SAFER
VEHICLE AND TRAFFIC SAFETY CENTRE AT CHALMERS

Annual Report to Shareholders

Operative Year # 7

April 1st, 2012 – March 31st, 2013



Enclosure 1: Seminars & Conferences
Enclosure 2: Research Reports
Enclosure 3: Competence Areas
Enclosure 4: Project overview

Reflections on year 7

This first year of Stage 3 has been comprehensive. Based on the experience of Stages 1 and 2 and the international evaluators report, a strategy for the coming four years was proposed by the Board and approved at the Shareholders meeting in April 2012. With this new "Wanted Position 2016" as our guideline we have proceeded in the development of our Focus Topics, the project portfolios and of SAFER as a hub for Swedish safety research. Early in the year we executed a benchmarking study as a response to the Stage 2 evaluation report to identify the centre's international standing. We also initiated the creation of a strategic innovation agenda. Many researchers at SAFER are engaged in EU 7 FP projects, collaborative projects in other parts of the world, especially USA, Japan and China, as well as in the preparation for Horizon 2020 research programme.

By stressing the importance of our competence areas we have increased their activities resulting in more researcher interactions in workshops and seminars. The new SAFER partners that joined in Stage 3 have provided valuable contributions in this development.

SAFER has been trusted with projects and programmes enhancing our role as a neutral, pre-competitive arena for broad safety issues where many perspectives and stakeholders need to collaborate. We take action in the development of research infrastructure and are excited by the opportunities that ASTAZero, the active safety test area, will offer when it opens in 2014.

The SAFER community is growing and every day activities in the SAFER environment are vital. During year 7 the educational portal "SAFER Insight" was launched, offering all partners in SAFER to expose their education programmes to the SAFER community and beyond.

2013 is thus full of new initiatives and in September Göteborg will host two safety conferences - The 3rd International Conference on Driver Distraction and Inattention and IRCOBI, the International Research Council of Biomechanics of Injury, founded by Professor Aldman 40 years ago. Vehicle and Traffic Safety will be in the spotlight with top international researchers presenting their latest findings.

Lindholmen in April 2013

Anna Nilsson-Ehle
Director

1. LONG-TERM VISION, MISSION AND STRATEGY

Vision

SAFER provides **excellent multi-disciplinary** research and **collaboration** to eliminate fatalities and serious injuries, making Swedish **society, academy and industry** a **world leader** in vehicle and traffic safety.

Mission

- 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.
- Combine the multi-disciplinary scientific competence available within SAFER to enhance scientific excellence as well as innovation capability.
- Serve as an open innovation centre for partners and international researchers and provide the prerequisites for creative and productive research collaboration.
- Develop world-class competence, including research tools and methods, in SAFER focus topics.
- Inspire students, researchers and product developers to be devoted to the area of traffic safety.
- Disseminate results and knowledge to society.

Strategy

To significantly contribute to the vision and become a well renowned international centre of excellence SAFER has to deliver results, build competence and create strong networks in selected areas.
The strategy is built on the pillars **Excellent competence**, **Multi-disciplinary research** and **Collaboration.** The strategic plan is to build long-term competence in defined Competence Areas necessary to achieve outstanding research and innovation in chosen Focus Topics. The Focus Topics together form a framework for project content and for development of competences and collaborations.

Presently the six Focus Topics are:

- **Incidents and accidents – priorities and effect analysis**
- **Driver state/action/reaction**
- **Prediction for accident prevention**
- **Methods for evaluation of vehicle and traffic safety**
- **Safety for novel vehicles and vehicle combinations**
- **Human body models and Biomechanics**

The strategy also includes a common **work environment**, **seminars** and work **methods**, and a **uniting name** – SAFER. Multi-disciplinary research and collaboration are supported by the SAFER environment where researchers and project members can meet and work side by side. This creates an atmosphere of true collaborative research and an ongoing dialogue involving many different actors within the safety area.

Wanted Position 2016

1. Visible and measurable results in practice
2. Hub for Swedish traffic safety research
3. Acknowledged as a world leader in traffic safety research
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

Values

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". The hallmark for SAFER should be values to support that. The atmosphere should express: Open minds, respect for each other, cooperative spirit, high aspirations, curiosity and joy.

Financing

According to the partner agreement for Stage 3, running from April 1st 2012 to March 31st 2016, SAFER has a funding of 126 MSEK. VINNOVA is providing cash 40 MSEK, while the partners contribute 86 MSEK whereof cash 10 MSEK and the rest in in-kind.

It is important to follow the finances from the start of SAFER as projects run over several years and the resources are booked as soon as a decision is taken. At the end of Stage 2 (120331) all funding for the first six years had been used but some 2,7 MSEK that is transferred to Stage 3.

Chalmers Transport Area of Advance was granted Swedish national strategic research funding for Traffic Safety. The amount of this grant is well in the order of Chalmers in-kind commitment in SAFER and the research grants play an important role for the development towards a world class research centre.

The common costs for SAFER are approximately 53 % of the funding, 60% of the cash contribution and 50% of the inkind contribution. As SAFER grows, so do the common costs. Thus, the ability to attract external funding for projects is increasingly important as well as finding complementary cash funding for centre activities.

Project finances

Projects in the SAFER environment are split in two categories," own projects" governed according to SAFER financial rules and project procedures and "associated projects" with external grants and governance but part of the total project portfolio and follow-up. The total project turnover, including all projects, own and associated, in the SAFER environment is monitored regularly. The goal for SAFER is to reach an annual project portfolio turnover of 200 MSEK by year 2016. When SAFER started in 2006 the existing annual project portfolio was estimated to 60 MSEK. The result for year 6 was 140 MSEK and 170 MSEK at the end of year seven, where of SAFER's own projects were 46 MSEK.
Currently, the total project portfolio is slightly more than 500 MSEK.

The growth of the project portfolio reflects the outcome of SAFER efforts, but also the effect of changes in national and international research programmes for automotive research.

2. ORGANISATION AND MANAGEMENT OF THE CENTRE

Partners and Shareholders meeting

The partners in SAFER are:
AB Volvo, Acreo Swedish ICT, Autoliv, City of Gothenburg (Traffic and Public Transport Authority), Chalmers University of Technology, Folksam, Lindholmen Science Park, Region Västra Götaland, Scandinavian Automotive Suppliers, Scania, Swerea IVF, Swerea SICOMP, SP Technical Research Institute of Sweden, Swedish Transport Administration, University of Gothenburg, Viktoria Swedish ICT, Volvo Car Corporation, VTI Swedish National Road and Transport Research Institute, TÖI – the Norwegian Institute of Transport Economics, and ÅF (former Epsilon).
At the start of Stage 3, five new partners joined: Halmstad University, If Insurance, KTH Royal Institute of Technology, Lund University and Sweco. All partners hold a place in the Shareholders meeting. VINNOVA is the main funder.

Board

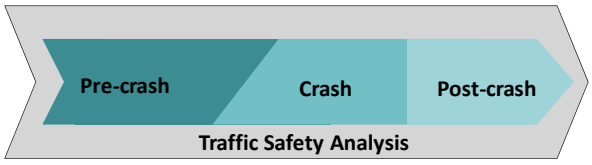
The executive board of SAFER consists of representatives from the large partners. Year 7 the board has consisted of 9 members: Jan Olsson, Autoliv; Hans Nyth, Volvo Cars; Karin Svensson, AB Volvo (Chair person); Jan Andersson, VTI Swedish National Road and Transport Research Institute; Claes Tingvall, Swedish Transport

Administration; Mikael Nybacka, KTH; and Anna Dubois, Per Lövsund and Jan Smith, Chalmers. Eric Wallgren, VINNOVA, is an adjunct member.
There have been seven board meetings during year 7, including one longer strategy meetings in November 2012.

Reference groups

The research at SAFER is conducted in four research programmes, each led by a reference group leader. Projects are initiated, discussed and recommended to the board by reference groups for each programme. These groups include representatives from all SAFER partners (that want to participate) and are the base for establishing world class competitive project portfolios. Each programme is host for a mix of projects: previously established by other parties, newly established and pre-studies for future projects.

The four research programmes are: *Pre-Crash* which handles projects on accident prevention (accident avoidance and crash mitigation), *Crash* handles projects concerning injury prevention, *Post-Crash* handles projects on mitigating consequences and *Traffic Safety Analysis* concerns projects aiming at understanding traffic and the causation and dynamics of accidents and injury occurrence.



Pic 1. The four research programmes

Leader of the **Pre-Crash** Reference Group is Dr. Yngve Håland, Adjunct Professor in Vehicle Safety at Chalmers, formerly Vice President Research at Autoliv Inc. and now Senior Advisor at the same company. The secretary is Ms Daniela Michael. Five meetings were held during year 7, with in average 12 partners participating at each meeting.

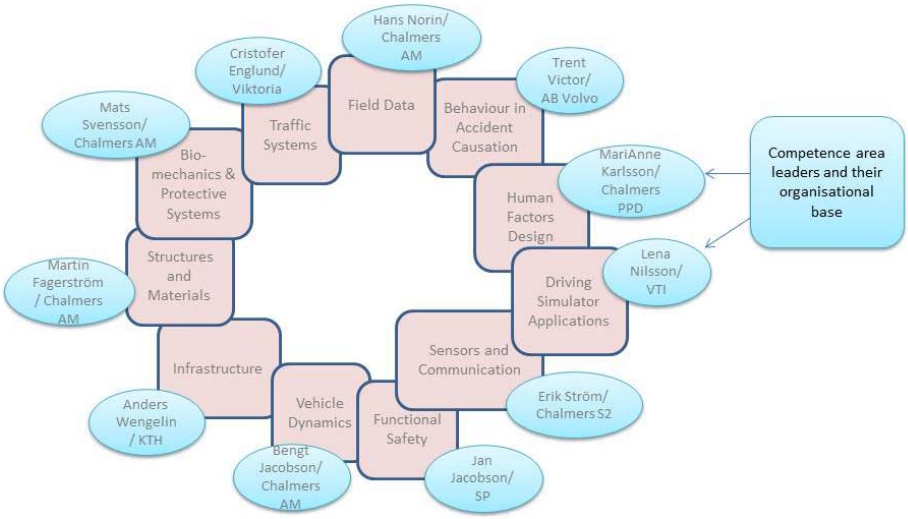
Leader of the **Crash** Reference Group is Dr. Lotta Jakobsson, Adjunct Professor in Vehicle Safety at Chalmers and senior technical leader at Volvo Car Corporation. The secretary is Dr. Stefan Thorn, AB Volvo. Six meetings were held, with in average 8 participants, ranging from 6 to 13. In total 13 partners are on the distributions list, whereof 12 attended meetings during year 7

Leader of the Reference Group **Post-Crash** is, Dr. Bengt Arne Sjöqvist, Professor of Practice in Healthcare Informatics at Chalmers. During the year 7, four reference group meetings were held. As an average 10 SAFER partners are active in the group at this stage.

The Traffic Safety Analysis Reference Group is led by Dr. Robert Thomson, Associate Professor in vehicle safety at Chalmers and researcher at VTI. The secretary is Ms Daniela Michael. Four meetings with 10-12 participants per meeting were held with and 6 to 8 unique SAFER organisations are active in the group.

Competence areas

The competence areas at SAFER are: Field Data, Behaviour in Accident Causation, Human Factors Design, Driving Simulator Applications, Sensors and Communication, Functional Safety, Vehicle Dynamics, Road Infrastructure, Structures and Materials, Biomechanics and Protective Systems, and Traffic Systems. The AstaZero research council is considered equivalent to a competence area.



Pic 2. The competence areas and their leaders

Each area is led by a competence area leader (CAL) who gathers key persons from SAFER partners with their main research interest in the competence area. It is the responsibility of each competence area to know state-of-the art of global research and what's perceived as world-class research. Each should have a short and a long-term plan for the development of their specific competence at SAFER.

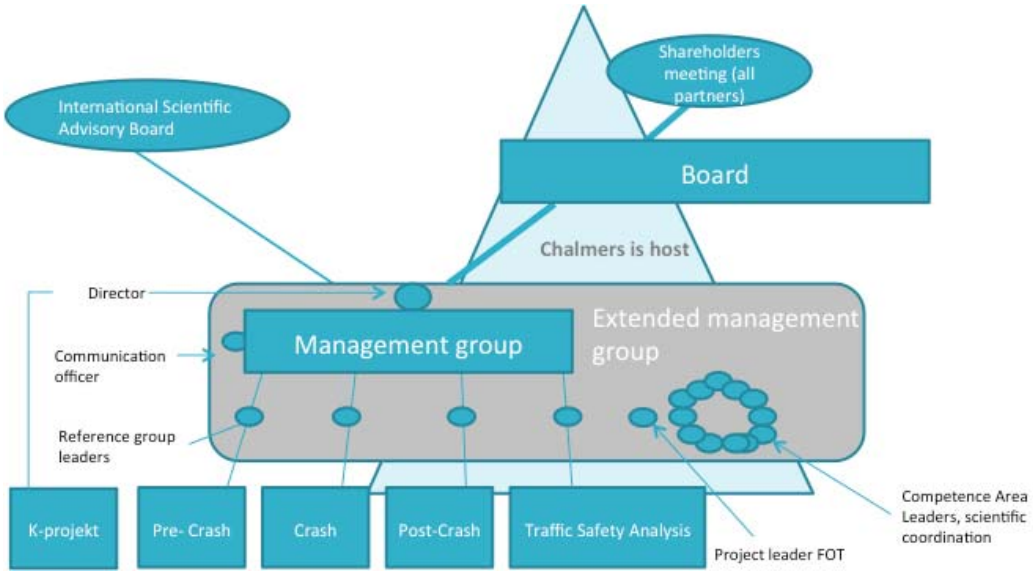
Centre Director and Management groups

SAFER has two management groups. The Operative Management Group which consists of the Director, the Reference Group leaders and the Communications officer, and the Extended Management Group, which besides the Operative Management Group also includes the Competence Area Leaders, the International

coordinator and “Large project” leaders. The Scientific Leadership for SAFER is distributed to the competence area leaders and reference group leaders.

Participants in the Operative Management Group are: Anna Nilsson-Ehle, director of SAFER; Yngve Håland, reference group leader Pre-Crash; Lotta Jakobsson, reference group leader Crash; Bengt Arne Sjöqvist, reference group leader Post-Crash; Robert Thomson, reference group leader Traffic Safety Analysis and Lisa Knutsson, Communications Officer.

Participants in the Extended Management Group are additionally: Cristofer Englund, Viktoria Institute; Martin Fagerström, Department of Applied Mechanics, Chalmers; Helena Gellerman, area manager Field Operational Test, SAFER; Jan Jacobson, SP; Bengt Jacobson, Department of Applied Mechanics, Chalmers; MariAnne Karlsson, Department of Product and Production Development, Chalmers; Lena Nilsson, VTI; Hans Norin, Department of Applied Mechanics, Chalmers; Erik Ström, Department of Signal and Systems, Chalmers; Mats Svensson, Department of Applied Mechanics, Chalmers; Trent Victor, Advanced Research and Technology, AB Volvo; Anders Wengelin, KTH; Christian Berger, Department of Computer Science and Engineering and AstaZero research council and Jac Wismans, guest researcher at Chalmers and SAFER.



Pic 3. The organisation of SAFER and relation to Chalmers

Chalmers is the host for SAFER and SAFER is the core of the research profile Traffic Safety within the Transport Area of Advance at Chalmers (Styrkeområde Transport).

International Scientific Advisory Board (ISAB)

The SAFER ISAB consists of three members. Present members are Dr. Joseph Kanianthra from USA, Dr. Kazuya Takeda from Japan and Dr. Anne Guillaume from

France. A first Scientific review meeting was held in February 2011. Based on written material, presentations and interviews the ISAB presented a report with findings and recommendations.

As SAFER was subject to two other international evaluations during 2011/2012 it has been decided to schedule the next Scientific review meeting in 2014.

3. WANTED POSITION RESULT YEAR 7, STATUS

1. Visible and measurable results in practice

SAFER was granted funding from VINNOVA to do a "Strategic Research and Innovation Agenda – SFIA" during year 7. The agenda should enhance SAFERs ability to innovate and promote innovation for traffic safety. The outcome of this work will be presented to VINNOVA in September 2013.

The project GCDC-SWE2012 was presented as demonstrations of cooperative vehicles driving in a platoon and making automated longitudinal and guided lateral movements. Two demonstrators were performed, in Björkvik September 6th and at Stora Holm November 22-23. The final demo in November was highlighted in the press.

SAFER Insight is the first comprehensive web-based portal in advanced traffic safety education on an international level, and it was launched on November 1. The purpose of SAFER Insight is to provide students and professionals with courses and seminars in vehicle and traffic safety.

Licentiate thesis and dissertations by SAFER PhD students are presented in Enclosure 2.

2. Hub for Swedish traffic safety research

SAFER is responsible for the SEVS 2 project which aims at exploring the driving forces for future transport solutions and the research and innovation needs that emerge depending on different scenarios of the future. This project combines Green, Safe and Affordability. It is a broad open innovation project with a multitude of research disciplines and contributes to SAFER's competence development as well as ability to run complex, collaborative projects.

A long-term cooperation strategy between VTI/ViP-Chalmers/SAFER in the field of driving simulation is under development.

The proving ground AstaZero focuses explicitly on active safety systems for rural and urban environments. Furthermore, exclusive and unrestricted access for researchers is a unique and beneficial opportunity for researchers in the domain for traffic safety.

The competence area Structures & Materials has organised (together with the competence centre LIGHTer) open seminar and workshops with focus on crashworthiness of joints (60 participants) where future research needs were identified

For High Capacity Transports (HCT) the need of a safety research programme has been identified. A programme manager has been appointed, Jesper Sandin VTI, one project is started and several projects are in preparation. Work encompasses accident statistics, vehicle dynamics for long vehicle combinations, traffic flow etc.

A number of initiatives to establish a relevant Post- Crash project portfolio and multidisciplinary team have been taken this year. This includes workshops, personal contacts, internal and external networking, project initiatives, research area marketing etc. In addition the post-crash reference group leader has initiated the formation of a new potential competence area; Human Monitoring, encompassing pre-crash as well as post-crash related aspects. To summarize; a reasonably solid platform for years to come has been put in place during year 7.

3. Acknowledged as a world leader in traffic safety research

The Field data analysis platform (C23) project has initiated a successful networking activity, connecting data analysts from different SAFER partners to discuss specific statistical issues. The associated project INTACT II has completed its first year of data collection. SAFER Glances (C27), the analysis project within the second Strategic Highway Research Program (SHRP 2) in the US, has progressed from the feasibility study phase to a full research project. The SAFER research team is one of three teams granted funding for a full project and the only non-US contractor. BikeSING (C30), a project on bike safety, has been granted with the objective to combine different information sources to understand single bicycle accidents.

The ASSESS project (A11) was completed and provided initial insight to the combination of active and passive safety system evaluation. There are several major SAFER projects underway exploring the use of driving simulators and test infrastructures (Safety for an Aging Population A14, Quadra A15, SHADES A28, Driver response to transient disturbances A34) as well as associated projects (EFFESOS, Non-Hit Car and Truck, Adaption).
Major activities within the area of materials and structures have started. A PhD project (Crash Comp) with the aim to develop experimental

characterization methods of CRFP material properties in crash relevant load cases was started. Also a FFI project involving two PhD students on Composite crash behavior was granted. These PhD students together with a post doc in Computational Material Mechanics, hired during year 7, contribute in strengthening the activities within this area.

SAFER partners Chalmers and Autoliv, are active in an on-going EU project (MATISSE – associated project) on crashworthiness of adaptive structures and storage tanks made of fibre reinforced composites. Chalmers is active within on-going EU project (SafeEV– associated project) focusing on pedestrian protection related to new electric vehicles. During the year, two more EU projects within the cluster of SEAM (SafeEV, ENLIGHT, ALIVE and MATISSE) involving several SAFER partners (above mentioned as well as Volvo and Swerea Sicomp) was started. Although covering a broader aspect of light weight materials, parts of the projects will contribute to SAFER activities in the area of crash performance of lightweight materials and new structures.
A close link between relevant activities in LIGHTer and SAFER was established. During year 7 a pre-study on Computational methods for glass involving six partners was successfully performed and a continuation project together with German researchers is starting.

SAFER has been active in EU project ELVA aiming at exploiting new freedoms in design for fully electric urban vehicles (not primarily safety, but safety is of course one part). Within the ELVA project, three electrical vehicle concepts have been developed. The project was successfully completed in the beginning of 2013.

The SEVS2 project, with the aim to explore the impact on new vehicles due to different future scenarios, has established a Driving Force model and is now analysing the consequences of different use cases applied in scenarios shaped by the driving forces. The project is attracting many different competences and has arranged several seminars and workshops.

During year 7, at least eight PhD students (Chalmers and KTH) together with several senior researchers (academic and industrial), including a newly recruited Post-doc in child occupant modeling, were active in the area of human body modeling (HBM), including both vehicle occupants and pedestrians as well as low-g and high-g (crash) situations. Important activities were made in the Active-HBM project establishing state-of-the-art validation data and parameter study for adult kinematics during braking. Similar activities were also made for child occupants when braking. The data will be used for improving models for low-g situations, both for adults and children. Some of the other HBM modeling projects continued into new projects and some were finalized. Unfortunately an EU application to further strengthen the area and to strengthen our network was rejected

Within the area of pedestrian biomechanics, important contacts were taken with IFFSTAR in France for producing validation data for HBM model validation. A new SAFER project was granted to facilitate this.

The EU project on whiplash injuries (ADSEAT) was finalized at the end of year 7. During this project's last year a SAFER PhD was produced together with several important project results and publications. The project results were acknowledged in several media, including a trip for the female prototype crash test dummy together with our new PhD, with airplane to TV4 morning show in Stockholm. SAFER activities will continue.

Within the area of child safety a PhD and a Lic exam was taken during year 7. The EU project CASPER was finalized and the SAFER project "Rear seat safety" was granted funding from FFI for a continuation of additionally three years. Important research and several papers were published during year 7, including studies in crash performance, modeling activities and children's behavior during riding in cars. Also a summary of all child occupant fatalities in cars in Sweden was made.

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

SAFER decided to engage as a core team member in the EU project – Priorities for Road Safety – PROS. This project aims at giving the EU-commission an overall view of prioritized research needs in Europe and to update it annually. SAFER has been responsible for WP 1 which covers future trends, strategic agendas and road maps in Europe.

The competence area Structures and Materials has established new contacts with Fraunhofer EMI to address research challenges with modelling of laminated safety glass and adhesives in crash events. The competence area has also formed a German-Swedish bilateral project consortium. Several German industry partners are interested (including OEMs).

SAFER is engaged on behalf of Chalmers in SAGE – Safe and Green Vehicles – which is a project aimed to build a pan-European cluster in this subject. VGR is the coordinator and other partners are clusters from Italy, France, Poland, and Germany. SAFER's MoU- collaborator in France, MOVEO, is a strong and active partner. SAFER has also introduced other MoU-partners to the project such as Nagoya University in Japan.

A MoU was signed in July 2012 regarding research collaboration between GREEMO (Green Mobility Centre) at Nagoya University and SAFER and Chalmers.

SAFER completed a project on Global links 2 and Benchmarking, funded by VINNOVA. This was a result of the international evaluation of SAFER in 2011 where an international benchmark was suggested by the evaluators. This study concluded that the complexity of SAFER in three dimensions – scope, number of partners and engaged academies – was unique and of great value for further development.

19 safety research organizations in Asia, US and Europe, including Sweden, were selected and visited in order to assess if cooperation could contribute to enhancement of SAFER´s competitiveness and attractiveness. 5 leading organizations were identified and studied in order to define success factors for a collaborative research environment and to draw conclusions for SAFER´s further development.

SAFER's director is the Chalmers representative and project leader with the task, together with people at Volvo and Volvo Cars, to establish a research centre for traffic safety in China in collaboration with to Chinese partners, RIOH and Tongji University. This is a China-Sweden collaboration sprung from a MoU between the countries and a Framework Agreement was signed December 2012. SAFER is the Swedish platform for collaboration between the Swedish partners in the Centre.

The SAFER Scientific Advisory Group on the Malaysian project iSTREC (Innovative Solutions to Reduce Crashes between Trucks and Motorcycles) – simulation competence of particular interest.

During year 7, SAFER joined up with Children's Hospital of Philadelphia (CHOP) in a research project resulting in a joint-association with CHOP.

The High Capacity Transport (HCT) programme was initiated in year 7. This collaboration between SAFER and CLOSER contains analysis of larger vehicles in traffic and will provide opportunities for future projects.

5. A balanced project portfolio and a long term financing of the core operations

The Board has initiated the work to address the issue of long-term financing. A strategic working group within the board was formed in November, consisting of Karin Svensson, Chairperson and AB Volvo, Anna Dubois, Chalmers, Jan Andersson, VTI and Anna Nilsson-Ehle, director.
The use of SAFERs own resources during Stage 1 & 2 have been analyzed and four different scenarios for SAFERs future have been described and discussed by the full board. Based on this the scenario where SAFER continuous to grow and to have some seed money for exploring, applications and special activities

will be further elaborated to serve as a basis for the boards next strategy meeting in 2013.

Recently a FP7 funded project iGAME (interoperable Grand Cooperative Driving Challenge AutoMated Event) was granted and the project will run over three years. The project will end in 2016 and the result will be demonstrated as a competition within automated cooperative driving. The project will provide a base financing for research within cooperative systems, specifically rules and scenarios for the competition will be developed, cooperative communication messages and interaction protocols along with a software service for communication testing will be developed by the SAFER representatives.

4. RESEARCH PROGRAMME

The research projects are addressed to one of four project portfolios that together make up the research programme. The projects build the road maps for the six Focus Topics. Some projects fit into several Focus Topics.

Projects present at SAFER can be initiated at SAFER **or** be started by SAFER partners in another context and wish to be associated to the SAFER environment. SAFER initiated projects can be financed in several ways, by national/international funders or by SAFER and SAFER partners. Often there is a mixed financing, where SAFER finances a pre-study which evolves to a pre-project, partly SAFER financed, and eventually a full project with external financing.

SAFER keeps track of all projects and their progress and turn-over but takes the full project responsibility for projects with SAFER financing and for projects where SAFER is project manager towards an external funder. This is the case for instance when SAFER acts as Joint Research Unit (JRU) in EU programmes but also in several national projects. Projects, for which SAFER takes full responsibility, are named “own” while all other projects are named “associated”. A list of all projects, own and associated, are continuously up-dated and presented to the SAFER board at each meeting.
A total of 67 projects and pre-studies are ongoing, out of which 35 are “own” projects and 32 are “associated”. See Enclosure 4.

5. FOCUS TOPICS – SCOPE, OBJECTIVES AND ACTION PLAN

Vehicles in this document are defined as vehicles with two or more wheels such as bikes, mopeds, cars, trucks and buses with a driver for transport of people and goods on roads.

Incidents and Accidents – Priorities and effect analysis

Scope: The Focus Topic "Incidents and accidents – priorities and effect analysis" covers development of methods for collection, storage and analysis of field data) to provide a holistic understanding of the causations and effects of road incidents and accidents. This Focus Topic is primarily connected to research in the Traffic Safety Analysis reference group and the Post-Crash group, but has applications in all of SAFERs research areas.
The most important competence areas to develop this focus topic are Field Data, BIAC, Biomechanics & Protective Systems, and Driver Simulator Applications. The new potential competence area Human Monitoring will also be relevant for this focus topic.

Objectives: To be at the forefront of research on the occurrence and causing factors of incidents and accidents. To be knowledgeable in methodology for effect analysis

Within the post-crash area, and the overall goal of saving lives and minimizing injuries, the objective is to be in the forefront of research/action research related to handling and treatment of victims, safe and secure extrication, and secondary effects of a traffic accident with potential to effect life or injury.

Priorities: Further foster and develop the established core competence in accidentology. Enhance the international position of SAFER as a premier centre for collection, processing, and analysis of driving studies. Naturalistic data for vulnerable road users is a spin-off activity to be further promoted. Within post-crash the priorities are to initially establish a stable and sustainable multidisciplinary team of researchers and dedicated individuals from all relevant stakeholders. Then, with this team as base, initiate projects aiming at relevant challenges related to the post-crash scenario.

GAP analysis: There is a need to increase competence in the area of processing video data. Research projects to increase experience with analysis of the data is a weak area for certain activities. There is a significant need to increase projects analyzing data for the new databases such as from INTACT, bicycle NDS, etc Post-crash: Establish a relevant project portfolio and the multidisciplinary team.

Action plan (yearly updated): Extension of NDS research to bicycling is developing and should be encouraged to expand. Analysing Naturalistic Driving Data, which today

has been built up within SAFER, will be consolidated and further developed. At the end of Stage 3, a long-term building of a database for in-depth studies of accidents has been established and researchers with high skills in accident data analysis are participating in the continuous project activities. Since post-crash so far cannot rely on a long research tradition it is important to initially establish a relevant project portfolio and establish the multidisciplinary team. This work has been initiated during 2012 (SAFER year 7) and will continue.

Results year 7:
see status Wanted Position

Driver State/Action/Reaction

Scope: The Focus Topic "Driver state/action/reaction" covers how we actually behave in traffic, not just how we are supposed to behave. All vehicle drivers (of cars, trucks, buses, mopeds, bikes etc) are included. It covers, for instance, driver inattention and distraction, permanent and temporary states of the driver (such as fitness for driving - impaired drivers), why and how we take risks and what we do to compensate for risks. It also covers the driver´s interaction, HMI, 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 and lane keeping assist. A new area is automatic vehicle driving (automated vehicles). A possible paradigm shift in driving responsibility from the driver to something else will raise a lot of questions.

Special attention must be given to the now largest group of severely and fatally injured road vehicle users, namely bicyclists. Use of electric bikes will mean new challenges to traffic safety because of higher speeds, but will also mean new possibilities with the access to electric energy which can be used for various safety measures such as sensing systems controlling actuation of emergency braking.

Already today combinations of some active safety support systems (e.g. lane keeping assist and adaptive cruise control) can permit semi-automatic driving. How this will impact driving behavior and driver´s attention must be investigated. Besides positive effects there may also be negative effects. The next step, automatic driving (automated vehicles) will be a real challenge. New automated driving and safety functions must be carefully evaluated, not least from the driver´s point of view.

The competence areas most relevant for the development of the focus area “Driver State/Action/Reaction” are Behaviour in Accident Causation , Human Factors Design , Field Data , and Driving Simulator Applications . The new potential competence area Human Monitoring will also be relevant for this focus area.

Objectives: Establish a multi-disciplinary human factor research platform with the main objective to understand various driving behaviour and from that knowledge define, develop and evaluate what is needed for safe driving (including automatic

driving of cars and trucks) of a road vehicle (from bikes to trucks). Build the foundation for strong collaboration between partners in SAFER and international researchers to perform groundbreaking behavioral, research.

Priorities: Monitoring of the vehicle´s driver and of the surrounding of the vehicle are prerequisites for understanding various drivers´ behaviors and what countermeasures are needed. To keep the driver´s attention to the very driving is fundamental for safe driving. Automated vehicles will add a new dimension. Is it really possible to leave the driving responsibility to the "vehicle"? Strengthening of the leadership and the resources of the competence area Behaviour in Accident Causation is urgent in order to meet the objectives for this important focus area. There is also a need to strengthen the competence area Human Factors Design.

Action plan (yearly updated): By analyzing Field data, performing simulator studies (e.g. in SIM 4), and testing with cars in active safety test areas (like ASTA) build up a deep know-how about the consequences of drivers not having their "eyes on the road" during various long-term intervals in different traffic environments and for various reasons (communication, manual-visual interaction with in-car information systems, use of nomadic devices etc.).
By the end of Stage 3 there should be an understanding of good design principles for driver-to-vehicle HMI for various information, communication, and ADAS functions to minimize driver distraction and inattention. Auditory-vocal communication between driver and vehicle has been evaluated as a tool to meet the requirements for acceptable levels of driver distraction (e.g. as specified in NHTSA Driver Distraction Guidelines of February 2012).
By the end of Stage 3 there should also have been evaluated how automatic interventions of brakes and steering of a vehicle must be done to be accepted by the driver and to not result in any consequences, which could be negative compared to not intervening automatically. This includes how drivers react to ADAS functions in semi-automatic driving (e.g. lane keeping assist and adaptive cruise control) and if there are any negative consequences.
During stage 3 a Swedish competence platform for "Boundary conditions for vehicle driving automation" has successively been built up encompassing the HMI and behavioural aspects as acceptance and adoption.

By the end of Stage 3 naturalistic studies of bicyclists have led to an understanding of typical risky behaviors, and some countermeasures (e.g. sensor based control of emergency braking of electric-bikes) have been evaluated for effectiveness as well as bicyclist acceptance.

Results year 7:
See status Wanted Position

Prediction for accident prevention

Scope: The Focus Topic "Prediction for Accident Prevention" covers how different systems can predict a potential crash, and gives input to the control of the vehicle to avoid it. Technologies concerned are, for instance, real-time wireless communication (V2V , V2I and others X2Y e.g. vehicle-to-bicyclist), sensing of own vehicle's motion and behavior, driver status, sensing of the surrounding traffic, signal/image processing and algorithms, functional safety, vehicle dynamics control systems, and the vehicle dynamics during automatic intervention of a crash avoidance system. The requirements on sensing, communication and actuating systems will get another difficult dimension by introduction of various automatic vehicle driving systems (automated vehicles). Not least the driver´s situation and responsibility must be carefully evaluated.

The competence areas most relevant for the development of the focus topic “Prediction for Accident Prevention” are Sensors and Communication, Functional Safety, Vehicle Dynamics, Road infrastructure, and Traffic Systems.

Objectives: Support cutting-edge fundamental research on enabling technologies within sensor, computers and communications engineering. Create a research platform combining multi-disciplinary expertise from fundamental and applied areas. (Ref. is given to the CoAct platform for cooperative autonomous vehicle trains and the Competence Area Traffic Systems.) Build strong research in robust vehicle dynamics including (semi) automatic accident avoidance and aerodynamic effects. Develop leading edge competence in sensor fusion and vehicle communication for accident avoidance technologies. Build up a Swedish competence platform for ”Boundary conditions for vehicle driving automation”.

Action plan (yearly updated): At the end of Stage 3 research vehicles will be able to avoid, or mitigate, collisions in a number of frequent accident scenarios based upon sensed information (from vehicle based sensors) about the surrounding traffic. This latter means other vehicles as well as vulnerable road users (VRU). Collisions avoidance will be achieved not only by automatic (emergency) braking but also by steering with advanced and robust vehicle dynamics
At the end of Stage 3 there will also be research vehicles equipped with low latency (in real time) V2V communication systems that are being used for evaluations in active safety test areas (such as ASTA) as well as in real traffic. Each vehicle broadcasts continuously to other vehicles its own position (GPS based) and speed, information each other vehicle can continuously use for estimation of risk of collision. The research vehicles are used for the development of reliable V2V communication principles in different traffic environments. One specific application is the further developed competence platform with vehicles capable for cooperative autonomous driving in vehicle (car and truck) trains.
During stage 3 a Swedish competence platform for ”Boundary conditions for vehicle driving automation” has successively been built up encompassing all technical aspects but also legal and policy issues.

Results year 7:
See status Wanted Position

Methods for evaluation of vehicle and traffic safety

Scope: The Focus Topic "Methods for evaluation of vehicle and traffic safety" covers the assessment of the safety performance of different components of the transportation system. The main targets of these evaluations include drivers, infrastructures, vehicles, nomadic devices and safety systems (incl. sensing and communication systems) and the evaluation contexts include simulators, test areas, and real traffic environments.
The competence areas most relevant for the development of the focus topic Methods for evaluation of Vehicle and traffic safety are Field Data, Driving simulator applications, Human factors design, Sensors and Communication, Biomechanics and protective systems, Vehicle Dynamics , Road infrastructure , and Traffic Systems and also other platforms such as ASTAZero and TSS**.** The new potential competence area Human Monitoring will also be relevant for this focus area.

Objectives: Actively contribute to the development of new infrastructure and analysis methods needed for the evaluation of future safety systems.
Priorities: Develop evaluation methodologies of drivers, vehicles, nomadic devices and safety systems in simulators, test areas, and in real traffic environments that reflect various relevant real traffic scenarios. Also, to develop assessment methods to evaluate the safety performance of key systems for road safety such as road marking, roadside equipment, and sensing and communication systems. These methods can include new statistical analyses of databases for benefit analyses, development of scenarios for evaluating safety countermeasures in full scale or simulated traffic environments, development of new test or simulation infrastructure, transfer functions to interpret results from one evaluation environment to another, etc. Historical Swedish experience in passive safety is to be strengthened in new projects and new capabilities and expertise in active safety system evaluation is to be promoted with this Focus Topic.

Gap analysis: The integration of data coming from driving simulators, field data, and test sites needs to be further explored in analysis projects. Development of test scenarios for repeatable and relevant evaluation of different countermeasure investigations also needs to be pursued, particularly for physical testing with a driver in the loop. Simulation tools for materials like glass, plastics, and composites are needed to address the needs for lighter vehicles. Statistical methods for evaluating the different types of driver responses are needed including methods to connect accident analysis (i.e. DREAM) to driver monitoring data.

Action plan (yearly updated): By the end of Stage 3, NDS data has been analyzed using new automated video and statistical analysis procedures to identify a number of (dangerous) driving behaviour. These situations can be seen (repeated) in driving simulators (as SIM4), as well as in driving experiments in active safety test areas (as

ASTAZero). Research has then found what the prerequisites are for these driving behaviour and potential countermeasures. These findings will increase the value of future use of simulators and active safety test areas in the study of driving behaviour and the development and evaluation of countermeasures. Due to the high testing requirements for active safety systems, new methods to streamline the verification process are needed. This includes the design of a test programme as well as the automation of the testing procedures in both physical and computer generated environments.

Results year 7:
See status Wanted Position

Safety for novel vehicles and vehicle combinations

Scope: This Focus Topic covers safety challenges and opportunities due to new vehicle designs. It includes vehicle dynamics, structural requirements (design guidelines) regarding crashworthiness (self and opponent protection) for new lightweight designs, including protection of batteries / capacitors, development of design and assessment tools (mathematical models and virtual testing) and system design optimization for novel vehicles. Also, the areas of fire and electrical safety (incl. post-crash) are included. These may also be of relevance within the post-crash area of research since they may affect both potential victims and rescue personnel. SAFER has the ambition to be a major actor identifying safety aspects of future vehicles strategies, mainly by understanding consequences of future transportation scenarios.

The competence areas most relevant for the development of the Focus Topic are Field Data, Human factors design, Structure and Materials, Biomechanics and Protective systems, Vehicle Dynamics, and Traffic Systems

Objective: To create strategies and develop edge competence for increased crashworthiness and safe vehicle dynamics by advanced structures and novel propulsion and drivelines beyond 2030.
Priorities: Participate in strong multi-disciplinary collaborative research projects with national and European partners. Create a critical mass of researchers and PhD students in the competence areas crucial for safe novel electric vehicles in order to establish a leading research hub.

Gap analysis: More can be made within several areas. Some areas such as fire and electrical safety are not addressed yet. Also, any activities within safety for novel propulsion and drivelines should be included within the SAFER portfolio.

Action plan (yearly updated): Specific goals for 2016 will be exemplified by performing 3 full size research projects within CAE modeling of lightweight material (incl polymer composites) and other essential structures (e.g. glass). Demonstrations will be made by prototypes of models and implementation strategies for industry combining competences in biomechanics and structure engineering. Based on

opportunities in smart materials and structures new strategies have been implemented for increased safety for occupant and VRUs. A research project is being performed during Stage 3 concerning the balance between active and passive safety measures for future small (and light) vehicles for mainly urban traffic. There will also be a much better knowledge of battery safety (crash safety as well as measures to prevent thermal run away in a battery cell with high risk of fire).
Within the area of vehicle dynamics vehicle motion in ground plane and how vehicles are actually driven in safety-critical, traffic situations are in focus. One challenge is vehicle dynamics of small novel electric vehicles (two- three- or four wheels driven). Another, quite different challenge, is vehicle dynamics of new heavy vehicle combinations driven on several axles.

Results year 7:
See status Wanted Position

Human body models and Biomechanics

Scope: The Focus Topic Human body models and Biomechanics covers mechanical and mathematical occupant and vulnerable road user models, biomechanical injury mechanisms, responses and consequences as well as the protection principles including safety system usage
The competence areas most relevant for the development of the focus topic are Field Data, Human Factors Design, Structure and Materials, Biomechanics and Protective Systems and to some extent Driving Simulator Applications.

Objective: Within the area of human modelling the objective is to build edge competence valuable to SAFER's partners by creating a strong network and a critical mass of researchers and PhD students.
Within the area of Biomechanics, the overall aim is to guard and develop the world class reputation of SAFER researchers in the area of applied biomechanics and injury prevention.

Priorities: Extra high ambitions are stated within the area of whiplash research and child safety, by joining efforts to maintain one of the main centres of excellence, contributing to external activities and setting the agenda. Also, within thorax, shoulder and brain biomechanics the objective is to be an active part within a wider research community, developing a niche of fundamental research. A special focus is also taken with respect to differences in individuals, such as gender, age and body constitution differences. Within the area of pedestrian safety, the objective is to combine knowledge of human modelling, biomechanics, field data analysis, aiming at real world pedestrian safety knowledge.

Gap analysis: Fundamental biomechanics research is essential for reaching a high level of applied research. There is a lack of funding alternatives for the fundamental biomechanics research, since the involvement of industry is a problem. The

participation of medical expertise within the project could be improved, i.e. increase the involvement of SU and similar partners.

Action plan (yearly updated): We will continue building leading edge competence and tools valuable to SAFER's partners, focusing on fundamental research and applied aspects with complex kinematics and various human properties. We expect a human body model to work in low-g and high-g situations, helping to predict injury in complex situations, also including longitudinal and lateral pre-crash kinematics.
We also expect increased international network in human body model development as well as strengthened acknowledgement within identified SAFER core biomechanics competence areas, focusing on selected topics and basing the research on real world safety needs for the context concerned.

Results year 7:

See status Wanted Position

6. THE RESEARCH ENVIRONMENT, OPEN INNOVATION AND INTERNATIONAL COOPERATION

The research environment

SAFER is a meeting place with a physical work area of 1500 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, Closer, Open Arena Lindholmen, Visual arena and Test Site Sweden (TSS).
The space is a mix of workplaces (approx. 100), small meeting/dialogue rooms, conference rooms and project areas. 45 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 informal lunch seminars. This makes SAFER a multidisciplinary and diverse meeting place.

SAFER people

Each person belonging to SAFER is employed by a partner. People who need access to SAFER environment on a more regular basis may get a key to the facilities. Presently SAFER has 275 “key people”. Of this 43% are employed at Chalmers, and 57% are from other partners. Of these “key-people” 17 are academic PhD students and 16 are industrial PhD students thus making the PhD students 12 percent of the total staff. One third of the key people are women. The number of master students is currently 18.

Open innovation

SAFER is studied by a research project “Management of Open Innovation”. This project has run from 2008 – 2012 and is conducted by three senior researchers at Chalmers and one full time PhD student. The dissertation will be in June 2013.

A general finding is that all interviewed partners value the partnership and SAFER as such, but want to more actively utilize SAFER's full potential. SAFER is said to give an increased credibility for the partner through its affiliation. Although several of the partners meet in other constellations, 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 “near zero” fatalities and serious injuries. Furthermore, many partners appreciate the possibility to influence the perspectives on future transport systems and also find it politically important to be able to influence and have insight into the “safety agenda”.

Internationalisation

SAFER has a strategy for creating global links, including an action plan for the first phase of the execution of the strategy.

The aim of the strategy is to create strong links to world class research environments, an inflow of international researchers and a high rate of exchange of young researchers. It also aims at achieving a reputation as a highly innovative melting pot where collaboration between industry and academy is outstanding. This will also make it possible to influence the international research agenda.

SAFER is involved in the SAGE (Safe and Green Vehicles) project which consists of a consortium of five regional clusters in Europe. Within SAGE, four Asian regions (Nagoya, Beijing, Shanghai and Daejeon) have been selected for their relevance for research and innovation in the automotive area but also for their established links with European partners in the SAGE consortium. One objective of SAGE is to develop collaboration between regions and for each of these clusters an international collaboration strategy will be developed. SAFER is leading this work for the Nagoya region.

A Memorandum of Understanding (MoU) was signed during 2012 with the Green Mobility Collaborative Research Center of Nagoya University in Japan and discussions regarding collaborative projects are ongoing.

The international recognition of SAFER as a well-renowned player within vehicle and traffic safety has resulted in SAFER being asked to have an advisory role in a Malaysian project. The research project is financed by Agensi Inovasi Malaysia (AIM) and is conducted in Malaysia by partners from industry, academia and society. The SAFER engagement is funded by VINNOVA. Long-term collaboration beyond this

project is under discussion. VINNOVA is positive about the possibilities to strengthen the collaboration between Sweden and Malaysia within research and innovation and regards this project as an interesting pilot for collaboration driven by Swedish stakeholders in another country (so called stakeholder's driven internationalization).

SAFER continues to be an active member in EARPA, both in the Safety group and in the board via prof. Per Lövsund.

7. EDUCATION, COURSES, SEMINARS AND CONFERENCES

Chalmers Area of Advance

SAFER is part of the Chalmers Transport Area of Advance (AoA) and the director is part of the AoA Transport management team. The active research fields within the profile Traffic Safety are very close to the Focus Topics and the Chalmers researchers within traffic safety are encouraged to contribute to these fields. Presently some 58 senior researchers at Chalmers are active within Traffic Safety and get strategic research funding and all together more than 140 researchers and PhD students at least eight departments engage in traffic safety related research.

SAFER Insight

SAFER Insight is the first comprehensive web-based portal in advanced traffic safety education on an international level. The purpose of SAFER Insight is to provide students and professionals with courses and seminars in vehicle and traffic safety. During year 7, SAFER Insight has been developed and implemented and encompasses today nearly ten training providers and 30-45 courses.

The training providers are the SAFER partners which are providing courses or seminars. The extended management group at SAFER functions as a guarantee for quality of the courses.

Guest researchers

During SAFER year 7, SAFER has had several guest researchers and visitors 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.

Dr. Jac Wismans is continuously a part-time guest professor and active within biomechanics and novel vehicles. Professor Michael Regan from UNSW in Sydney,

Australia, is yet again highly involved in the Driver Distraction and Inattention Conference which will take place in September 2013.

Dr. Kristy Arbogast from Children's Hospital of Philadelphia (CHOP) has visited SAFER six times in total, one time during SAFER year 7, and had fruitful discussions within the child safety projects (B5, B20).

Professor Tim Gordon, University of Michigan, USA, is strongly connected to the vehicle dynamics competence area and visits SAFER regularly (May 2012 and March 2013). Dr. John Lee, University of Wisconsin-Madison, USA, has visited SAFER a couple of times during year 7. Professor Geetam Tiwari, TRIPP, Indian Institute of Technology Delhi, India was at Chalmers and SAFER in June 2012.

Professor Pongsathorn Raksincharoensak from Tokyo University of Agriculture and Technology (TUAT) visited SAFER in March 2013 in conjunction with discussions about the FAST-Zero conference. Professors Masahiro Abe and Kazuya Takeda from the Green Mobility Collaborative Research Center of Nagoya University (GREMO), visited SAFER in July 2012 for the signing ceremony of the MoU between SAFER and GREMO.

Seminars and conferences

Internal

Every second week during year 7, SAFER has arranged lunch seminars for internal cross-fertilization and exchange of knowledge and ideas. 19 seminars with 45 speakers have been conducted during year 7.

External

SAFER organises a vast amount of seminars and workshops. They are all appreciated as skills development and offer a great opportunity to network. SAFER is also active in dissemination activities in EU projects. When the EU project euroFOT had its final event in Brussels in June 2012, SAFER was a great player with exhibition and several speakers in the program.

A list of conducted seminars can be found in the Enclosure 1.