

# Annual Report to Shareholders

Operative Year # 5

April 1<sup>st</sup>, 2010 – March 31<sup>st</sup>, 2011

## ***Table of content***

<b>HIGHLIGHTS .....</b>	<b>3</b>
<b>1. LONG-TERM VISION, MISSION AND STRATEGY.....</b>	<b>4</b>
○ Vision .....	4
○ Mission .....	4
○ Strategy .....	4
○ Values .....	5
○ Financing .....	5
○ Project economy .....	6
<b>2. ORGANISATION AND MANAGEMENT OF THE CENTRE.....</b>	<b>7</b>
○ Partners and Shareholders meeting.....	7
○ Board.....	7
○ Reference groups.....	7
○ Competence areas.....	8
○ Centre Director and Management Group.....	8
○ International Scientific Advisory Board .....	9
<b>3. RESEARCH PROGRAMME.....</b>	<b>10</b>
○ 3.1 Focus Area Road Maps.....	10
○ 3.2 Pre-Crash Safety .....	10
○ 3.3 Crash Safety .....	14
○ 3.4 Post-Crash Safety .....	17
○ 3.5 Traffic safety analysis .....	18
<b>4. THE RESEARCH ENVIRONMENT, OPEN INNOVATION AND INTERNATIONAL CO-OPERATION.....</b>	<b>21</b>
○ The research environment .....	21
○ SAFER people .....	21
○ Open Innovation .....	21
○ Internationalisation .....	22
○ Vision Zero Academy.....	22
<b>5. EDUCATION, COURSES, SEMINARS and CONFERENCES.....</b>	<b>23</b>
○ Chalmers Area of Advance.....	23
○ Guest researchers.....	23
○ Seminars.....	24
<b>6. REPORTS.....</b>	<b>25</b>
○ Research reports: Dissertations and licentiate thesis' .....	25

Enslosure 1: Project overview

Enslosure 2: Short project descriptions

Enslosure 3: List of all publications

## HIGHLIGHTS FROM YEAR 5

- The project Safe, Efficient, Vehicle Solutions, SEVS 1, with a broad set of partners including SHC, explored future transport scenarios and research issues for vehicles beyond 2030.
- First step of results in the focus area active Human body model.
- Recruitment of PhD student to carry on the heritage of Chalmers child safety and to establish a more solid platform for Swedish child safety research.
- Chalmers-KTH and industry joint project in pedestrian safety.
- Collaborative project on field data collection INTACT finalized. EU project DaCoTA has chosen the INTACT methodology as the tool for European collection of data. Application has been submitted for national funding of continuous collection of data.
- Involvement in several projects and applications on FOT/Naturalistic Driving studies. Projects in the area of Driving studies (SeMiFOT 1 & 2, Dreami etc) are attracting great international interest.
- The US SHRP2 has granted SAFER researchers an analysis project – first ever in this area to be granted non-US researchers.
- First evaluation by SAFER International Scientific Advisory Board was done in February 2011. SAFER on right track, improvements suggested regarding clarity, scientific publications, structure.
- A database has been compiled with all SAFER publications and reports as a move to enhance knowledge dissemination.
- Project CoAct on competence for cooperative systems started. Chalmers, KTH and Halmstad Högskola each supplying one student team to the international competition on "Grand Cooperative Driving Challenge" i Holland in May 2011.
- SAFER is part of the Chalmers Transport Area of Advance. Some 40 senior researchers at Chalmers are engaged and receive strategic funding for safety research. 11 Postdoc positions were granted December 2010.
- Several new projects have been started in all four reference groups and the project portfolio is growing. In total 56 projects are on-going, of which 11 are funded by EU 7th FP. SAFER is participating as JRU SAFER in six EU projects.
- SAFER moved into a new office in August 2010 with higher functionality for open innovation and collaboration with the different activities in Lindholmen Science Park.
- In line with the strategy for international collaboration, MoUs have been signed with TRIPP in New Delhi, HTAS in NL and IFSTTAR in France.
- SAFER is active in EARPA with several collaborative ideas for next call in the EU 7th FP. Contributions have been made to the ERTRAC working group on the strategic research agenda and road maps for Road Safety towards 2030.
- "SAFER Insight" mapped needs for educational programs to enhance competence at all levels.
- 5 dissertations and 4 licentiate thesis have been completed.

## 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 areas.
- Inspire students, researchers and product developers to be devoted to the area of traffic safety.
- Disseminate results and knowledge to society.

### Strategy

To reach 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 Areas. The Focus Areas together form a framework for project content and for development of competences and collaborations.

Presently the six Focus Areas are:

- **Incidents and accidents – priorities and effect analysis**
- **Driver state/action/reaction**
- **Prediction for accident prevention**
- **Methods for evaluation of safety systems**
- **Safety for Novel Electric Vehicles and Vehicle Combinations**
- **Human 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 is supported by the SAFER environment where researchers and project members can meet and work side by side. This is to create an atmosphere of true collaborative research and an ongoing dialogue involving many different actors within the safety area.

## 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 2, running from April 1<sup>st</sup> 2009 to March 31<sup>st</sup> 2012, SAFER has a funding of a total of 92,255 MSEK. VINNOVA is providing cash 30 MSEK, Chalmers is responsible for 3 MSEK in cash and the remaining 59,255 MSEK is in-kind. All other partners’ undertakings are in-kind so far, although the agreement is prepared for annual cash contributions.

The follow-up of partner contributions is done through a so called “sign-off” procedure. SAFER is forecasting the total economy for Stage 1 and Stage 2 at each board meeting. It is important to follow the economy from the start of SAFER as projects run over several years and the resources are booked as soon as a decision is taken.

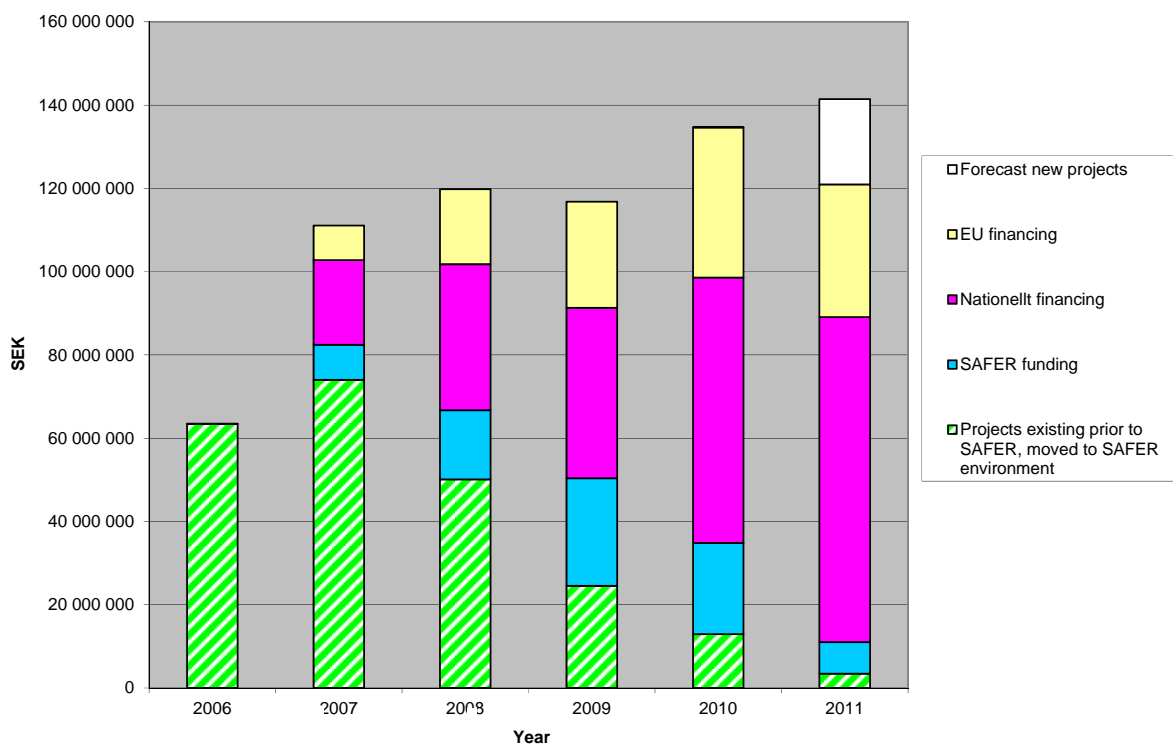
Chalmers Transport Area of Advance is granted Swedish national strategic research funding for Traffic Safety. The amount of this grant is well in the order of Chalmers in-kind undertaking in SAFER and these research grants plays an important role for the development towards a world class research centre.

As SAFER grows the common costs are also growing and are now close to 50% of the cash contribution. The ability to attract external funding for projects is increasingly important. The total yearly project portfolio is shown in picture 1.

## Project economy

SAFER “own” projects are controlled according to SAFER economy and project routines. Since the start of SAFER 92,5 MSEK of the resources have been allocated to projects, whereof 38,3 MSEK is cash and 54,2 MSEK is in-kind.

The total project turnover, including all projects, own and associated, in the SAFER environment is monitored year by year. The goal for SAFER is to reach an annual project portfolio turnover of 200 MSEK by year 2016. The result for 2010 is 132 MSEK.



*Pic.1. Total project portfolio, factual 2006 – 2010, forecast 2011  
(green=present before SAFER, blue= SAFER financed, Pink= national funding, Yellow= international funding, White= applications and forecast)*

The picture reflects the growths of the project portfolio, but also the effect of a change of national research programmes for automotive research taking place in 2008/2009. The new national programme (FFI) setup was also influenced by the ongoing recession, shifting focus towards more short-term applied research. SAFER chose to start some PhD projects with own funding to bridge this situation and proactively prepare for the coming research needs and funding programmes.

## 2. ORGANISATION AND MANAGEMENT OF THE CENTRE

### Partners and Shareholders meeting

All the partners from Stage 1 have continued with the renewed agreement for Stage

2. The partners are:

AB Volvo, Autoliv, Chalmers University of Technology, Epsilon, Folksam, Imego, Lindholmen Science Park, Region Västra Götaland, Saab Automobile, Saab Electronic Defence System, Scandinavian Automotive Suppliers, Scania, Swerea SICOMP, SP Technical Research Institute of Sweden, Swedish Transport Administration, Telia Sonera, University of Gothenburg, Viktoria Institute, VINNOVA, Volvo Car Corporation, VTI Swedish National Road and Transport Research Institute, and TÖI – the Norwegian Institute of Transport Economics. Two new partners are joining (Swerea IVF and City of Gothenburg, Traffic and Public Transport Authority). All partners hold a place in the Shareholders meeting.

### Board

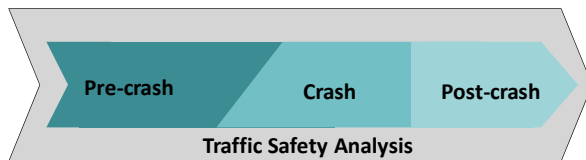
The executive board of SAFER consists of nine members: Jan Olsson, Autoliv (Chairman), Hans Nyth, Volvo Cars, Per Lenhoff, Saab Automobile, Karin Svensson, AB Volvo, Pontus Matstoms, VTI Swedish National Road and Transport Research Institute (vacant from October 2010), Claes Tingvall, Swedish Transport Administration and Anna Dubois, Per Lövsund and Jan Smith, Chalmers.

There have been eight board meetings during year 5, including a longer strategy meeting in September and a workshop in March.

### Reference groups

The research at SAFER is conducted in four research programmes, each led by a research coordinator. 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.

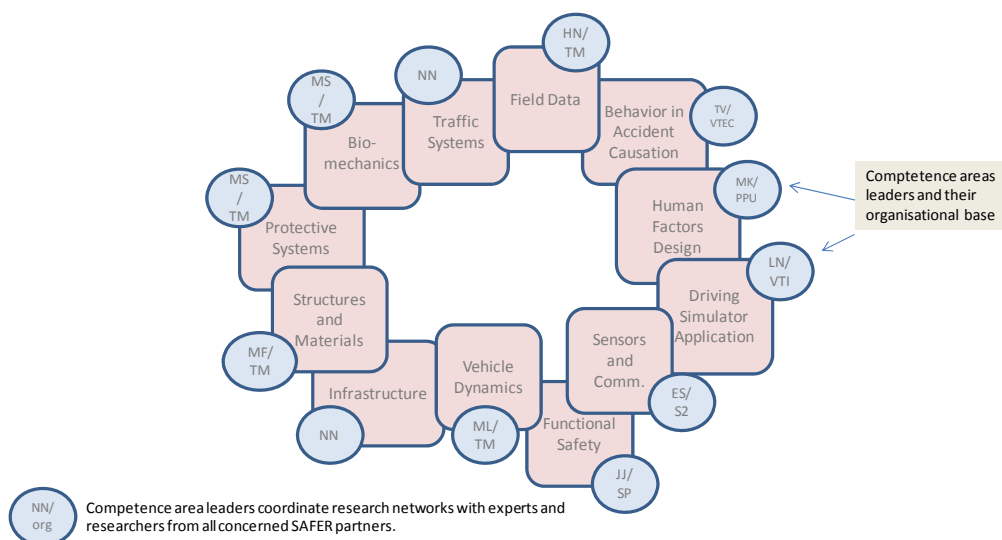


*Pic 2. The four research programmes*

## Competence areas

The competence areas have been strengthened during the last years. Twelve equal competence areas make up a suitable representation of traffic research. The competence areas shown in Picture 3 are: Field Data, Behaviour in Accident Causation, Human Factors Design, Driving Simulator Application, Sensors and Communication, Functional Safety, Vehicle Dynamics, Infrastructure, Structures and Materials, Protective Systems, Biomechanics, and Traffic Systems.

## Competence area management at SAFER



*Pic 3. The twelve competence areas and their leaders*

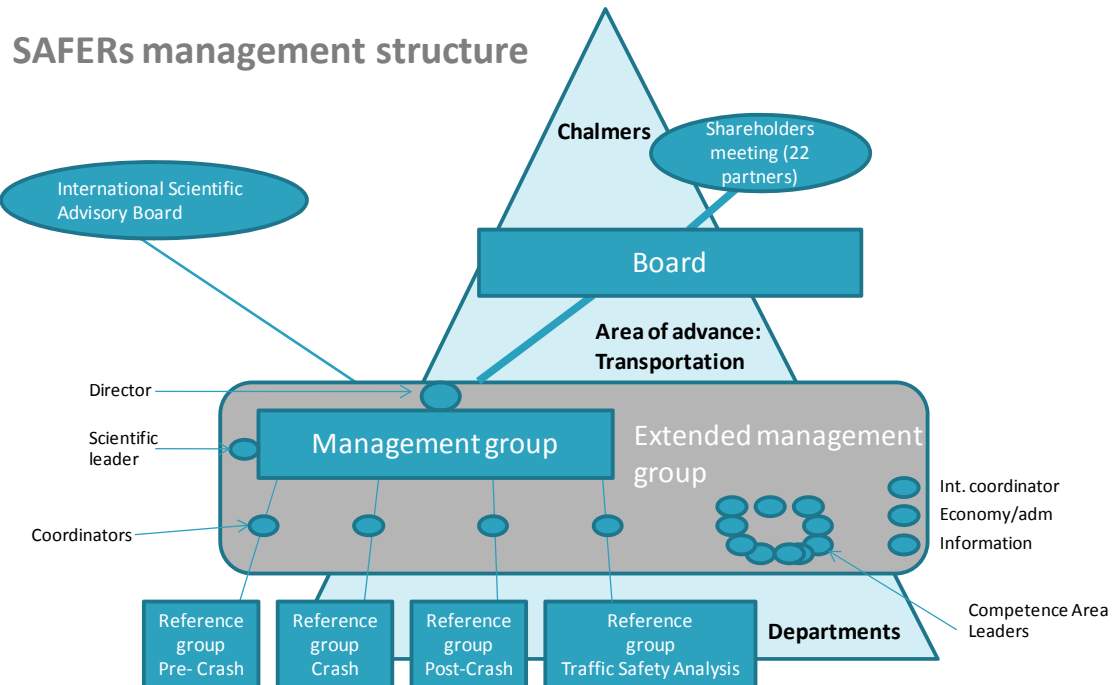
Each area is led by a competence area leader (CAL) who gathers key persons from SAFER partners with their main research interest in the competence area. It is the responsibility of each competence area to know state-of-the art of global research and what's perceived as world-class research. Each should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

## Centre Director and Management group

SAFER has two management groups. The operative which consists of the Director and the Research Coordinators and the Extended Management Group, which also includes



the Competence Area Leaders, the International coordinator, the Communication officer and the financial officer. “Large project” leaders are also invited. A scientific leader is to be responsible for the International Scientific Advisory Board. The position is presently vacant.



*Pic 4. 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 3 members. Present members are Dr Joseph Kaniyanthra from USA, Dr Kazuya Takeda from Japan and Dr Anne Guillaume from France. A first meeting was held in February 2011. Based on written material, presentations and interviews the ISAB presented a report with findings and recommendations. Action based on this report will be discussed in the board meeting in August. The general impression was that SAFER is on the right track, with the different partners well engaged, research programs with relevant topics, strong pre-competitive collaboration and stimulating work environment. However, there is room for improvement regarding internationalization, volume of scientific output, organisational clarity and efficiency, structure and availability of material and presentations and proactivity. Furthermore SAFER was encouraged to continue with the in-depth investigations and enhance field data analysis work.

### **3. RESEARCH PROGRAMME**

The research projects are placed in one of four project portfolios who together make up the research programme. The projects build the road maps for the six Focus Areas. Some projects fit into several Focus Areas and below are described how the project portfolios contribute to the goals for the Focus Areas.

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.

#### **3.1. Focus area road maps**

As mentioned above, the Focus areas are a guide for the research programmes to focus on the right projects. Thus, each focus area has a road map showing how present and planned projects contribute to the strategic development.

#### **3.2 Pre-Crash Safety**

Leader/coordinator of the Pre-Crash reference group is Dr. Yngve Håland, adjunct professor in Vehicle Safety at Chalmers University, formerly Vice President Research at Autoliv Inc. and now Senior Advisor at the same company. Secretary is Ms Daniela Michael. The Pre-Crash reference group meets 6 times per year with about 12 participants each time.

The main aim for pre-crash safety is to prevent accidents from happening. However, if an accident cannot be avoided, another aim for pre-crash safety is to mitigate the severity of the accident. Pre-crash safety covers traffic from normal driving, as well as driving with various risk situations, up to the point when an accident may happen.

Four of the Focus Areas are especially relevant for the Pre-Crash group. These Focus Areas are:

### ***Driver state/action/reaction***

Driver state/action/reaction content should cover permanent and temporary driver state (fitness for driving, risk taking, and risk compensation), reaction to and acceptance of warnings for pending dangerous situations, reaction to and acceptance of automatic interventions of safety systems, mathematical driver behavior models, and interaction with in-vehicle information systems and nomadic devices.

#### **Objective:**

Establish a multi-disciplinary human factor research platform building the foundation for strong collaboration between partners in SAFER and international researchers to perform ground-breaking behavioral research.

#### **Status and actions:**

- Collected data in various NDS projects are very important prerequisites for formulating new projects in the focus area "Driver state/action/reaction".
- The competence areas "Driving simulator application" has had several meetings during 2010, while the areas "Behaviour in accident causation" and "Human factors design" recently started to work.
- One project about elderly drivers is on-going and an international project has been formulated and partly funded.
- An international workshop is in planning on "Cognitive Neuroscience and Driver Attention". The central issue is "How can modern cognitive neuroscientific research on attention be applied to the problem of driver distraction and inattention?"
- SHADES project (about HMI and dependable systems) on how drivers react to technical errors (e.g. when an Adaptive Cruise Control accelerates above a set speed) is reaching interesting results.
- The QUADRA project will try to develop mathematical models of driver behaviours in a number of traffic scenarios.
- "Human monitoring" to measure how fit the driver is (driver state)
- In the EFESOS project the HMI design aims at presenting information during normal driving in new ways that enhance accidents avoidance.
- Future projects should cover driver risk taking, impaired drivers, reaction to and acceptance of warnings and/or automatic interventions, and how to counteract driver distraction and inattention due to interaction with in-vehicle information systems and nomadic devices.

### ***Prediction for accident prevention***

Prediction for accident prevention should cover real-time wireless communication (V2V and V2I), sensing with signal/image processing and algorithms, functional safety of sensing, communication, and vehicle dynamics control systems, and vehicle dynamics during automatic intervention of crash avoidance safety systems.

#### **Objectives:**

- Support high class fundamental research, on enabling technologies within sensor, computers and communication engineering.
- Create a Swedish research platform combining multi-disciplinary expertise from fundamental and applied areas, enabling development of technologies crucial to new safety systems

- Building competence in robust vehicle dynamics in connection with (semi-) automatic accident avoidance
- Develop edge-competence in sensor fusion and vehicle communication for accident avoidance technologies including location of sensors for optimum performance

**Status and actions:**

- The competence area "Functional safety" is established. The area "Sensors and communication" has recently started. "Vehicle dynamics" has formally not yet started, but there is an established group since a couple of years. Research needs have to be defined in all areas.
- Active safety system sensors are involved in several projects (like Scenario based testing, Systems for roadway departure/avoidance, Human monitoring, Grand cooperative driving challenge/CoAct, Enhanced/robust stability control).
- Project "Functional safety for system of road vehicles (A18)" has started.
- Project "PreEVAL" is the first SAFER-project to involve road infrastructure.
- Future project considered for "Sensing and vehicle dynamics" is an experimental vehicle platform with sensors for active safety and actuators for controlled vehicle dynamics.
- Possible cooperation with researchers at Stanford University regarding sensing based advanced controlled vehicle dynamics during automatic intervention of accident avoidance systems (brakes, steering, torque vectoring).
- Planned project on sensing based crash avoidance by braking and steering of heavy vehicles (vehicle combinations).

***Methods for evaluation of Vehicle and Traffic Safety***

Methods for evaluation of vehicle and traffic safety should cover methods to be used in active safety test areas (e.g. the planned Swedish ASTA), methods for driving simulators including human behavior simulation models, strategic pre-crash methods, methods for evaluation of various accident avoidance systems (vehicle as well as infra-structure based) in real traffic environments, and evaluation of in-vehicle information systems and nomadic devices.

**Objectives:**

- Actively contribute to the development of new test areas meeting the needs of evaluation of future safety systems
- Develop evaluation methodologies of drivers, vehicles, nomadic devices and safety systems (incl. sensing and communication systems) in simulators, test areas, and in real traffic environments that reflect various relevant real traffic scenarios

**Status and actions:**

- Actively involved in pre-studies and preparations for ASTA
- Collaboration with VIPS (Competence centre in simulator methodology, VTI)
- SAFER partners involved in projects on assessment of active safety systems (e.g. e-Value, Assess)

### ***Novel electric vehicles and vehicle combinations***

Safety for novel electric vehicles and vehicle combinations (as far as pre-crash safety is concerned) should cover vehicle dynamics, and assessment tools (virtual testing).

#### **Objectives:**

- Create strategies and develop edge competence for increased crashworthiness and safe vehicle dynamics by advanced structures and novel propulsion and drivelines beyond 2030
- Participate in strong multi-disciplinary collaborative research projects with SHC and European partners
- Create a critical mass of researchers and PhD students in the area of safe novel electric vehicles

#### **Status and actions:**

SEVS 1 project finalized in June 2010 and has successfully created a good collaboration platform within SAFER (and with SHC) and taken the first steps in the area of safety for novel electric vehicles.

Plans and ambitions are found in separate discussion regarding SEVS 2 (see also Crash).

### **Summary of Pre-Crash own and associated projects**

The largest running SAFER projects in the Pre-Crash safety area are for the time being: Systems for Roadway Departure Avoidance, Analysis and Verification of Active Safety Functions, System Safety through Combination of HMI and Dependable , Assessment of Integrated Vehicle Safety Systems for Improved Vehicle Safety (ASSESS, an EU FP7 project) Scenario-Based Testing of Pre-Crash Systems (finalized 2010), Safety for an Aging Population, Enhanced/Robust Stability Control, Quantitative Driver Behavior, Modeling for Active Safety Assessment – QUADRA, Physical Layer Techniques for Vehicle-to-Vehicle Communications ,and Principal Other Vehicle Warning - POVW . There are also a number of associated projects running: Algorithms and Software for Improved Safety – ASIS ,VISAS ,Interactive ,EFESOS and IBS-Truck .

PreACT and CoACT are two interesting projects concerning cooperative driving aiming at building a broad competence among the partners. CoACT includes participation by three student teams ( Chalmers, Höskolan I Halmstad and KTH) in the competition Grand Cooperative Driving Challenge in Holland mid May 2011. A number of pre-studies (less than 0.1 MSEK each) have also been approved.

### **Competence Areas relevant for Pre-Crash**

Six of the SAFER Competence Areas are relevant for Pre-Crash. These are Behavior in Accident Causation, Human Factors Design, Driving Simulator Applications, Sensors and Communication, Functional Safety, and Vehicle Dynamics. More information about the various areas can be found in chapter 3.6. The number of PhD students involved in the various projects is for the time being 21 in total.

### 3.3 Crash Safety

Leader/coordinator of the Crash Reference Group is Adj. Prof. Dr. Lotta Jakobsson, Volvo Car Corporation, and secretary Dr. Stefan Thorn. Thirteen partners are members of the reference group and six meetings were held during the year.

The crash reference group coordinates the crash project portfolio and drives the research within the crash area. Crash safety aims at protection of people in traffic by minimizing injury risks when a crash occurs. Situations include drivers and passengers of all sizes and ages in passenger cars and heavy vehicles (trucks and busses) as well as vulnerable road users such as pedestrian and occupants on two-wheelers.

Competence areas regularly reporting to the crash reference group are "Biomechanics", "Protection system" and "Structures and Materials". The focus areas mostly related to the crash reference group are "Human Models and Biomechanics" and "Novel Electric Vehicles and Vehicle Combinations", which will be described further down. All projects in the Crash portfolio, except one, are related to these two focus areas. The exception is the EU project FimCar aiming at developing a frontal impact test method, thus related to the focus area "Methods for evaluation of vehicle and traffic safety" where one of the objectives are to contribute to the development of strategic crash test methods.

#### ***Human Models and Biomechanics***

The focus area of Human Models and Biomechanics covers mechanical and mathematical occupant and pedestrian models, biomechanical responses and injury consequences as well as the protection principles including safety system usage.

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. Thanks to strategically investments with SAFER resources, SAFER now has a strong core group of activities in the area of human modelling involving researchers in more than 6 projects. The activities are a combination of projects funded by EU (THORAX), FFI (Biomechanics heavy vehicles) and SAFER (B5, B7, B8 and B9) involving both academic and industrial PhD students. Totally five PhD students have been active during the year together with nine senior researchers from Chalmers, Saab, Autoliv, Volvo Technology and Volvo Cars. Also, master thesis projects have been performed within the area. Beside the international cooperation within the EU project THORAX, international cooperation in the area mainly include a joint study at Delft Technical University by one of the PhD students, regularly contacts including two meetings/workshops with the researchers at Graz University and regularly contacts with researchers at University of Virginia.

Most of the PhD students use a common research tool; the adult THUMS human body model, investigating both the human properties in low-g (such as pre-crash braking) and high-g situations for occupants in passenger cars as well as heavy trucks. The plan is to further strengthen the area by additional PhD students and projects also including more research in the area of muscle modelling, child occupant modelling

and vulnerable road users, mainly pedestrians. The application "Human body model with Active Muscles and Detailed Head for Pedestrian Protection"(B13) was granted FFI funding late 2010 and one PhD student at Chalmers and one PhD student at KTH are hired to work in the project together with the four industrial partners. This project further strengthen SAFERs research within pedestrian safety and also tighten the collaboration with the researchers at KTH.

Within the project of "Rear seat occupants for small occupants" (B5) a human body child model is used by one of the Industrial PhD students and an academic PhD student was hired during 2010 who might include human body models as a complement to the child dummy models in her research. An application was submitted and is waiting for approval for the second step of "Car occupant low-g modelling" (a continuation of project B8) involving activities of 2 PhD students and 4 industrial partners. Also, applications have been submitted to research funds for fundamental research within muscle modelling.

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. Extra high ambitions are stated within the area of whiplash research and child safety. 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. The involvement in the EU projects THORAX and ADSEAT, the Human body modelling projects and the national brain project (B11) are examples of this, with the ambition to further strengthen these areas. Within the area of whiplash one PhD student and several SAFER senior researchers are active in the EU project ADSEAT (Adaptive Seat to Reduce Neck Injuries for Female and Male Occupants). One of the main results of the project is a FE model of a scaled down BioRID model. SAFER partners being the creator of the BioRID dummy during the 1990:ies, this project is a clear example of the continued leadership in the area. Based on a SAFER pre-study in 2008, preparation of a project within rear end impact test methodology is discussed for further strengthening the industrial partners' leadership in whiplash protection system development. Within the area of thorax and shoulder, the EU project THORAX and project B7, form the platform for this research and international cooperation.

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. The recently started project "Human body model with Active Muscles and Detailed Head for Pedestrian Protection"(B13) forms the platform for this research and cooperation.

Within the project of Rear seat safety for small occupants (B5), additional funding from FFI enabled the project to be expanded to an additional PhD student as a complement to the two industrial PhD students halfway through the project. This project is a good example of how joined efforts by four partners will help maintain Sweden and SAFER to be a main centre of excellence, contributing to external activities and setting the agenda in child safety and rear seat safety research. SAFER hosted the spring meeting 2009 of the ISO working group of Child Restraints and the

project has direct connections to ISO activities as well as the ECE R44 update during the recent year.

The Rear seat safety for small occupants project (B5) hosts a visiting professor as part of the project. Kristy Arbogast from Children's Hospital of Philadelphia spent a week at SAFER, supporting the PhD students and as a follow up on the extensive work (one-day national seminar on Child Safety and a two-day project workshop with six invited senior researchers from USA) during 2009 and for the planning the follow-up workshop in 2011. During 2011, a follow-up workshop together with an expanded group of the US researchers as well as researchers from Australia and Spain are planned. During the project, regularly contacts are taken with research groups in Australia and USA regarding methodology on naturalistic driving studies of rear seat occupants' behaviour during driving. A joint application was submitted for Australian funding waiting for response in 2011. Also, Chalmers is a part of the European child safety project CASPER.

### ***Novel Electric Vehicles and Vehicle Combinations***

The crash area focus of Novel Electric Vehicles and Vehicle Combination covers structural requirements (design guidelines) regarding crashworthiness (self and opponent protection) for new safety driven, 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.

A first step towards the overall objective of creating strategies and develop edge competence for increased crashworthiness and safe vehicle dynamics by advance structures and novel propulsion and drivelines beyond 2030 was taken within the work of SEVS (B12). Within SEVS, scenarios, strategies and research topics were identified as well as steps taken in creating a multi-disciplinary collaborative research with Swedish Hybrid Centre (SHC) and possibly future European partners. SEVS presented the results of Phase 1 in June 2010. Applications for further project within the area are being prepared aiming at the overall goal of creating a critical mass of researchers and PhD students in the area of safe novel electric vehicles. Waiting for the large applications to be successful, a smaller SAFER project (B15) was carried through during 2010 to explore the CAE tools for composite body concept assessment. This area is of high importance for effective composite development in vehicle design and also exemplifies the strength within SAFER to combine large and small projects addressing the different needs of the partners.

A pre-study during 2009-2010 resulted in an EU application ELVA, which was granted funding and started 2010. ELVA joins efforts with 6 international partners within the area of advanced electric vehicle architectures and adds on to area of safety for future light weight vehicles.



### 3.4 Post-Crash Safety

The Director of SAFER, Anna Nilsson-Ehle is acting as Leader of the Reference Group Post-Crash. Eight partners are active within the Post-Crash Reference Group. During the year 5 4 meetings were held.

Post-crash aims at reducing the consequences of accidents and the main effort in the reference group has been towards issues concerning information from the accident scene and how this can adequately support the rescue management. A common opinion in post-crash research is that the response and rescue time is of great importance and the Post-Crash reference group has decided to limit the scope to the immediate actions of treatment/rescue and taking involved persons to the hospital and clearing the accident site. This encompasses research on alarming (i.e. e-call), organization of response, rescue and extrication methods and the availability of vehicle and occupant information.

Two Focus Areas are relevant to Post-crash: Incidents and Accidents and Novel Electric Vehicles and Vehicle Combinations.

#### ***Incidents and Accidents***

The focus area is described in more detail below in the section on Traffic Safety Analysis. It is relevant to Post-Crash as it deals with the understanding of real traffic situations and how to get correct information and communication real-time across to the relevant response (rescue) actors.

In 2008 SAFER, Security Arena and Viktoria Institute started a pre-study on sensor-assisted situational awareness (E1). This was successful and has led to two consecutive projects, LiveResponse 2 and LiveResponse 3 (E3 and E4, totaling SEK 697), led by project leader Jonas Landgren. In short LiveResponse is about live video capabilities for emergency response work. The different response actors, like ambulance and rescue staff, share the same information that is broad-casted via mobile phone by the team "first-on-scene". Thus the understanding of the actual situation is improved and actions can be discussed and prepared in interaction with someone present at the accident. These projects have been highly appreciated and the solution is being implemented. It has created international interest. One company has been started in 2010 in connection to this technology.

In November 2-5 2009 SAFER was visited by Dr M. Varghese, traumatologist from TRIPP (The Transportation Research and Injury Prevention Programme at the Indian Institute of Technology) in New Delhi. A project idea was outlined and in early 2010 a MoU between SAFER and TRIPP was signed covering this project (E5). The project will compare long-term outcome for people injured by accidents in two different cases: "high-tech ambulance service" and "brought to hospital by any transport". The project name is "SAFER - TRIPP study on emergency care of trauma patients". Responsible at SAFER is Dr Per Örtengren, University of Gothenburg/Region Västra Götaland. Each party bears its own cost. SAFER part will be financed by in-kind from

GU/VGR. The first results from TRIPP were shown in December 2010. Final results will be presented May 2011.

Preparation for a SAFER workshop in fall of 2011 is ongoing. Stakeholders are interviewed about their key interests by Ants Silberberg, Chalmers, Jonas Landgren, Viktoria Institute, and Christer Karlsson, SP.

### ***Novel Electric Vehicles and Vehicle Combinations***

The Focus Area Novel Electric Vehicles and Vehicle Combination covers structural requirements (design guidelines) regarding crashworthiness (self and opponent protection) for new safety driven, 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.

Post-crash aspects on these designs are important. New challenges to the rescue situation are introduced due to, for instance, high-strength materials and to high-voltage electricity on-board. In spring 2010 it was decided that the Crash reference group will cover also these aspects as the solving of the problem is integrated in the crash protection design process.

SAFER collaborates in this research area with Security Arena at Lindholmen Science Park. This creates important synergies as Security Arena and TUCAP (SOS Alarm development department established at Lindholmen) gather the different response actors and service providers for “home-land security and emergency”. A good and unique network is formed and SAFER can serve as a research collaborator to more implementation and development-oriented projects.

## **3.5 Traffic Safety Analysis**

Leader/coordinator of Traffic Safety Analysis Reference Group is Associate Prof. Dr. Hans Norin and Secretary Ms Daniela Michael. Thirteen partners are active within the reference group and in average 7 meetings are held annually.

Traffic Safety Analysis (TSA) aims at developing knowledge and methods within the area of field data, where activities for data collection, data storage, data analysis, and effect analyses are in focus, mainly dealing with accident investigation (statistical, in-depth) and naturalistic driving studies (field operational tests, naturalistic driving studies). The reference group coordinates the research within the area and develops the project portfolio.

The competence group regularly reporting to the TSA reference group is “Field Data”, which will be described later in this document. The competence areas “Behavior in Accident Causation” and “Human Factors Design” have occasionally reported activities to the reference group.

The focus area mostly related to the reference group is Incidents and accidents – priorities and effect analysis.

## ***Incidents and accidents – priorities and effect analysis***

### ***Driving studies***

The area of driving studies covers activities within Field Operational Tests (FOT) and Naturalistic Driving Studies (NDS). Data from normal driving in real traffic with vehicles equipped with different types of sensors, cameras etc will help understanding causes of incidents and accidents, including driver behavior characteristics as driver action/reaction, and adaptation to new vehicle systems. This area has develop significantly during the last years within SAFER and has given SAFER a prominent position in the international cooperation within the area.

By a strategic planning and investments and strong commitment from the SAFER partners, SAFER has built up competence in the area and established among the leading researchers in the field. As a base for strategic planning of the development of the area the project BasFOT has been ongoing and finished 2009. Project BasFOT2 started in the beginning of 2010 and will continue to the end of the year, with a possible extension to 2012.

During Stage 2 some extensive projects have been ongoing.

EuroFOT (C2) – a European large-scale Field Operational Tests on vehicle systems, will continue to the mid of 2011.

SeMiFOT (C3) – Sweden Michigan Naturalistic Field Operational Test finished in December 2009, and was reported during 2010. This project gathered 13 organizations from the automotive industry, Swedish road authority and academia around the topic of development of the *Naturalistic FOT method*. This method combines elements from both Naturalistic Driving Studies and field Operational Tests. A new project SeMiFOT2 (C12) started in April 2010 and will continue to the mid of 2011.

The project FOT-Net (C6), which was essentially a project for networking, continued to the end of 2010. A continuation of this project FOT-Net2 (C15) was started early 2011.

Ongoing is also project Drive c2x (C16), dealing with FOT cooperative systems, and a comparative analysis of driver behavior between US and EU based on FOT test data (C17). A project with an industrial PhD-student, Field data acquisition and analysis methods for car safety (C8), will present two scientific articles before summer 2011. This project is relevant for both accident investigation and naturalistic driving studies.

## ***Incidents and accidents – priorities and effect analysis***

### ***Accident investigation***

The area of accident investigation has been of high priority for many years, and several of the SAFER partners have a long tradition and deep knowledge in the field. The goal is to maintain a leading position in the area and continue to be an internationally attractive partner.

During the past year some extensive projects have been ongoing. INTACT is a project with Swedish partners from the industry, Chalmers, and the Swedish Transport Administration. The project has been ongoing since 2007, and finished 2010. A database has also been developed in this project. Activities to find possible long-term financing are ongoing.

Another ongoing project is DaCoTA (C5, C9), which started 2009 and will finish 2011. This is an EU-project, which is a preparatory project for a possible future European data collection activity.

The project FICA2 includes two PhD-students. The project Field data acquisition and analysis methods for car safety development (C8), has one PhD-student. The project started 2008 and will finish 2013. The Project Analysis of accidents and dangerous incidents in transport: Method development and opportunities for learning (C7), where Transportøkonomisk Institutt, in Norway, and Chalmers have been active, finished in April 2010.

As a result of these activities there have been several visits from Japan. One project DREAMi (C13) has started in March 2010, which will be a parallel project to a project within Japan Accident Research Institute (JARI).

## **4. THE RESEARCH ENVIRONMENT, OPEN INNOVATION AND INTERNATIONAL CO-OPERATION**

### **The research environment**

SAFER is a meeting place with a physical work area of 1500 sqm situated on the 2<sup>nd</sup> floor in the main building in Lindholmen Science Park. SAFER moved here in August 2010, to get a bigger and more functional office connected to other open innovation activities such as Security Arena, Open Arena Lindholmen and TSS. The previous office was in the neighbor building.

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 204 key people. Of this 94 are employed by Chalmers, and 110 are from other partners. Of these "key-holders" 19 are academic PhD students and 18 are industrial PhD students thus making the PhD students 18 percent of the total staff. One third of the key people are women. The number of master students is currently 25.

### **Open innovation**

SAFER is more and more seen as an Open Innovation centre and this is supported by the findings of the research project "Management of Open Innovation". This project is running from 2008 – 2012. This has resulted in several publications and conference presentations. In March 2011 the researchers held a workshop with the Board of SAFER on the subject "How to measure SAFER". The aim is to explore how to quantify and qualify the added value of a centre like SAFER. Five main areas to measure were identified – Competence, Collaboration, Attractiveness, Mobility, Project impact. Indicators for performance in each area will be developed and discussed by the board during the strategic meeting in August 2011. The added value of SAFER is tentatively called Open Innovation Capabilities.

## **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.

During the year the goal is met regarding the pace of new MoUs (presently there exist 5) and regarding presence in Brussels. SAFER is active in EARPA, both in the Safety group and in the board via prof. Per Lövsund. The Director of SAFER is participating in the ERTRAC working group for Road Safety Research beyond 2030. She has also been a member of the Swedish project Transport 2030.

Several SAFER researchers have been present at conferences in US, EU and Japan. The Director participated in a Chalmers delegation to IITD in New Delhi in November and represented Chalmers with a speech on Traffic Safety in Shanghai in September.

In year #5, one MoU has been signed, with HTAS. The MoU with IFSTTAR (INRETS) has been extended. The MoU with TRiPP, IITD in New Delhi has been broadened and made part of a Chalmers/GU MoU regarding Research and education on "Mobility and Health".

## **Vision Zero Academy**

The Swedish Transport Administration and Chalmers has agreed to set up a Vision Zero academy at Lindholmen. This will be a valuable collaboration partner to SAFER and enhance SAFER's ability to reach the vision. The aim for Vision Zero Academy is to provide key players globally with knowledge and research based advice and recommendations on how a fast and effective innovation and implementation process of safety-systems-oriented measures is created.

## **5. EDUCATION, COURSES, SEMINARS and CONFERENCES**

### **Chalmers Area of Advance**

SAFER is part of the Chalmers Transport Area of Advance and the director is part of the Transport management team. The active research fields within the profile Traffic Safety are very close to the Focus Areas and the Chalmers researchers within traffic safety are encouraged to contribute to these fields. Presently some 40 senior researchers at Chalmers are active within Traffic Safety and get strategic research funding and all together more than 130 researchers and PhD students at at least eight departments engage in traffic safety related research.

SAFER researchers are involved in teaching at all levels within Chalmers. However, to strengthen the education in the safety area Chalmers has granted SAFER resources to develop a more complete programme, presently named SAFER Insight. The idea is to start from the existing courses and develop a complementary program so that all SAFER Focus Areas are supported by education. The courses shall be available for both students and practitioners and support the need of industry, society and academy. It will be connected to the Chalmers Automotive and Transport Academy.

### **Guest researchers**

During SAFER year # 5, SAFER has had several guest researchers and visitors from all over the world; USA, Japan, Europe. Most of these researches have given an open SAFER seminar (listed below), which is excellent knowledge sharing.

Dr Jac Wismans is continuously a part-time guest professor and active within biomechanics and novel electric vehicles. Adjunct professor Dr Michael Regan from IFSTTAR (prev. INRETS) has been highly involved in the Driver Distraction and Inattention Conference and active within the road user behavior area.

Dr Kristy Arbogast from Children's Hospital of Philadelphia (CHOP) has visited SAFER four times in total, one time during SAFER year #5, and had fruitful discussions within the child safety project (B5).

From Japan, Professor Pongsathorn Raksincharoensak from Tokyo University of Agriculture and Technology (TUAT) visited SAFER in December 2010. Discussions in the F.O.T. and Active Safety area with researchers in the SAFER network were conducted successfully.

## Seminars

### Internal

SAFER has established weekly lunch seminars for internal cross-fertilization of knowledge and ideas. 27 seminars with 48 speakers have been conducted during year 5.

### External

Conducted external SAFER seminars during year #5 include:

- “Speech Technology and its Application in Vehicle Industry”
- “SeMiFOT Final Event” “SEVS Safe, Efficient, Vehicle Solutions – seminar & exhibition”
- “Composite Materials in Vehicles: Design of composite materials in vehicles”
- “Composite Materials in Vehicles: Crashworthiness of composite materials in vehicles”
- “Composite Materials in Vehicles: Manufacturing and joining of composite materials”
- Robert Anderson, from Univeristy of Adelaide.
- Joseph Kianianthra - “Enhancing Safety: The Role of Advanced Technologies in Future Safety”
- Kazuya Takeda: “Behavior Signal Processing applied to improve the driving safety”
- Joseph Kianianthra: “Connected Vehicles – Its Promises and Possibilities”
- Anne Guillaume: “Research activities at LAB”
- “SAFER Project Day” is an event when we present recent research conducted at SAFER. 2010 we had 7 project presentations. We had a similar program but with three parallel sessions, one for each reference group, at our SAFER Open House in November 2010.
- SAFER had a session at the conference “Transportforum” in Linköping in January 2011.



## 6. REPORTS

### Research reports: Dissertation and licentiate thesis'

**Since April 1<sup>st</sup> 2010 , the following PhD Students working in the SAFER environment have written their dissertation thesis:**

Skarin, D. (2010) On Fault Injection-Based Assessment of Safety-Critical Systems. Dissertation thesis, Department of Computer Science and Engineering, Chalmers University of Technology, Gothenburg.

Alexandersson, R. (2010) On Aspect-Oriented Implementation of Fault Tolerance. Dissertation thesis, Department of Computer Science and Engineering, Chalmers University of Technology, Gothenburg.

Krave, U. (2010) Modelling of Diffuse Brain Injuries: Combining Methods to Study Possible Links between Transient Intracranial Pressure and Injury. Dissertation thesis, Department of Applied Mechanics, Chalmers University of Technology, Gothenburg.

Klomp, M. (2010) Longitudinal Force Distribution and Road Vehicle Handling. Dissertation thesis, Department of Applied Mechanics, Chalmers University of Technology, Gothenburg.

Huang, S. (2010) A study of an integrated safety system for the protection of adult pedestrians from car collisions. Dissertation thesis, Department of Applied Mechanics, Chalmers University of Technology, Gothenburg.

**Since April 1<sup>st</sup> 2010, the following PhD Students working in the SAFER environment have written their licentiate thesis:**

Östh, J (2011) Active Muscle Responses in a Finite Element Human Body Model. Licentiate thesis, Department of Applied Mechanics, Chalmers University of Technology, Gothenburg.

Nilsson, J. (2010) On Performance Evaluation of Automotive Active Safety Systems. Licentiate thesis, Department of Signals and Systems, Chalmers University of Technology, Gothenburg.

Mellegård, N. (2010) Method and Tool Support for Automotive Software Engineering - Improving Modelling of Automotive Software. Licentiate thesis, Department of Computer Science and Engineering, Chalmers University of Technology and University of Gothenburg, Gothenburg.

Ali, M. (2010) On Automotive Roadway Departure Prevention. Licentiate thesis, Department of Signals and Systems, Chalmers University of Technology, Gothenburg.