

## **IRCOBI 2008 Conference – Panel Discussion on the Future of Ircobi**

New technologies, loosely described as crash avoidance and integrated safety, are influencing the traditional activities of passive safety – the subject which Ircobi has been promoting since 1971. To explore how Ircobi should react to these challenges, a panel discussion was held at the 2008 Ircobi conference in Bern. Five presentations were made and they can be viewed below. In addition, subsequent general discussion gave rise to a good spectrum of views as to how Ircobi might best develop to further research in new directions.

In summary, it was generally agreed that Ircobi should expand its reach into Integrated Safety. This was defined rather loosely but consists mainly of any technology which operates within 2 to 1 seconds of the beginning of a crash. Here there are clear opportunities to modify sitting posture, restraint systems, the impending crash severity and vehicle structural characteristics. There are also potential gains in terms of real time transmission of the crash characteristics to the emergency response systems.

What was not so clearly agreed was how far Ircobi should get involved in the developing world of crash avoidance technologies. Such systems as ESP, blind spot monitoring, intelligent speed adaptation, adaptive headlights, obstacle and pedestrian warnings, lane departure warnings and enhanced night vision were examples cited. Here the man/machine/environment interfaces introduce different disciplines relating to human psychology and physiology, ergonomics and the ever-present question of risk compensation. These areas are remote from traditional impact biomechanics.

What was agreed was that improved accident data bases and improved science-based accident analyses are vital to the evaluation of both accident avoidance systems and integrated safety. The increased use of event data recorders was cited as one example where Ircobi should concentrate its future efforts. Thus the general conclusion of the participants was that Ircobi in the future should put special emphasis on data bases, crash analysis and integrated safety, as well as maintaining the biomechanics of injury as subject areas for future conferences and courses.

Presentation by Dominique Cesari

# Virtual Testing for Vehicle Safety Assessment

## Main Aims

- To optimize test conditions for crash tests
- To enlarge test conditions for standard procedures
- To improve the prediction of injury risk for specific body parts
- To facilitate the introduction of new safety systems

## Research needs

- Critical review in relation to current regulations and use
- Dummy/human models accuracy and validation
- Architecture and modularity of cars and components models
- Better knowledge on variations:
  - accident conditions (multiple scenarios)
  - within the population at risk (human tolerance)

# ADAS Systems and Integrated Safety

## Current situation

- Large number of new technologies:
  - inform
  - alert
  - take control
- Interact with driver behaviour
- Effects on global safety, but not known
- Not standardized and almost not regulated

## Research needs

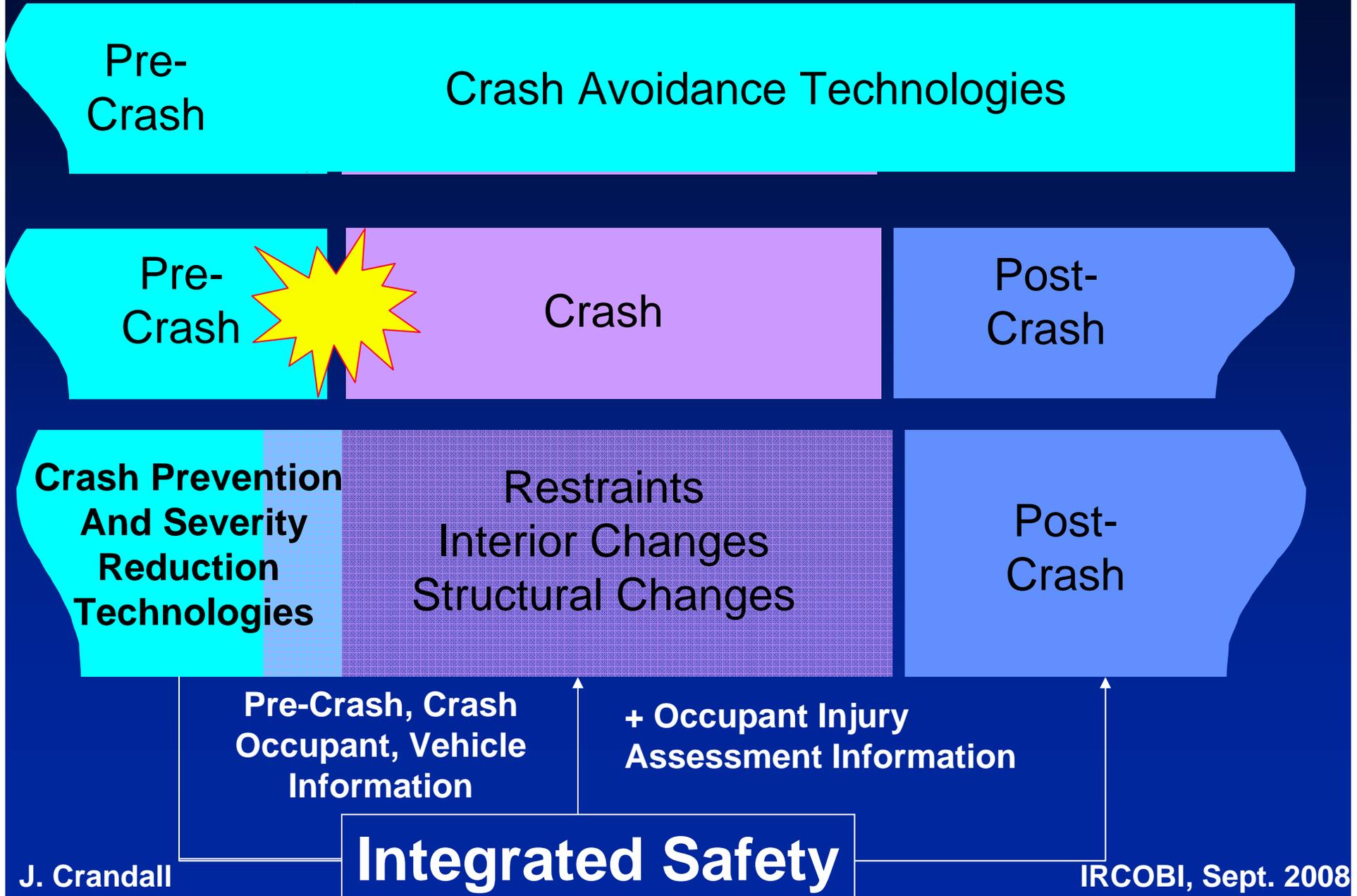
- Methods for evaluation of safety performance (combining technical and human aspects)
- Cost/benefit analysis
- Human behaviour
  - within specific sub-groups
  - special attention on extremes in the population
  - in relation to training possibilities

# Forum for discussion on the future of road safety research

- Former Passive Safety Networks (PSN, EVPSN, APSN) contributed to promote & co-ordinate Passive safety research in Europe
- Initiated numerous R&D projects in successive EU FP's
- Fostered cooperative research between Industry and academia to develop safer roads
- Built a strong community of teams with complementary skills throughout Europe
- Integrated Safety Network is an association intended to continue the work of APSN
- Founded in March 2008
- Includes 12 former APSN members (2 Research centers and 10 universities)
- Action plan includes
  - Update of Strategic research agenda
  - Organize technical workshops
  - Training of young researchers
  - Initiate new research projects

Presentation by Jeff Crandall

# Expanded Definition of Active Safety



# Integrated Safety

- **Pre-Crash and Crash Vehicle Information** from **Active Safety Systems** when combined with **Occupant Information** (position, restraint use, bracing, etc.) can
  - greatly enhance the effectiveness of restraint systems (**40%** reduction in serious injury for optimized systems, **~50%** effective today)
  - Permit **pre-crash** configuration of restraint systems and interior (already done to limited extent but considerably more potential gains)
  - Continue through **crash event (real-time)**

# Real-Time Control of Restraints

Biomechanical Engineers+

Imaging

Electronics

Sensor

Human Factors

Design Engr.

Crash Reconst.

Collision Characteristics

Human Factors

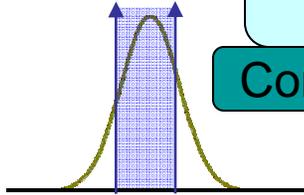
Occupant Parameters

Muscle/Bracing

Vehicle Properties

Design Engr.

Statisticians



Controller

Control/Dynamics

Real-Time Restraint

Design Engr.

Occupant-Vehicle-Crash Estimates

Restraint System Target

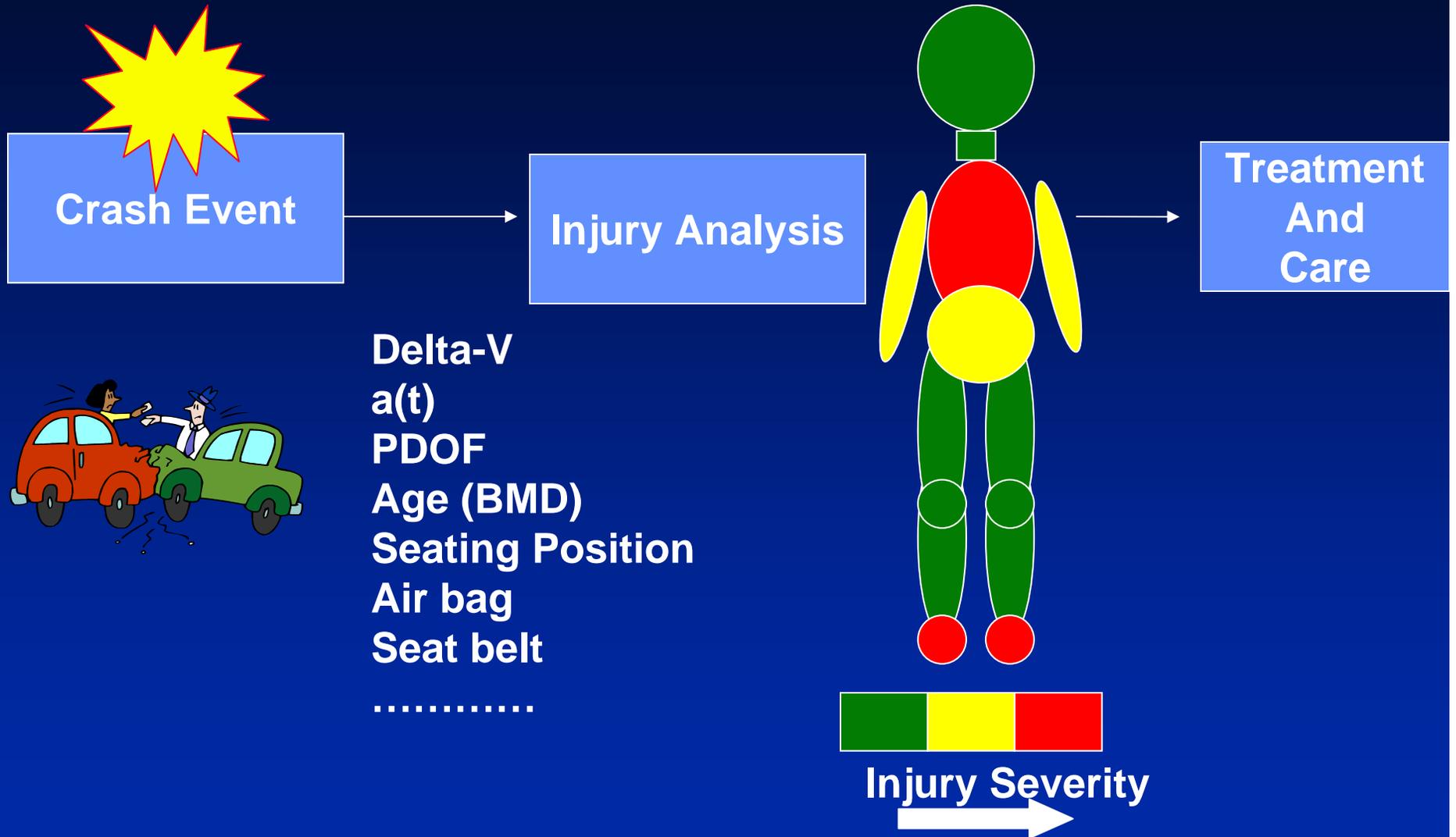
Modeling  
Optimization

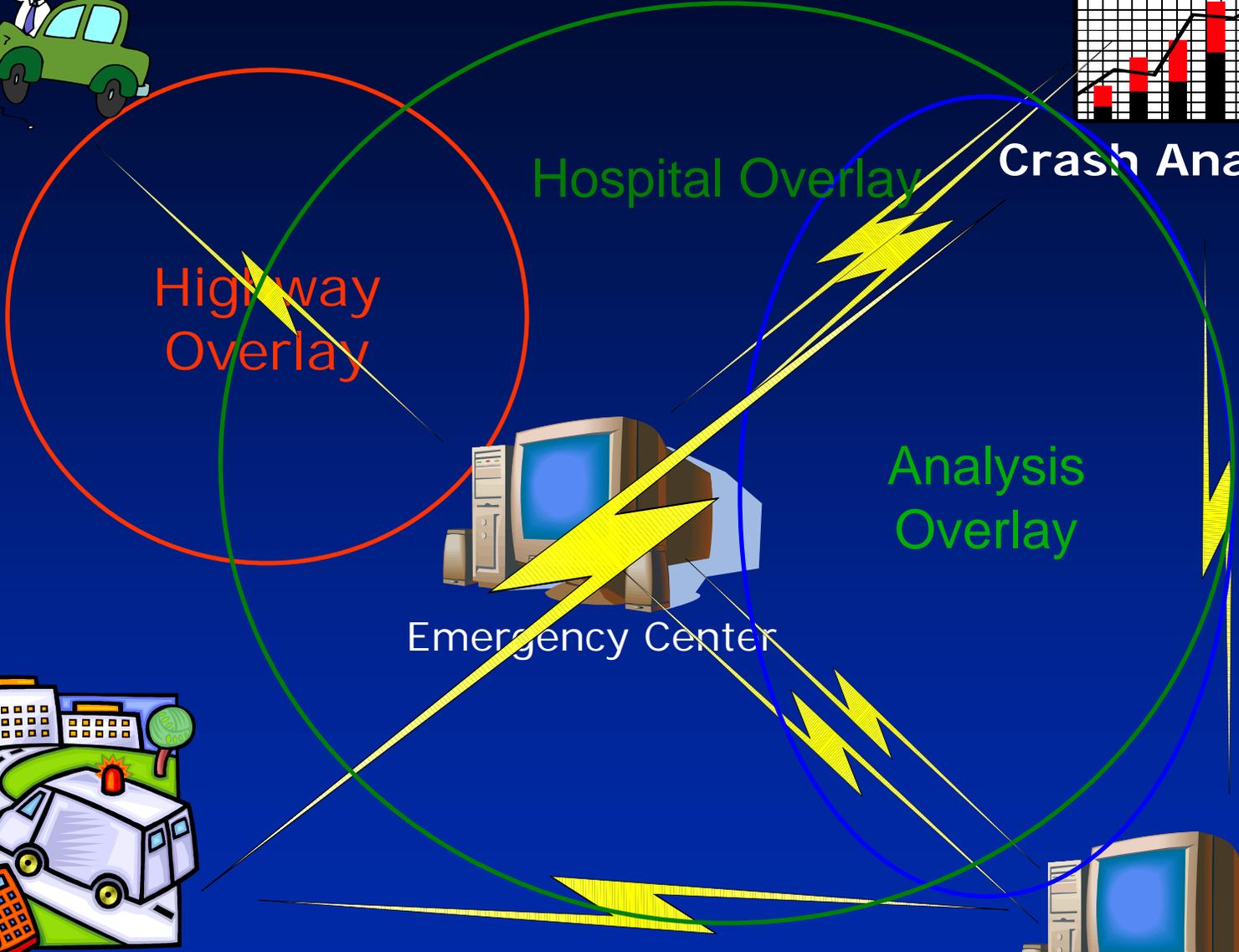
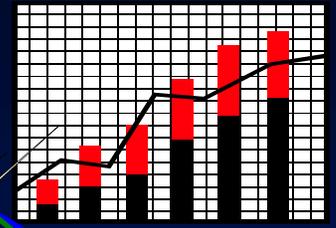
Injury Cost Objective fn.

Cost-Benefit  
Clinicians  
Injury/Disability  
Epidemiologist

Epidemiologist  
Crash Reconst.  
Clinicians  
Statisticians

# Post-Crash Analysis





**Crash Analysis**

**Highway  
Overlay**

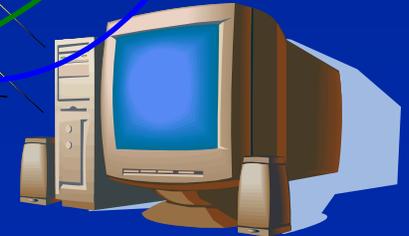
**Hospital Overlay**

**Analysis  
Overlay**

**Emergency Center**



**Hospital**



**Traffic Center**

# Opportunities

- Active Safety provides excellent opportunities to reduce the number of crashes
- In cases where crash still occurs (likely at diminished severity), pre-crash can be combined with crash phase data to begin to provide “optimized protection”
- Integrated Safety will require additional players beyond just active and passive safety folks (connect the pieces requires expertise)
- Successful technologies extend from pre- to post-crash phase

Presentation by Anders Kullgren

## **Integrated Safety – Is This in IRCOBI's Future?**

**Anders Kullgren**

**Folksam Research and  
Department of Clinical Neuroscience, Section of Personal Injury Prevention, Karolinska  
Institutet Sweden**

Most recent safety technology focuses on mitigating crash severity and to prepare for crash. Although the development of new safety technology aimed at avoiding crashes in the road transport system is increasing, crashes will continue to occur for a long period of time. As long as crashes will occur it will be important to have good knowledge of human tolerance for injury and of human errors in the design of a safe road transport system. In fact, knowledge of the human injury tolerance is fundamental in the design of all parts of the road transport system, including all safety technology with the exception of those completely avoiding crashes. With this in mind biomechanics is one of the key areas in injury reduction and will therefore also be essential in the development and research of integrated safety.

In a vehicle accident situation it is important to understand the whole chain of events, how the forces related to the impact speed may influence the injury outcome. Such chain of events may start even long time before the time of impact, and include the influence of safety technology aimed at avoiding crashes, those mitigating crash severity and those preparing for increased crash protection. In order to understand the potential of such technology, the correlation between crash severity and injury outcome is essential.

The human tolerance for injury can be achieved from different sources and with different perspectives in mind. Traditionally analytical and experimental work and accident analysis have been conducted. However, during the latest 10 or 15 years studies aimed at evaluating injury tolerance based on real-world crashes with recorded crash pulses have been presented. In these studies injury risks for different injury types versus recorded impact severity have been established.

Casualty reduction in car collisions can be divided in three main possibilities; by reducing the severity of the impacts, by reducing the number of collisions or by reducing the injury risk at a given impact severity. The first possibility can be achieved by, for example, reducing speed limits, or by reducing impact speed or by redesigning the road infrastructure. The second can be achieved by active safety measures aimed at preventing collisions from occurring. The third possibility addresses the passive safety of both vehicle and road infrastructure to reduce the risk of injury or fatality. New safety technologies aimed at avoiding crashes, mitigating crash severity and/or at increasing the protection by preparing for a crash situation addresses all of these three possibilities. Combining the possibilities has the potential to fully solve the problem with road traffic casualties.

If a crash is detected 1 or 2 seconds before the crash, it will mean a lot in the possibilities to reduce the impact speed and to increase the crash protection. As an example, if a vehicle brakes with only 0.5 g for 1 second, it will lead to a reduction in impact speed of 18 km/h.

Such reduction will lead to major reductions in number of seriously and fatally injured. And the combination of increased crash protection and reduced crash severity would lead to even larger reductions.

The quality of real-life data has often been a limiting factor in analyses of real-world crashes. By improving the validity and reliability in data from real-life crashes, studies of the link between impact severity and injury outcome could be a useful way of gaining knowledge of injury tolerance. Data from on-board crash recorders or Event Data Recorders (EDRs) entails a possibility to improve the measurement quality, both regarding validity and reliability. Lots of cars are to date fitted with EDRs, but very few data collection systems including EDR data exist. There is a need for more and larger databases that include EDR data, to be used also for analysing the effectiveness of new safety technologies. For a wider scope of IRCOBI regarding research of integrated safety, such analyses would be a great interest and importance.

Traditionally IRCOBI has concentrated on the biomechanics of impact injuries based on analytical and experimental work and accident analysis. In my view knowledge of injury tolerance and biomechanics will be essential also for future safety technology in the area of integrated safety and collision severity mitigation. Considering the potential in casualty reduction of recent technologies often named integrated safety it would be desirable that IRCOBI also include research of such technologies and their performance.

Presentation by Hugo Mellander

## **“Integrated Safety – Is this in Ircobi’s Future?”**

### Ways to reduce the consequences of human error and risk taking behaviours in road traffic.

Hugo Mellander PhD  
Traffic Safety Research & Engineering AB

With the invention of transportation using “self propelled” ground vehicles mankind became exposed to an epidemic of road trauma. During the 100 years that motorized vehicles have existed in great numbers it is estimated that at least 25 million people have died a premature death in road crashes and several hundred of millions of people have been injured.

As drivers we all make mistakes and some of us even take calculated risks when operating a vehicle. These characteristics in human behaviour are in many cases the underlying cause of traffic conflicts leading to crashes.

Traditionally we have tried to reduce the likelihood and occurrences of traffic conflicts through the design of the road system, laws and law enforcement activities, information campaigns and training of drivers.

Crash injury prevention measures have primarily been based on the philosophy of “putting a strong box with interior padding around china e.g. the occupant” leading to more crashworthy cars.

In terms of road handling the introduction of better brakes, studded tyres in winter, better handling and acceleration affecting the feedback loop between car/road and the driver may well have resulted in changes in driving behaviour. Some researchers claim that human risk compensation tendencies have to some extent neutralised the conflict reducing effects of these systems. Thus the influence on the actual crash involvement rates is uncertain. Such technologies do not automatically lead to safety benefits.

Up to now the driving of a vehicle have been a free exercise in which you, as a driver, take full responsibility for all the actions you take, with the possible exemptions of the automatic intervention taken by ESP and anti locking brake systems in modern vehicles. However, there are now other systems on the market with the purpose of supporting the driver to make it more likely that he will take the correct and necessary actions when a conflict occurs to avoid a crash. Examples of such systems are: short range radar to provide adaptive cruise control, lane change and pedestrian warning devices, brake warning, active brake support, etc.

Other systems exist that prepare the car for a pending crash like belt tightening devices, automatic seat positioning etc. Advanced systems for adaptive restraint systems and front structures are being developed and will soon be on the market.

However, in comparison to the freedom to chose, in terms of where to go, when and how fast during the last century and now, there are large and obvious differences in most places in the industrialised world. A change that has been generally accepted

as the density of cars has increased on the roads and in large cities and as safety awareness has also increased. The question then becomes, will the drivers and the car buyers in the future accept an even greater invasion of privacy as the driving tasks and responsibilities are taken over by the “intelligent car” in order to realise a further reduction of traffic conflicts, crashes and casualties. There are already cars on the market that will brake the car if a crash is unavoidable, according to the “intelligence” of the car, regardless of what the driver thinks about it. The introduction of the “intelligent car” concept will certainly give us the possibilities to intervene when drivers make mistakes.

However, to fully comprehend the complexity of the issue of a sustainable future safe road transportation system many things have to be considered. The future of the automobile is governed by a multitude of factors such as environmental concerns, fuel and raw material supply, road access and traffic flow, reduction goals for road casualties, economic growth, political decisions and last but not least consumer acceptance and demand. It is the car buying public that in the end decides the evolution of the car. Therefore it is essential that we understand what the future generation of car buyers and drivers will ask for in terms of active safety devices.

Go by train and you will be transported safely, at a very low risk of being injured, and without your direct involvement. Go by road transportation, as in a car, and you will have to accept a certain risk, consciously or unconsciously, and your behaviour is in some way related to the risk you will be exposed to. “Intelligent cars” may change some of this. How will future drivers respond to this new technology?

It is not the lack of knowledge in physics that has hampered the evolution of vehicle safety up to now. Cars in the sixties were poor in terms of crashworthiness but mankind flew to the moon in that decade. It is rather the characteristics of human behaviour and preferences, economical and political decisions that have influenced the design of current road vehicles with its pros and cons.

It is my forecast that passive safety features in vehicles are here to stay and will have to be even further refined because the down-sizing of vehicles will continue and new “propelling systems” will be introduced. The interrelationship between active and passive safety as expressed in the word “integrated safety” will have to be further explored.

However it is my estimate that the introduction of active safety measures will be of increasing importance but advances will be made gradually and will have a different context than the evolution in the past when the passive safety technology was introduced.

Therefore the most important research needs right now are to keep up with the rapid and intense development in active safety technology with more and better research into the science of human behaviour and the man/machine interface.

My recommendation therefore is that IRCOBI should continue its commitment to encourage the advances in the science of the biomechanics of injury, but also to broaden its scope and the Council composition to include integrated safety with a focus on the science of human behaviour in road transportation.

Presentation by Pete Thomas



# The impact of intelligent vehicle safety systems – *a developing research domain*

IRCOBI conference 2008  
Bern

***Pete Thomas***  
***Professor of Road and Vehicle Safety,***  
***Vehicle Safety Research Centre,***  
***Ergonomics and Safety Research Institute***  
***Loughborough University***



# Secondary Safety

- Major improvements in crashworthiness driven by EuroNCAP and legislation
- Accident data shows a reduction in fatality rates of drivers of 22%

**Vehicle based measures have been highly effective**



# Importance of secondary safety

- Secondary safety is a mature science
- Based on well developed engineering approaches
- Engineered into vehicle
- Require only that the driver is restrained



## Further casualty reduction from

- Side impact performance
- Vehicle compatibility
- Pedestrian protection
- Rear seat occupant protection
- Chest injury reduction/frontal impacts
- Neck injury reduction (whiplash)

**Intelligent systems will contribute to all of these areas**



# Human factors and primary safety

- The driver is “in the loop”
- Drivers will learn and adapt their behaviour
- Drivers may not be consistent in their behaviour
- Driver behaviour can modify performance of primary safety systems
- This may reduce the system effectiveness



# Research Domains and Methods

- Accident analysis – macroscopic and in-depth
- Human factors
- Engineering
- Crash/non-crash investigations
- Simulator studies
- Naturalistic driving
- Behavioural studies
- Field operational trials



# The Challenge

- Ensure there is a strong scientific basis for new IVSS
- Subject research to a high level of peer review
- Develop and apply new research tools and approaches

# Contact

Pete Thomas

Professor of Road and Vehicle Safety

Vehicle Safety Research Centre

Ergonomics and Safety Research Institute

Loughborough University

*p.d.thomas@lboro.ac.uk*



Queen's Anniversary  
Prize, 2007