERs approach to scientific excellence. VZA@SAFER is a platform in Vision Zero Academy securing and further developing the Swedish Transport Administration research skills linked to Vision Zero and evaluation of road safety solutions in relation to other sustainability objectives.

The infrastructure leaders for Revere and for Naturalistic driving data are also in the new management group. The new management group structure was implemented from January 1st 2017.
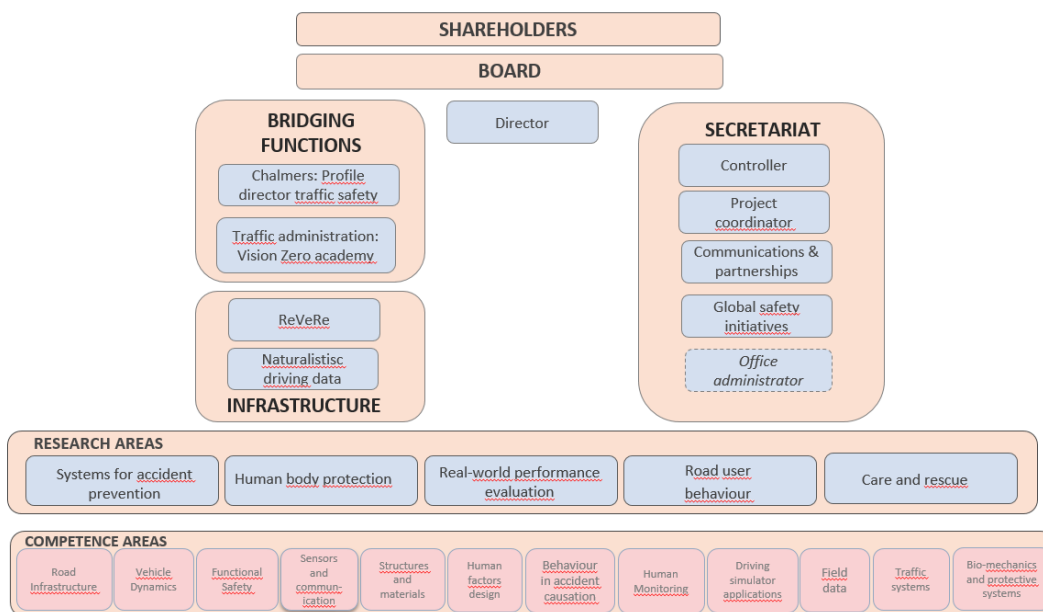

Figure 3: The organisation of SAFER from January 1st, 2017.

> ***Management group year 11, from Jan 1st, 2017:***
>
> - *Anna Nilsson-Ehle, Director*
> - *Lotta Jakobsson, Research area director*
> - *Christian Grante, Research area director*
> - *Torbjörn Andersson, Research area director*
> - *Tania Dukic Willstrand, Research area director*
> - *Bengt Arne Sjöqvist, Research area director*
> - *Fredrik Von Corswant, Infrastructure leader Revere*
> - *Helena Gellerman, Infrastructure leader Naturalistic driving data*
> - *Johan Strandroth, Vision Zero Academy*
> - *Mats Svensson, Chalmers profile director traffic safety*
> - *Kristina Lindblom, Controller*
> - *Ines Heinig, Project coordinator*
> - *Malin Persson, Communications and partnerships*

Research areas

The research at SAFER is conducted in research areas, each with a governing reference group, led by a Research Area Director, which is supervising the project portfolio. The research areas are the formal arena for partners to meet and identify key issues and initiate needs-driven research. The reference groups include one representative from each SAFER partner and representatives from the competence areas. The group is the base for establishing world-class competitive project portfolios. The reference groups are responsible for development of the road maps, which is considered to be the vision for SAFER's research agenda. Projects are initiated, discussed in the respective reference groups and recommended to the Management group and the Board. The groups meet four to six times per year to discuss projects. Each programme hosts a mix of projects: pre-studies for future projects, small and large national and international projects.

The five research areas are described in chapter 7, Research areas – scope and objectives and the results is presented in chapter 9, Contributions to targets year 11.

Systems for accident prevention

Christian Grante

Road user behavior

Tania Dukic Willstand

Human body protection

Lotta Jakobsson

Care and rescue

Bengt Arne Sjöqvist

Real-world performance evaluation

Torbjörn Andersson

Figure 4: SAFER's Research area directors.

Competence areas

Essential competences for SAFER have been divided into twelve competence areas. The core of a competence area is the academy, but all SAFER partner researchers are equally important. The competence supply at SAFER is based on the notion that the partners (institutes, industry, institutions) make resources available, recruit personnel when needed and develop the competences identified as crucial.

Each area is led by a Competence area leader who gathers SAFER partners' key persons with their main research interest in the respective field. The competence areas are: Field Data, Human Monitoring, Behaviour in Accident Causation, Human Factors Design, Driving Simulator Applications, Sensors & Communication, Functional Safety, Vehicle Dynamics, Infrastructure, Structures & Materials, Biomechanics & Protective Systems, and Traffic Systems.

The competence areas develop through strong projects, international collaboration, visiting professors and researchers and the participation of all partners. Each competence area knows state-of-the art of global research and what's perceived as world-class research.
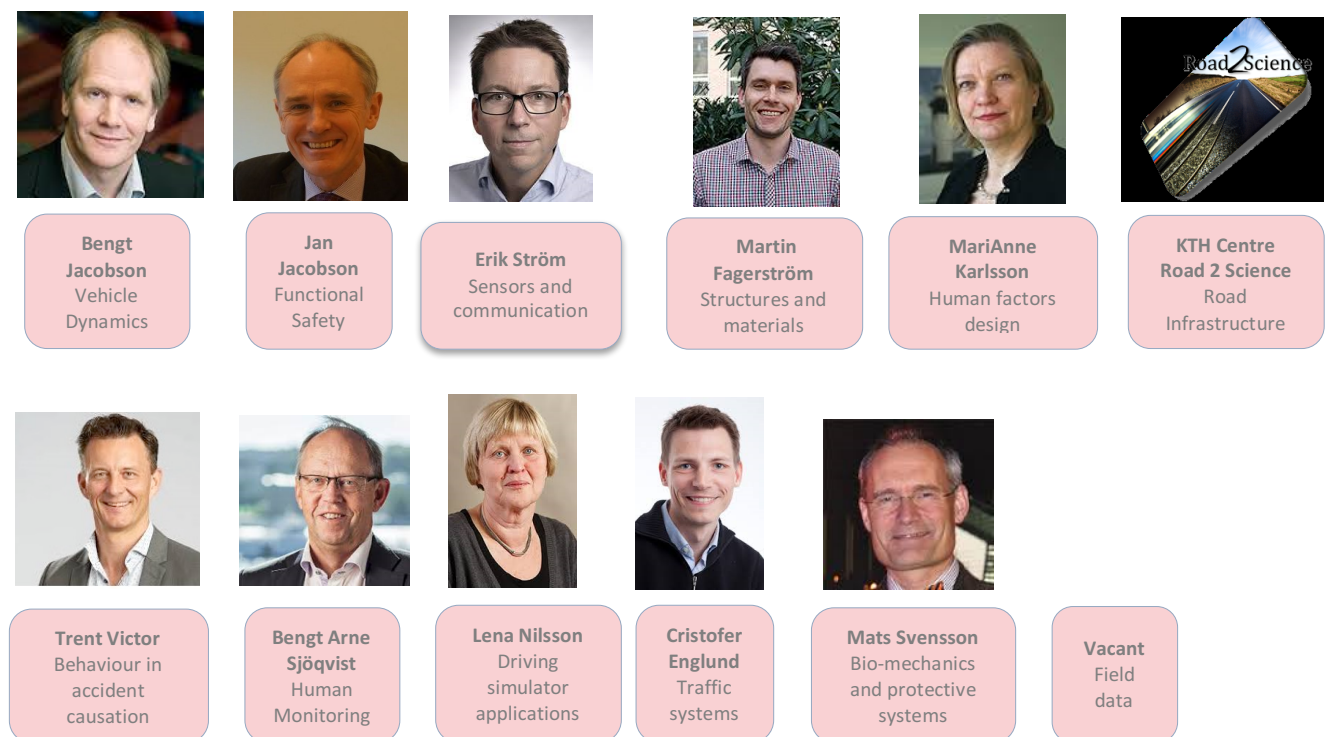

Bengt Jacobson
Vehicle Dynamics

Jan Jacobson
Functional Safety

Erik Ström
Sensors and communication

Martin Fagerström
Structures and materials

MariAnne Karlsson
Human factors design

KTH Centre Road 2 Science
Road Infrastructure

Trent Victor
Behaviour in accident causation

Bengt Arne Sjöqvist
Human Monitoring

Lena Nilsson
Driving simulator applications

Cristofer Englund
Traffic systems

Mats Svensson
Bio-mechanics and protective systems

Vacant
Field data

Figure 5: The Competence areas and their leaders.

6. FINANCING

According to the partner agreement for stage four, running from April 1st 2016 to March 31st 2019, and adjusted for changes regarding Lindholmen Science Park and Region Västra Götaland (VGR), SAFER has a funding of at least 41,9 MSEK, whereof cash 11,8 MSEK. The associated partners add a contribution of 0,4 MSEK. Additionally, VGR has decided to fund SAFER with cash 7,5 MSEK for the period and new partners are joining in year 12. All in all, the prognosis for stage four is based on cash contributions 20 MSEK and in-kind contribution of slightly above 30 MSEK. "In-kind" is resources contributed by a partner without transferring cash to SAFER. It can be man hours, use of test equipment or other means of value to SAFER.

The cost for SAFER Core includes the management and secretariat, the rent and a very lean budget for expenditures. The common costs have been reduced by approximately 22% compared to stage three. The cost prognosis for SAFER Core in stage four is cash 20 MSEK and in-kind 10 MSEK. The additional in-kind will be used for projects. However, the project in-kind need to be matched by some external cash funding and the work in the management team and in the reference groups to identify new project opportunities will be very important. A large portion of the in-kind to projects are postdocs and senior researchers from the academy, mainly Chalmers, and industrial PhDs, researchers and equipment from other partners.

By experience we know that the workload on the secretariat has a relation to the size of the project portfolio. Thus, SAFER needs to find ways to increase the secretariats critical mass to be able to provide support resources on demand.

Project finances

Projects in the SAFER environment are split in two categories; *own projects* and *associated projects*. Own projects are governed according to SAFER financial rules and project procedures and associated projects have external grants and governance, but are part of the total project portfolio and follow-up. These are projects where SAFER partners are engaged, often originating from SAFER pre-studies, and the projects are part of and contribute to the SAFER environment and community.

The total project turnover for all projects, both own and associated, is monitored regularly. SAFER 10-years self-assessment report (dated April 2016) summed up to a total of more than 230 project since 2006, with a project value of more than 1 400 MSEK. The present project portfolio consists of 50 ongoing projects with a total project value of 397 MSEK.

The growth of the project portfolio reflects the outcome of SAFER activities, but also the effect of changes in national and international research programs for automotive and transport research. National funding from Vinnova, FFI (Fordonsstrategisk forskning och innovation) and different SIPs (Strategic innovation programmes)and The European research program Horizon 2020 are the most important sources for traffic safety research projects at SAFER. SAFER is recognized as a Joint Research Unit (JRU) in H2020.

7. RESEARCH AREAS – SCOPE AND OBJECTIVES

The Research areas together form a framework for project content and for development of competences and collaborations. During year 11 it was decided to update the structure of the Research areas and align and merge them with SAFER Focus Topics, giving SAFER five new Research Areas; *Systems for accident prevention, Road user behaviour, Real-world performance evaluation* and *Care and Rescue.*

Systems for accident prevention

This Research area covers how different systems can predict a potential crash, and to the control of the vehicle to avoid driving into critical situations. There are four main research focuses Perception, Threat assessment and decision, Vehicle motion, Cooperative traffic systems and also Methods, tools and infrastructure to support research and development in these areas. Perception relates to sensors but the focus is on sensor fusion using both traditional sensors but also other information for instance, real-time wireless communication (V2V and V2I). The automotive industries advances towards driver support with automation of some driving tasks and even self-driving vehicles stresses not only sensing of the surrounding traffic, but also sophisticated strategies for decision of the vehicle behaviour and vehicle control. The huge potential gains and possibility of introducing automated vehicles comes in going from a single vehicle perspective to a vehicle systems perspective where automated vehicles can cooperate for safety and efficiency. Functional safety is the main challenge in designing these new live saving systems. Functional safety in highly automated systems is actually the same as traffic safety and it requires new methods, tools and test infrastructure to be proven. Research in these areas therefore has high importance for SAFER partners.

Important research questions for the Research area are:
- How can active systems predict potential crashes and avoid them?
- How can vehicles be partially or fully automated to eliminate driver mistakes that causes accidents?
- How can potential hazardous situations be avoided by automation?
- How can infrastructure, vehicles and vulnerable road users interact to improve performance of active safety systems?
- How can highly automated system be proven to be safe?
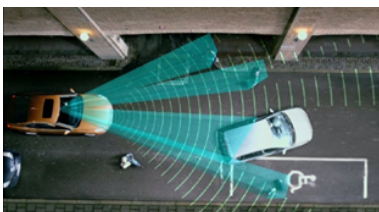
Road user behaviour

This Research area covers how drivers of vehicles (ranging from bikes to trucks) and Vulnerable Road Users (VRUs) actually behave in traffic, not just how we are supposed to behave. It covers permanent and temporary states of the driver, such as fitness for driving (including impaired drivers), why and how we take risks and what we do to compensate for risks. It also covers the driver's interaction with in-vehicle information systems (including nomadic devices) and interaction with advanced driver assistance systems, how the driver reacts to and accepts warnings as well as automatic interventions of active safety systems such as emergency braking. An emerging area affecting *Road user behaviour* is automation. Risk management is another emergent area within this

Research area. It implies that SAFER's research is not limited to vehicle on-board systems but also addresses planning before the trip, back office support during the trip and feedback for improvement after the trip.

Important research questions for the Research area are:
- How do drivers behave in traffic?
- How can driver distraction and inattention be minimised?
- How can semi- and fully autonomous driving support (unfit) drivers?
- How should the transition between automated vehicle functions and the driver be designed?

Real-world performance evaluation

This Research area develops methods to process and analyse field data, in new and innovative ways, and develops assessment procedures using data from both real and virtual environments. Its research projects address methods to be used in all fields of SAFER, i.e. active safety testing, such as for the AstaZero proving ground, methods for driving simulators, including human behaviour models, development of improved passive safety analysis tools using physical and numerical methods, real traffic evaluation of accident avoidance systems, vehicle as well as infrastructure based. Moreover, evaluation of in-vehicle

information systems and nomadic devices are included. SAFER is uniquely positioned regarding real-world performance evaluation with its broad range of data sources, both experimental, field and simulation. These complement each other and can thus provide comprehensive system evaluations. The general issues are among others about system performance parameters and also about how to collect relevant data and how to integrate data as a basis for performance assessment. The main priorities and research issues for new projects are found within:
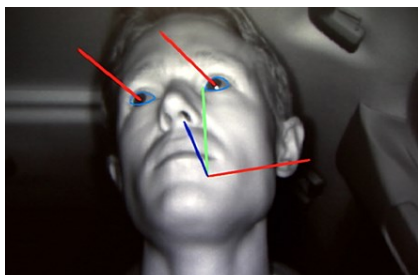
- Effect analyses using different research platforms (AstaZero, driving simulators, FOT/NDS, road accident databases, etc.).
- Transfer of data across research platforms (simulator, tests, etc.).
- Analyses of combined data sets and meta-analyses, respectively.
- Predictive performance evaluation tools for new safety systems.

These priorities are critical not least for securing the effectiveness of new safety systems (including automation) and for providing trust in the systems to enable market introduction.

Human body protection

The Research area encompasses research needed to understand and develop countermeasures to prevent injuries in accidents. Focus is on solving current/immediate safety-critical issues as well as on emerging challenges driven by increasing needs for a sustainable transportation system.

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

Important parts of current research comprise human kinematics and behaviour together with other influencing factors in pre-crash events, and how to model these. SAFER has pioneered this research area for car occupants, and aims to continue this journey. Additionally, within the area of traffic safety related composite research, SAFER and its partners are currently one of the world-leading groups focusing on developing modelling and simulation tools for composite structures in crashes. Many aspects are still unresolved and will require significant research efforts for years to come.

Examples of future prioritised questions within the Research area are:
- How to model and measure injury consequences for humans in a crash, including preceding events?
- How do pre-crash factors and individual differences influence injury outcome?
- How to proactively develop principles and prerequisites for crashworthiness of novel vehicles?

This is to be addressed by focused activities within:

- Pre-crash factors' influence on injury outcome.
- Injury mechanisms and consequences, including a special focus on long term consequences.
- Human Body Model (HBM) developments including scaling and tuning, variety of acceleration levels and omnidirectional injury risk prediction.
- Biomechanical research supporting HBM validation data and injury prediction, focus on gender, age and other individual differences.
- Development of numerical models for crashworthiness assessment of novel vehicle structures, focusing on lightweight materials and particularly crushing of conventional laminated composites.
- Experimental characterization and development of simulation tools for new and more ductile composite materials, both aspects essential for future market introduction.

- Crashworthy hybrid-material solutions where a mix of materials are used for optimal safety. This includes addressing challenges with respect to joining and methods for optimal material selection.
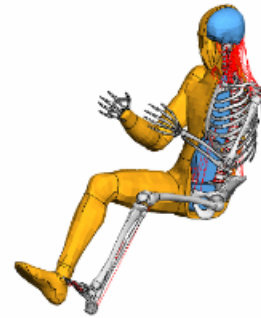
Care and Rescue

According to WHO, EU and others post crash actions play a significant role in order to reduce overall mortality and injury severity for road traffic accidents. Improvements in this area will significantly reduce societal costs and human suffering. The research area Care and Rescue started as a consequence of a revitalization of the post crash group activities during 2012. In 2014 it was recognized as a new SAFER Research area and today several projects are running under this umbrella.

Care and Rescue addresses challenges for all road-users related to the phase after a traffic accident is a fact through research and development within three defined domains:
1. Incident detection, prioritizing and dispatch
2. On-scene support
3. Reducing secondary effects of traffic accidents

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

prioritization including injury severity prediction.

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

Within *Reducing secondary effects of traffic accidents* the objectives are to look into

methods and actions to eliminate additional accidents and reduce effects on traffic system as a consequence of a traffic accidents.

In general Care and Rescue covers cross-disciplinary research and development involving a broad spectrum of stakeholders and disciplines within academy, industry and society. These include SAFER partners as well as new actors representing areas like emergency rescue services, healthcare, ICT and MedTech industry.
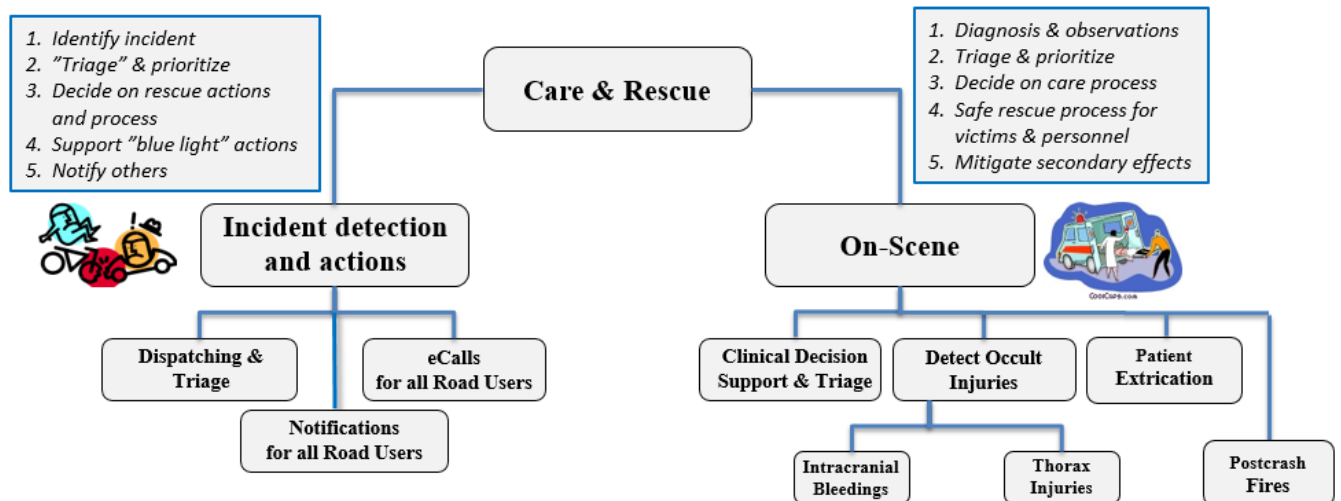

Figure 6: The Care and Rescue research area.

8. THE RESEARCH ENVIRONMENT AND INFRASTRUCTURES

SAFER is a meeting place with a physical work area of 1200 sqm situated on the 2nd floor in the main building of Lindholmen Science Park. It is connected to other open innovation activities such as Security Arena, Prehospital ICT Arena, Closer, Vehicle ICT Arena, Visual arena and Test Site Sweden (TSS). The space is a mix of about 70 workplaces, 15 small meeting/dialogue rooms, conference rooms and project areas. Around 40 persons have this as their permanent work place while all other SAFER people use the facilities temporarily. Reference group meetings and project meetings are taking place within the facility as well as internal and external lunch seminars. This makes SAFER a multidisciplinary and diverse meeting place.

Each person belonging to SAFER is employed by a partner. People who need access to the SAFER environment on a more regular basis may get a key to the facilities. In April 2017 about 280 people have a key to SAFER. However, the SAFER network is much larger.

The open innovation aspect of SAFER is a strong asset. Several project applications that have been submitted during year 11 are based on partner constellations with quite complex set ups. It is evident that the prerequisites and capability to organise strong consortia have grown and it has also been possible to respond quickly to proposals from international research groups that look for Swedish partners.

Researchers in the field of "Management of open Innovation" have followed the development of SAFER over the years. A general finding has been that partners value the partnership. SAFER is said to give an increased credibility for the partner through its affiliation. They find that SAFER has a unique value and an important role to play as an open innovation centre where collaborative multi-stakeholder research enhances the partner organisation's competitiveness and ability to contribute to

a transport system with close to zero fatalities and serious injuries. Furthermore, many partners appreciate the possibility to get insight and ability to influence the safety agenda as part of the transport system and city development.

Revere - Resource for Vehicle Research

Revere contains a research lab and its resources – equipment, vehicles, and supporting personnel. The main objective with Revere is to enable that ideas related to vehicles are developed into cutting edge research and break-through innovations, in particular within automated driving and collision avoidance.

Figure 7: Revere's test vehicle Volvo XC90.

Revere works proactively to create synergies for the SAFER projects for research, pilots and demonstrations. It's a Chalmers infrastructure located within the Computer science and engineering department. Revere interacts with AstaZero, WARA (Wallenberg autonomous systems and software program) and other environments for automation.

The Naturalistic Data Platform

The SAFER Naturalistic Data platform (SAFER ND platform) is a secure, world-class platform for handling data from naturalistic data collection. The three main parts are 1) state-of-the-art data management, 2) several large datasets and 3) a worldwide recognized research competence regarding naturalistic data. The data management includes storage infrastructure and tools for analysis, remote access capabilities, connection and utilization of the data storage

capabilities at Swestore (a Swedish national data centre), moreover data acquisition systems for cars, trucks and bikes. The extensive competence in the ND field among the SAFER partners covers, in addition to fundamental road traffic research, also the development of data loggers, storage, advanced data analysis and code books, as well as automatic annotation and anonymization of video data, moreover management of data privacy, confidentiality and IPR. SAFER researchers have also access to the in-depth crash database INTACT and SAFER administers the crash database for the international project "Initiative for the Global Harmonization of Accident Data" (IGLAD).

Figure 8: The data bases of naturalistic driving data at SAFER contains 5 millions of driving kilometers.

Asta Zero Proving ground

AstaZero is the world's first full-scale test environment for future road safety and automation. It has several different traffic environments that make it possible to test advanced safety systems and their functions for all kinds of traffic scenarios, both urban and rural. This enables a broad range of research and AstaZero serves as an international arena open for many different stakeholders. SAFER is responsible for coordination of calls for open, academic research.

Figure 9: The availability of the test track is a strong asset for the SAFER researchers.

The name AstaZero is a combination of ASTA Active Safety Test Area and Zero, which refers to the Swedish Parliament's vision for road safety with zero fatalities and seriously injured in traffic.
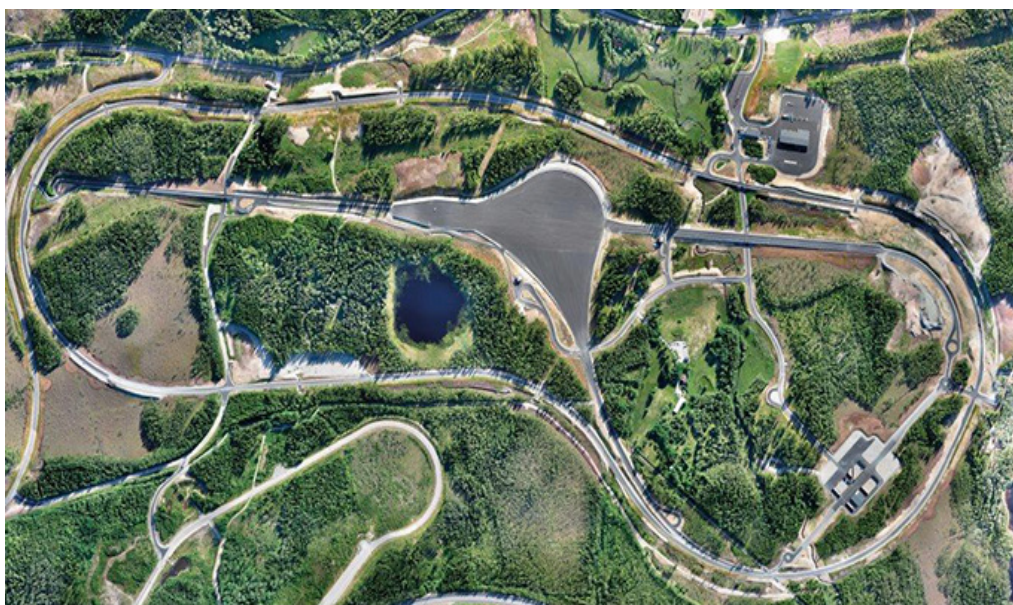

Figure 10: Map of AstaZero.

9. CONTRIBUTION TO TARGETS YEAR 11

SAFER's *Wanted Positions* are evaluated regularly. Below you can read more about our main achievements. Many activities and results have a bearing on a number of targets, but to simplify the presentation, they occur only once.

> ## Target contribution – highlights in brief
> - Implementation of SAFER core and the new strategy.
> - Research and development within autonomous drive – e.g. Drive Sweden, Grand Driving Cooperative Challenge and Drive Me.
> - Winning consortia in H2020 in strong competition:
>   - CARTRE
>   - SaferAfrica
>   - L3Pilot
>   - MeBeSafe
> - Revere now well established as a SAFER infrastructure.
> - Successful FOT Net Anonymization workshop – unique competence at SAFER in the area of Naturalistic driving data.
> - SAFER established as professional host of important and valuable conferences - IV2016, ISCC2016 and DDI2017.

Wanted Position 1: Visible and measurable results in practice

Safety for connected and automated vehicles is one of SAFER's main and most focused research topics. It is the topic where SAFER has received the most visibility and most results. COPPLAR is one of SAFER's flag ship projects, read more in the side bar on next page.

Furthermore, SAFER participated in a parliamentary debate on self-driving vehicles, as well as in several important conferences including a key note speech at the Automated driving conference Road Safety & the Human Factor in Vienna. Own seminars have also been organized on the theme, such as the Transport Forum in Linköping and in Gothenburg together with NTF, see complete list in enclosure 1.

The capability to host high quality, well-attended scientific conferences is yet another sign of a well-respected community with high impact in this field. As a token of credibility, SAFER was trusted with hosting the 5th International Conference on Driver Distraction and Inattention in Paris, March 20-22, 2017. The theme was Meeting the Challenges of New Technology and Automation.

SAFER has also been engaged in the International Cycling Safety Conference, in Bologna, November 2-5, 2016. SAFER was the main sponsor of a workshop on "Naturalistic Cycling Analysis". The workshop had about 30 participants from 10 countries and 4 continents. The event

gave SAFER researchers an opportunity to show their broad competence and to build new international networks.

In June SAFER arranged and co-hosted the highly appreciated IEEE Intelligent Vehicles Symposium 2016 (IV'16). Almost 600 participants from 42 countries attended. 206 papers (28 oral presentations and 178 posters) were included in the program with 742 authors from 29 different countries.
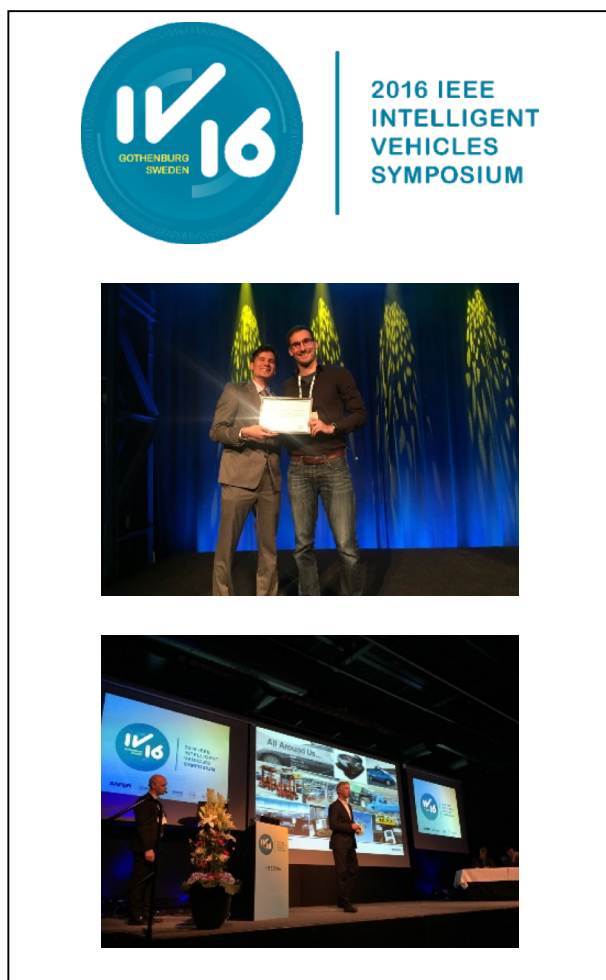

Figure 11: The IV'16 conference arranged by SAFER was very successful.

COPPLAR

The COPPLAR project (Campus Shuttle cooperative perception and planning platform) aims to take the first step towards the vision of an autonomous vehicle that can handle city traffic and challenging weather conditions. The focus is on the interaction between the vehicles to safely navigate in the complex inner city environment. The goal of the project is to build a prototype and a research platform. During the year tests of several complex scenarios have been performed at AstaZero and the project developed as anticipated.

Other examples of Visible and measurable results in practice is that SAFER presented new research results on the global safety development conference "Road Safety on Five Continents" in Brazil in May 2016 and presented "Economics of Road Safety – What does it imply under the 2030 Agenda for Sustainable Development?" at the UN-conference in Lao March 2017.

Grand Cooperative Driving Challenge (GCDC)

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

Figure 12: Autonomous vehicles competing in GCDC.

"Liv och trafik" is a knowledge pod about traffic safety where SAFER researchers are interviewed in short episodes. So far 31 episodes have been released, Topics varies and covers automated vehicles, cycling, child safety, visibility in traffic, motorbikes, traffic history, heavy vehicles and much more.

Figure 13: All you need to listen to Liv och trafik podcast is a pair of ear plugs!

During the year SAFER has continued to arrange seminars regularly to bring research results both to SAFER partners, to the researcher community and to the public. The latter mainly in collaboration with NTF. SAFER has increased visibility on the international arena in particular in Europe but also in Asia and the US.

Wanted Position 2: Hub for Swedish traffic safety research

SAFER welcomes the re-launch of the government's Vision Zero and is confident to be a key partner to help facilitate the vision. The collective knowledge and competence as well as the established working structure at SAFER has proven to be successful. During the operational year, SAFER's expertise has given input to the government's re-launched Vision Zero strategy and has also participated in the Swedish traffic administration's result conference Vision Zero.

Like the Swedish Government's main focus on vulnerable road users, this area is also a priority for SAFER. During the year, SAFER took the responsibility as chair for the development of the ITS strategy for unprotected road users. SAFER has also submitted valued input to the Swedish roadmap for unprotected road-users.

SAFER is, as an assignment from FFI, doing a follow up and revisit of the research needs for cycling safety in interaction with motorized vehicles. SAFER is also active within the Group for National Collaboration to reach an update of Safe Cycle Strategy v2.0.

The collected competence in connectivity, automation and self-driving vehicles at SAFER is very large. Therefore, SAFER has received several prestigious assignments in this rapidly developing field. For instance, SAFER was granted funds to perform a feasibility study in Drive Sweden's call "Effects of Automation". The project is conducted and reported, see sidebar "SEVS". Furthermore, SAFER participated as co-partner to City of Gothenburg in the exploration of
"How can automated transports create value in cities?" and supplied input to the ITS roadmap for automated vehicles, as part of the broad ITS Sweden effort to do road maps for different parts of the Swedish ITS strategy.
SAFER's director is part of the Drive Sweden's program management and SAFER has also been appointed as responsible for Drive Sweden's "Test site Automated Highway".

Influencing the European agenda
SAFER was in 2014 granted a "Platform for influence in H2020", called TS-Europe. This assignment finished in December 2016, but have been granted a continuation, a stage two running until December 2018. The vision for TS-Europe is to raise awareness

SAFER AS A HUB FOR SAFETY KNOWLEDGE

Safe, Efficient Vehicle Solutions (SEVS)
SEVS is a strategic explorative project addressing the need for new tools and capabilities to analyse complex societal and technological challenges - specifically regarding the future transport system. The study has involved many experts from the industry, academy and public sectors. It has resulted in insights and answers as well as tools for analysing complex problems using multidisciplinary teams.

Figure 14: The SEVS method.

Electricity 2.0
Electricity is a platform for the development and testing of services and products that can contribute to more attractive public transports. For example, new bus stop solutions, traffic management systems, business models and safety concepts as well as systems for energy supply and energy storage. The second phase, which will have a strong focus on safety, started during year 11. SAFER have been involved in setting up the project framework.

Figure 15: The electric bus 55 at Lindholmen.

of road safety at European level during H2020. The project has two broad objectives:

1.Traffic safety-related topics, reflecting Swedish priorities and interests are well represented in Horizon2020-calls and in the next FP9 program.

2. Swedish players are included in the approved projects and the winning consortia.

The first stage, TS Europe 1, has clearly contributed to the fact that Swedish players are well positioned, networks nationally and internationally are stronger and the knowledge of the European system of research funding and cooperation is greater. Road safety is on the European research agenda, mainly integrated in larger systems issues. Swedish players have been successful in the recent calls relevant to road safety including automated vehicles and transportation systems.

SAFER has participated actively in working groups in EARPA (European association of automotive R&D organisations) and ERTRAC (European Road Transport Research Advisory Council) as well as in national and European meetings. SAFER has made contributions to effective call texts and other text input to the commission. One specific visible result is the MeBeSafe project in the call "safe road user behavior". Only two projects, out of more than 60, were finally approved and SAFER is one of four members in the core team.

Wanted Position 3: Acknowledged as a world leader in traffic safety research

SAFER first year of stage four has delivered strong results in the research, despite a reduced funding. During the operational year SAFER had a total of 50 ongoing projects in the project portfolio. Many doctorial research projects are conducted at SAFER. Five PhD students reached their doctoral degree this year, see list in enclosure 2.

Below is a short summary of the main research results per Research area. A complete list of projects can be found on chalmers.se/SAFER. Enclosure 3 lists the publications published during year 11.

Human body protection

In recent years, significant steps have been taken to develop accurate and efficient CAE tools for crashworthiness assessment of composites. In the end of 2016, a three year FFI-funded project involving 10 Swedish partners (7 SAFER partners) was ended. This project has been the core and common ground for the partner activities in this research area. Significant advances in terms of new material models and numerical methods have been developed as a basis towards the end goal of having a robust, accurate and industrially applicable simulation methodology for composites in crash by 2020.

This project has this year resulted in three journal publications (where one was specially highlighted by the editors of the renowned Journal Composites Science and Technology), publications and presentations at several international conferences, and the delivery of two licentiate theses on crash modelling of composites. It also led to the formation of at least four new projects on the same topic (~30 MSEK for three years). One of these projects is a new, approximately three years, project involving most of the partners from the first stage. Thus, also for the coming years there will be a strong platform for collaboration on composites in crash.

Complementing the activities on composites, research activities have also been performed on developing material models and numerical methods for simulating laminated safety glass in

crashes. SAFER partners together with European partners from Germany (e.g. Fraunhofer EMI and Saint Gobain) and the United Kingdom (Jaguar-Landrover) finalized earlier this year a collaborative research project (CompMethGlass) developing a Finite Element model for the simulation of the response of windshields of laminated glass in crash situations. This model is now being implemented at the two automobile manufacturers in the project consortium: Volvo Cars and Jaguar-Landrover. The collaboration was successful in terms of both building a strong network of researchers and development engineers in academia, institutes and industry, but also on characterizing the materials involved and in developing models for the mechanical behaviour. However, it was still realised that more research is needed whereby an application for a continuation was submitted to the European Union which is still under evaluation.

Figure 16: Simulator tests in the SAFER project Småfolk, a project contributing to setting the global child safety agenda.

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

The Human Body Modeling (HBM) activities within SAFER are world class and well acknowledged in the field. The strategic investment made 10 years ago has paid out well. Several projects build the foundation of the activities in the area with the goal to develop HBMs with omnidirectional injury risk prediction, including scaling and tuning and variety of acceleration levels.

During 2016, the first international publications on industrial application of our Active HBM (A-HBM) were presented, and well received. The project partners now have a competitive advantage of a unique tool to evaluate occupant protection in a crash, which is preceded by an evasive braking. During 2016, an extensive test series with volunteers in evasive steering events were performed and the data is used to further develop the SAFER A-HBM for developments of active safety technologies including steering assist. Enhancements of injury prediction capabilities of the HBM in crash have also been noted during 2016. A project on pedestrian HBM with the inclusion of the advanced head and neck by KTH (Kungliga Tekniska Högskolan) was finalized late 2016. The third generation project of injury prediction for occupant HBM was started early 2016, adding a post-doc to the team at Chalmers and SAFER. The successful Vinnova financed ViVA project resulted in a first generation open-source average female HBM. This is a world-first Human Body Model representing a mid-size female. Together with the SAFER associated crash test dummy EvaRID, this model is the only one that represents a mid-

size female, which is a true proof of SAFERs devotion to real world human body protection for a heterogeneous population. More focus is needed in this area.

Figure 17: SAFER's A-HBM model.

During SAFER year 11, some valuable fundamental biomechanics research was made, exemplified by a PhD in head injuries and exciting multi-disciplinary project in whiplash injury research. However, the limited funding available for fundamental biomechanics research is a threat. This is critical, since fundamental biomechanics research is essential for reaching a high level of applied research. Especially this is pronounced in the application for collision mitigation systems (pre-braking, pre-steering), which requires expanded knowledge on biomechanics and development of tools to enable decisions form an omni-directional loading perspective.

Care and rescue

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

Arena at Lindholmen Science Park. This triple-helix collaboration platform with some 30+ parties is the result of the SAFER associated project Metis running between 2012 and 2014.

During the year, a lot of attention was given to the project Via Appia – including concept development, further partner involvement, and applications for funding. Via Appia is a concept aiming at efficient handling of road user alarms, using smartphones and ICT to improve road safety at a broader scale, and facilitating the packaging of new ICT offerings containing alert notifications of various types. It has a wide partner group and addresses ICT as a tool to improve road safety. The aims are to reduce fatalities and injuries, as well as societal costs resulting from road traffic accidents, by enabling smarter handling of various eCall like solutions, collecting incident related information and providing notifications in open format on "acute" traffic incidents. Apart from cars, road users like bicycles, motorbikes, all terrain vehicles and horse riders are included. During the year, a special focus was given to public transport - particularly buses. Incidents with buses are cumbersome to analyse and prioritize as quickly as desired. Several examples in media during the year clearly illustrated this. Unfortunately, funding applications to Vinnova failed twice, but the project group all strongly believe in Via Appia and is therefore seeking other routes to make it happen.

Projects and collaborations within the area of occult injury detection where making good progress during the year. The originally SAFER initiated project aiming at prehospital TBI-detection (Traumatic Brain Injury) using micro-waves developed nicely and results from the first tests where encouraging and gained significant attention in various media. Micro-wave technology is also evaluated for detecting pneumo- and haemo-thorax, and SAFER associated projects in this area continues. Also, the SAFER, i.e. Folksam funded, and associated projects related to utilizing EBI (Electrical Bio Impedance) for occult

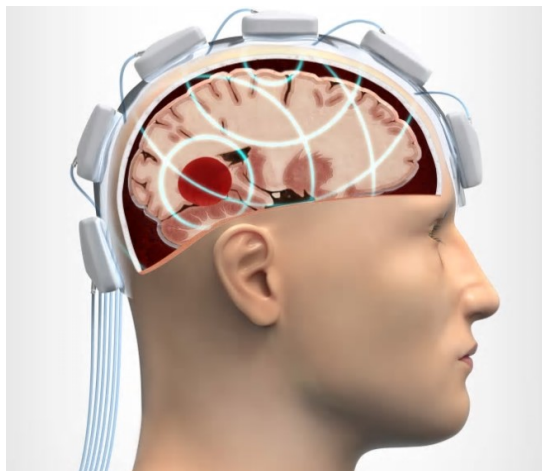trauma detection have continued and shows promising results.

Figure 18: Helmet for occult injury detection.

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

Finally, new project areas have been explored through discussions and pre-studies. Examples are post-crash fires, extrication and safety for personnel at accident scene. Engagement in these areas may result in new partners joining SAFER and new research projects in the year to come.

Real-world performance evaluation

SAFER has worked with many other stakeholders in the NDD field over the years, i.e. with some 25 partners in Europe, University of Michigan Transportation Research Institute (UMTRI) and Virginia Tech in USA, Nagoya University and Tokyo University of Agriculture and Technology in Japan and UNSW in Australia.

Visible recognition of SAFER's know-how is the selection of SAFER to:

- The award as one of three consortia for analysis of the SHRP2 data (The second Strategic Highway Research Program**)**, the largest ND dataset in the world, in strong competition with 22 consortia in USA.
- Be the Central Data Center in UDRIVE, to date the largest Naturalistic Data Study in Europe (on-going),
- Lead the Data Sharing Framework in the FOT-Net Data Sharing Framework,
- Lead the data management of the largest FOT in Europe (L3Pilot), a 350 MSEK project on automated cars including 13 vehicle manufacturers.

During the past year, the infrastructure was further enhanced with several new features. The FOT-Net Data Sharing Framework, directed and developed to a large extent by SAFER, was finalized. It consists of seven topics with detailed guidelines about what to address. The Data Sharing Framework was much appreciated by the USDOT, Virginia Tech, UMTRI, Nagoya and UNSW, among others. The framework formed the base for the data management in UDRIVE. Documents can be found on the FOT-Net.eu.

In December 2016, Jonas Bärgman defended his PhD-thesis on methods for analysis of Naturalistic Driving Data. The thesis includes research on both quantitative and qualitative analysis methods of NDD, in particular regarding the method Counterfactual Simulation, which can be used to understand the crash and injury risks related to the glance behaviors associated with different driver behaviors (e.g. radio tuning and text messaging). It can for example be used when evaluating driver vehicle interface

designs with respect to crash risk. The research also demonstrates that the choice of driver models when using simulations to estimate safety benefits of ADAS has a very large effect on the benefit estimations – up to a factor of three.

Overview – Accident Data

Chalmers University has developed the Swedish in-depth database INTACT, which is a holistic database, including information about all phases of road crashes. The collected data has now been released to SAFER researchers and has enabled novel analyses of in particular crash causation and long-term consequences of road crashes. The on-going project "Initiative for the Global Harmonization of Accident Data" (IGLAD) is dealing with harmonized in-depth accident data from several countries on four continents, including eight EU countries. Chalmers has been the administrator for the database for three years and in 2016, SAFER was elected by the project partners to the administrator role for additional three years. IGLAD is acknowledged as the most relevant source of comparable in-depth crash data globally. IGLAD data has been analysed in various projects by now, including the EU project PROSPECT. SAFER has submitted a referral this year about a planned update of the data management procedure in Swedish national road database STRADA (Swedish Traffic Accident Data Acquisition).

SafetyCube is a promising EU research project with the goal to create a database resource for road safety stakeholders so they can make informed decisions. Collecting, evaluating and organizing data on published safety risks and countermeasures are the primary research activities.

UDRIVE is a SAFER project that has been running during the third and fourth SAFER phase. This is the largest naturalistic driving study in Europe to date. It is an EU FP7 project with 19 partners throughout Europe, where SAFER has a key role in data management. The SAFER partner Chalmers is sub-project leader for the UDRIVE analysis.

Figure 19: UDRIVE is the first large-scale European Naturalistic Driving Study on cars, trucks and powered-two wheelers.

The four and a half year project ends in June 2017, having collected car data in Great Britain, Germany, France, Poland, and the Netherlands, truck data in the Netherlands, and powered two wheeler (scooter) data in Spain. Research topics range from risk assessment methods and studies of secondary task behaviour through better understanding of the interactions between drivers and vulnerable road users as well as eco driving. In the last year, the Data Protection Concept was finalized. The DPC consists of data protection requirements on each step of a FOT and has been applied to UDRIVE through-out the project. Also, the remote access IT infrastructure was put to the test during a condensed period of intensive analysis and is now proven to work. This infrastructure allows for remote access to other secure enclaves. This was earlier tested in a project with UMTRI, who holds several important datasets being a hub for automation in USA.

CARTRE (Coordination of Automated Road Transport Deployment for Europe) started in October 2016. The funding is 3 M€ and 249MM divided among 36 partners from nine EU member states. SAFER is participating as a Joint Research Unit (JRU) including the partners Volvo Cars, Chalmers and Lindholmen Science Park (Drive Sweden). AB Volvo does participate individually. The mission of CARTRE is to accelerate development and deployment of automated road transport. There are eleven objectives, for instance to support the alignment of national plans, support international cooperation and ART pilots, provide a platform for data, information and experience exchange and establish a European annual conference. The first six months has been concentrated on arranging the first European Conference on Connected Automated Driving, which took place on April 3 and 4 in Brussels. The SAFER partners contribute to most tasks, in particular AB Volvo being the WP leader for Deployment Support and Roadmap Dissemination and SAFER being the task leader for the Data exchange platform.

L3Pilot (Piloting Automated Driving on European Roads) is the largest FOT supported by EU and will start in September 2017. The overall objective is to test the viability of automated driving as a safe and efficient means of transportation. The funding is 36 M€ and the project includes 13 vehicle manufacturers; eleven partners will participate with automated cars. The project consists of 34 partners in total, including three SAFER partners, i.e. Volvo Cars, Autoliv and Chalmers. Volvo Cars provides automated cars and collects data, Chalmers is doing both human behaviour and technical analysis, whereas Autoliv is contributing to the Code of Practice for Automated Driving. SAFER Core is leading the data management tools and procedures in the project.

PROSPECT (Proactive Safety for Pedestrian and Cyclists). This EU research project is on-going and will finish in the end of 2018. There are five key objectives: 1) a better understanding of relevant VRU

scenarios, 2) an improved VRU sensing and situational analysis, 3) advanced HMI and vehicle control strategies, 4) four vehicle demonstrators, a mobile driving simulator and a realistic bicycle dummy demonstrator, and finally 5) testing in realistic traffic scenarios and user acceptance study. The consortium includes the majority of European OEM's, including Volvo Cars. Accident research will be performed by Chalmers and VTI among others.

Figure 20: PROSPECT will further grasp real-life scenarios of crashes with VRU's.

QUADRAE (Quantitative Driver Behaviour Modelling for Active Safety Assessment Expansion) is an on-going VINNOVA-FFI project with the aim to develop driver models for simulations and benefit analyses of new active safety systems. Accident data will in particular be used in the development and validation of the virtual driver models. The project will finish in the end of 2019.

E-FRAME was finished in 2016. This FFI project is in short an analysis framework for safety systems and services. Modern commercial vehicles are equipped with a range of passive and active safety systems with a strong potential to increase traffic safety and reduce safety-related costs, both from a societal and a transport operator perspective. To optimize the safety benefits of these safety systems and services, it is required to have a detailed understanding of the problems that they are intended to solve and of the effectiveness of the systems or services in preventing or mitigating these problems is needed. In this context, the objective of the project is to develop a generic safety evaluation framework that integrates different relevant data sources,

methods and tools into a structured process for the safety evaluation of commercial vehicle safety systems and services. The framework should target not only severe accidents (injuries/fatalities) but also property damage as well as non-traffic-related accidents (e.g., backing up collisions). The envisioned framework and its components will re-use and adapt as much as possible the results from previous and ongoing projects in Sweden and elsewhere. The safety evaluation framework will be used to perform a cost-benefit analysis in order to understand the effectiveness of a system/service before its introduction in the market.

HIFI VISION/RADAR TARGETS. This on-going VINNOVA-FFI project started in 2016. The objective is to improve the targets used for active safety testing for automotive vision and radar systems, respectively. In addition, there will be input to international standardization regarding methods and limits.

Road user behavior

This area is a result of the split of Pre-crash area into Road User Behaviour and Systems for accident prevention. This area has studied normal driving behaviour to learn more on how accident and incidents happen.

From the projects which are running now, two different area can be highlighted. One area is about automated driving and how systems could be designed to fit human beings. Human Factors have been investigated to design automated systems in several projects both national with for example HATric and also with European project such as AdaPTIVE. AdaPTIVE has received a lot of attention during the 1st European conference on Connected and Automated Driving organised in Brussel on April 2017.

The second area of interest is within biking. The project "Bike Model" used naturalistic data as from traditional and electric bike (pedelec). The aim of the project was to develop rider models to support cycling safety including infrastructure and electrical bicycle design. Results showed that individual cyclists increase speed when moving from a traditional to an electric bicycle. Electrical bicycles are not only faster than traditional bicycles they also experience lower lateral and longitudinal accelerations. Braking behaviour is also different depending on whether a cyclist ride an electric or a traditional bicycle. In particular, e-cyclist are more likely to experience unexpected situations requiring harsh braking.. The main conclusion of the study is that in general, e-cyclist are faster, have harder time planning braking, and overtake other road users more often than other cyclists. As a consequence, many situations that are already challenging for cyclists (e.g. obstacles on the bike lane, poor visibility, construction work, etc.) become even harder and potentially critical for e-cyclists.

An emerging area within Human factors is "nudging" which comes from "nudge", i.e. touch gently, where the concept behind is to encourage people to behave correctly without direct instruction, legislation nor enforcement. The new European project MeBeSafe will dig into the concept of nudging to increase traffic safety.

Figure 21: Nudging, like a sign of this kind, will be evaluated in SAFER's project MeBeSafe.

Wanted Position 4: A broad set of partners and collaborations in order to ensure the strategy and explore new needs and countermeasures

The new vision and strategy of SAFER has also focused the importance of this wanted position – new partners and collaborations complementary to the existing SAFER core. Two new partners and three members will be adopted at the Shareholders meeting in April and others are in pipeline.

Partners have to be able to participate with own resources in collaborative research at SAFER. However, other collaborative set ups also exist with research environments in other parts of the world. Below are some examples described.

SRI – Stanfords Research Institute visited SAFER in spring 2016 and SAFER participated in their Stockholm seminar in collaboration with IVA on "Strengthening Sweden's Innovation Leadership". SAFER introduced SRI to a group of SAFER partners to explore mutual benefits and knowledge sharing.

University of Iowa has collaboration with different researchers at SAFER, from several departments, on different topics and a MoU with Chalmers. The question has been raised by University of Iowa if an enhanced collaboration on a more general level should be set up.

CTS - The China Sweden Research Centre for Traffic Safety (CTS), with Swedish founding partners Chalmers, Volvo Cars and Volvo and Chinese partners Tongji University and RIOH Institute for Highway Safety has grown with two new partners – Autoliv and Tsinghua University in Beijing. SAFER constitutes the Swedish research platform in this collaboration. Joint projects are ongoing as well as other activities to enhance safety in China. Examples where SAFER has been present is the ADAS conference in Shanghai June 2016 in collaboration with Tsinghua and Tongji universities, and SAE China, October 27, 2016, where CTS had an own session.

The University of Nagoya Green Mobility Centre (GREMO) has research in several areas of interest to SAFER. With a MoU since 2012 collaboration includes prof. K. Takeda as member of SAFER Scientific Board, support to the organising and content of the bi-annual conference FastZero, and during 2016 preparation for a research project on elderly drivers and automated driving in collaboration with among others Toyota and TUAT. Unfortunately, the joint call from Vinnova and JST did not, in the end, encompass this issue.

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

Collaborative structures

SAFER is a contributing partner in international and national collaborative structures such as joint technology platforms, CSAs (European Coordination and Support actions) strategic innovation programmes and the like. Below some examples of activities.

European Union
SAFER has continued to be an active member in **EARPA** (the association of automotive R&D organisations), both in the safety group and in the board via prof. Per Lövsund. This is a priority in the strategy for European influence and project consortia building.

ERTRAC (European Road Transport Research Advisory Council) is the important Joint Technology Platform for road safety. SAFER's director has participated in the ERTRAC safety group meetings in June and November. With

support from SAFER researchers texts to general future topics for the 2018 – 2020 The next step is to update the European Road Maps for road safety.

SAFER researchers have participated in the ITS World Congress 2016 in Melbourne and arranged the yearly FOT-Net international workshop. Two papers from European projects where presented at the ITS conference; data sharing content in project agreements are crucial, detailed from the Data Sharing Framework in FOT-Net Data and the Data Protection Concept in UDRIVE – both developed by SAFER. Additionally, SAFER researchers have presented how the data sharing framework can be adjusted to automation at the special session "Automated vehicle pilots: challenges for data collection and sharing". The Data Sharing Framework from FOT-Net Data was presented at the Transport Research Arena in Warsaw 2016.

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

Sweden
As earlier mentioned SAFER has a core position in the different platforms for Autonomous Drive where the property traffic safety is both a goal and a boundary condition. SAFER is a member of **Drive Sweden** program office as safety is an important perspective for a sustainable transport system. SAFER is also a member

calls as well as to the Position Paper for future Road Safety have been submitted. of the **DriveMe** program office, responsible for the involvement of Chalmers' different competences. The large research program **WASP** (Wallenberg Autonomous Systems and Software Program) involves researchers connected to SAFER. WASP has a test infrastructure**, WARA**, who has established contacts with Revere to ensure synergies.

Figure 22: Drive Me cars being tested in Göteborg.

AstaZero, is a key infrastructure for research at SAFER and collaboration is vivid. SAFER has an assignment from the owners of AstaZero to coordinate the curiosity driven research. The first call has just opened in March 2017.

GNS (Gruppen för nationell samverkan) – the national group for collaboration on traffic safety led by the Swedish Traffic Administration has invited persons from SAFER to participate. SAFER is also active in the GNS expert group on vulnerable road users.

Other international contacts

SDSN- The Executive Committee of the Sustainable Development Solutions Network (SDSN) has approved SAFER for membership in the Solutions Network. SDSN supports the implementation of the UN Sustainable Development Goals adopted by world leaders in September 2015. The 17 goals address the challenges of economic development, social inclusion, environmental sustainability, and good governance. Traffic safety is a global challenge and SAFER's research contributes to decrease the number of

fatalities and injuries. SAFER will work together with SDSN in support of sustainable development. SAFER aims to find further means of collaboration on research, solutions initiatives, and policy work. Much of this work will be facilitated by the National & Regional SDSNs. The Centre for Environment and Sustainability, GMV, in Gothenburg hosts the SDSN Northern Europe secretariat.

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

Wanted Position 5: A balanced project portfolio and a long term financing of the core operations

Year 11, the first year in stage four, includes also the closing of stage three, as projects financed by the Vinnova funding to SAFER competence centre were allowed to continue until September 30th 2016. The closing of stage three together with ending the 10 year framework agreement for SAFER as Vinnova funded competence centre, has been an extensive work.

In parallel the board and the management team have worked out and decided on a new financial strategy. It has sufficient funding for running SAFER based on partner contributions and support from region Västra Götaland (VGR). At the end of year 11 the financial base is in place, the costs have been adapted to the existing frame and the prognosis for stage four is showing a balanced situation. The

committed cash contributions are delivered. In-kind contributions are not yet compiled, but a qualified estimation based on the large partners involvement, who represent more than 80% of the total in-kind commitment, and the activities from all partners at SAFER indicate that commitments will be fulfilled.

The project portfolio is re-organised to fit the new research areas. New projects with external funding have been added during year 11, several new national and Horizon 2020 projects have been granted. The total number of ongoing projects are 50, where of 38 belong to the five research areas and 12 are other types of collaborative projects, such as the CTS-project (China Sweden Research Centre for Traffic Safety).
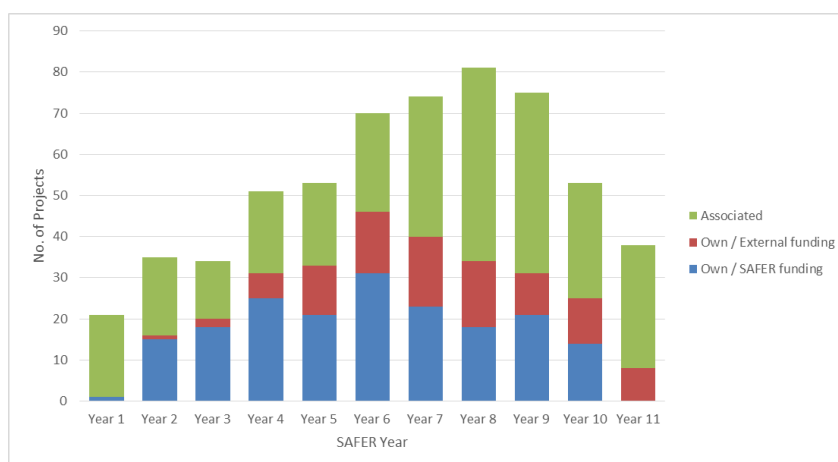

Figure 23: The development of the number of projects over the years. The blue "SAFER founded projects" include many small explorative studies and pre studies. The value of the ongoing project portfolio is appr. 400 MSEK. This is the same level as during stage three.

10. EDUCATION AND COURSES

Chalmers Area of Advance

SAFER is related to the Chalmers Transport Area of Advance (AoA) as earlier described. All Chalmers' researchers within traffic safety are encouraged to contribute to SAFER. Presently some 75 senior researchers at Chalmers are active within Traffic Safety. All together more than 140 researchers and PhD students from at least eight departments engage in traffic safety related research.

Education is primarily the responsibility of the universities involved in SAFER. Many master and PhD students are present in the SAFER environment. Five dissertations took place during SAFER's operational year 11. These are listed in enclosure 2.

SAFER Insight

SAFER Insight is the first comprehensive web-based portal in advanced traffic safety education on an international level (www.saferinsight.se).

The purpose of SAFER Insight is to provide students and professionals with courses and seminars in vehicle and traffic safety. Currently, the portal encompasses ten training providers and the number of courses varies between 15 and 45 depending on time of year.

The training providers are the SAFER partners, or MOU partners to SAFER, which are providing courses or seminars.

Visiting researchers

During year 11, SAFER has had several visiting researchers from all over the world; USA, Asia, Europe. Most of these researches have given an open SAFER seminar (listed in enclosure 1), which is excellent knowledge sharing.

Carol Flannagan, Research associate professor at UMTRI, has received a grant from Vinnova to take up a position as guest researcher at SAFER for the period 2017 – 2018. Her research area is Autonomous vehicles - challenges for road safety analysis.

11. SEMINARS AND CONFERENCES

External

SAFER organises a vast amount of seminars and workshops. They are appreciated as efficient means to enhance knowledge and offer a great opportunity to network. SAFER is acknowledged as a meeting place for competence and knowledge and serves as a centre for sharing competence.

A list of conducted seminars and conferences can be found in enclosure 1.

Internal

SAFER has arranged Thursday seminars every week during February to May and September to November, primarily for internal cross-fertilization and exchange of knowledge and ideas. The SAFER Competence area leaders and Research area directors are responsible for the content. During operational year 11, 25 seminars were conducted.

Figure 24: SAFER's Thursday seminars give valuable networking possibilities and knowledge exchange.

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Seminars & Conferences

Conducted external SAFER seminars, conferences and other events during year #11 include:

- SAFER 10 years' anniversary event with presentations of the key research achievements during this first decade, April 5, 2016.
- Seminar "Unique in traffic" at the Science festival in Gothenburg, April 15, 2016.
- Seminar "How does pedestrians and cyclists understand each other?", together with NTF Väst, April 26, 2016.
- AstaZero Researchers Day "Emerging Trends in Active Safety for Road Vehicles", May 10, 2016.
- Adjunct Associate Professor Lecture: Matthijs Klomp, Applied Mechanics, Chalmers, May 18, 2016.
- SAFER Seminar: Invited Researcher Seminar with Dr. Francisco López-Valdés, University of Zaragoza, June 2, 2016.
- Protecting two-wheeler riders in car crashes Rikard Fredriksson, Department of Applied Mechanics, Chalmers University of Technology, June 13, 2016.
- IEEE Intelligent Vehicles Symposium 2016 (IV'16). SAFER & Chalmers host the conference on June 19-22, 2016, at Lindholmen.
- 3rd ADAS China Forum conference in Shanghai June 2016 in collaboration with Tsinghua and Tongji universities.
- SAFER Seminar: "Intelligent Vehicles Meeting Intelligent Humans" by Prof. Klaus Bengler, Technical University of Munich, June 21, 2016.
- FOT Data Anonymization and feature extraction workshop, August 31-September 1, 2016.
- FOT-NET Data Hands-on Workshop on Data Re-use, September 14, 2016.
- SAFER seminar: Matt Reed: "People Are Not Dummies: Modelling Human Variability for Vehicle Restraint System", October 6, 2016.
- ICSC International Cycling safety Conference, Nov 2- 5 2016, in Bologna.
- SAFER Seminar: Kristy Arbogast: "Oblique child restraint testing, active safety research and other related topics", October 11, 2016.
- AstaZero Researchers Day, "Building trust in automated driving", October 18, 2016.
- Area of Advance Transport SOT Initiative seminar– Autonomus Transport System – "The good, the bad and the unknown", October 27, 2016.
- SAE China October 27, CTS session on traffic safety.
- "Autonomous drive, how will it really work"? A seminar together with NTF Väst November 11, 2016.
- Transportforum in January 11, 2017. SAFER led a session on Autonomous driving with five speakers.
- Dissemination seminar Eframe - Analysis Framework for Safety Systems and Services, January 25, 2017.
- Children, Life and Traffic, A one day seminar March 7, 2017 together with NTF Väst.
- Automated Driving: Road Safety & the Human Factor in Vienna, SAFER key note speaker, March 8-9, 2017.
- 5th International Conference on Driver Distraction and Inattention, March 20-22, 2017, Paris, France. Theme: Meeting the Challenges of New Technology and Automation. Co-hosted by SAFER, IFSTTAR & ARRB.
- SAFER seminar with Carol Flannagan, UMTRI, "From Model T to Waymo: Cars have gotten better—has transportation data science?", March 30, 2017.

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Dissertations

The following PhD students working in the SAFER environment have written their doctorial thesis during operational year 11 (April 1, 2016 – March 31, 2017):

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

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

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

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

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