Future role of passive and active safety
Trends in NCAP

Guido Adriaenssens
IRCOBI Conference, Krakow, 14 September 2011
Content

• Role of NCAPs
• Euro NCAP
• Latin NCAP
• Global NCAP
Role of NCAPs

• Comparative consumer programmes aimed at informing consumers about their buying choice

• Indirectly make safety issues commercially attractive to car manufacturers

• The NCAPs are becoming more professional in their communication strategies and the impact is growing
## Areas of Assessment

<table>
<thead>
<tr>
<th>Year</th>
<th>Frontal Impact (ODB)</th>
<th>Side Impact (MDB)</th>
<th>Side Impact (Pole)</th>
<th>Pedestrian Subsystem</th>
<th>Seat Belt (SBR)</th>
<th>Whiplash Subsystem</th>
<th>Stability Control (ESC)</th>
<th>Speed Limiter (SLD)</th>
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<td><img src="image7.png" alt="Icon" /></td>
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</table>
Euro NCAP Overall Rating

New 2010 limits

- Protocols
- Weights
- Thresholds

Vehicle Assessment → Box Scores → Calculate Weighted Score → Overall Weighted Score → Meeting balance criteria?

Y: Calculate Overall Star Rating
N: Downgrade
step increase in limits after introduction of new rating

“Balance” criteria for 5 stars
Improve Methods to Assess Occupant Protection

Sustain Safety Improvements for Vulnerable Road Users

Reward & Assess Emerging Avoidance Technologies

Strategic Agenda 2015
Adult Occupant Protection

- Updates to frontal/side/pole test
- Scenarios under review:
  - Adding full width frontal test
  - Using 5th and 50th percentile dummies
  - WorldSID for side impact
  - Include adult rear seat protection
- New protocols delivered by 2012-2013
- Costs may be limiting factor
Child Occupant Protection

- dynamic behaviour (frontal/side impact)
- different sizes
- CRS for taller children
- ISOFIX

**Static Test**
- CRS
  - best pick
  - EU27
  - 0, 0+, I, II, III
  - labelling, airbag switch etc.

**Dynamic Test**
- small passenger
  - dynamic behaviour frontal/side impact
  - different sizes
  - CRS for taller children
  - ISOFIX
  - ...

**Rear seats**

**Vehicle Assessment**
Develop and validate an assessment method for ESC

Timing – Depending on Board decision

- ESC fitment requirements only
- GTR test pass/fail
- GTR test rating
- Multiple test scenarios rating

2009-2010
2011
2012
2013>

Phase 1
Phase 2
Focus on systems that (voluntarily) assist driver to keep correct speed using map data and/or traffic sign recognition
Intention to add Autonomous Emergency Braking assessment to the rating scheme

First systems assessed in “Advanced NCAP”

Avoidance technologies – Car-2-car & Car-2-Pedestrian
Technology dossier
Assessment group
Consensus meetings
Reporting
Currently 14 systems rewarded

Range of different technologies – AEB, eCall, LDW, blindspot, etc.

After a few years some technologies might become mandatory to get 5 star rating (transfered to Active Safety box)
Latin NCAP
Test: Frontal crash 40% offset

64 km/h

40% overlap = 40% of the width of the widest part of the car (not including wing mirrors)
WHO ARE THE OCCUPANTS IN THE CAR?

Adults

50th percentile Hybrid III dummy (x2)

Child dummies

P1.5 (18 months old)

P3 (3 years old)
## Summary of 2010 results

<table>
<thead>
<tr>
<th>Car Model</th>
<th>Airbag Status</th>
<th>Star Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Corolla XEI</td>
<td>+ Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Chevrolet Meriva GL Plus</td>
<td>+ Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Fiat Palio ELX 1.4 Emotion</td>
<td>+ Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>VW Gol Trend 1.6</td>
<td>+ Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
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<tr>
<td>Peugeot 207 Compact 5p 1.4</td>
<td>+ Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Peugeot 207 Compact 5p 1.4</td>
<td>- NO Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
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<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
<tr>
<td>Geely CK1 1.3</td>
<td>- NO Airbag</td>
<td>⭐⭐⭐⭐⭐⭐⭐⭐</td>
</tr>
</tbody>
</table>
Next steps in Latin NCAP:

• Phase 2: Publication (10 cars) in November 2011
• Involve more governments and other stakeholders
• Extend programme to include side impact and active safety (ESV)
Promoting Safer Cars
IN THE UN DECADE OF ACTION
**Mission Statement**

GNCAP aims to support the development of new NCAPs in emerging markets where vehicle growth is strong but independent consumer information on crashworthiness is frequently not available. To achieve this GNCAP will offer support to NCAPs in emerging economies and regions by offering technical support guidance and quality assurance.

GNCAP will also provide a platform for cooperation for NCAPs and like organisations around the world to share best practice, to further exchange information, and to promote the use of consumer information to encourage the manufacture of safer cars across the global automotive market.

GNCAP will carry out research on innovations in vehicle safety technologies, their application in global markets, the range of policies that will accelerate their use, and monitor the progress of vehicle safety across the globe.

GNCAP will also develop a global awards scheme to recognise achievement in vehicle safety, innovation in safety related technologies, and products.
First steps

Yearly congress for NCAPs

Support Latin NCAP

Investigate feasibility ASEAN NCAP

Investigate feasibility Indian NCAP
Summary

• Increase in awareness of safety aspects of cars by the consumers
• Increased transparency in usefulness of safety features thanks to publications by NCAPs
• Proliferation of new NCAPs in emerging countries
• Strengthening of passive safety criteria
• Steep increase in sales of new active safety options
Thank you for your attention

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VEHICLE SAFETY RESEARCH

DATA OVERVIEW

RESEARCH STRATEGIC PLANNING PROCESS

RESEARCH PROGRAM AREAS
2009 Data - Fatalities and Fatality Rate, by Year

Fatalities: 33,186

Fatality Rate per 100M VMT
Strategic Planning Process

- Data Drives Priorities
  - Develop 3 year NVS Priority Plan
  - And-
  - Develop 3-5 year & longer-term Research Plans
Strategic Planning - Data Driven

- NHTSA's Research and Rulemaking programs are data driven
- These data are analyzed in various perspectives
  - Crash Type
  - Vehicle Type
  - Crash Partners
  - Countermeasures
    - Crashworthiness
    - Crash avoidance
# Crash Avoidance vs Crashworthiness

<table>
<thead>
<tr>
<th>Normal Driving</th>
<th>Crash Imminent</th>
<th>Crash Event</th>
<th>Post-Crash</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Passenger Cars/Trucks</strong>&lt;br&gt;• Driver Distraction&lt;br&gt;• Driver Support Systems&lt;br&gt;• Blind Spot Detection&lt;br&gt;• Alcohol Detection&lt;br&gt;• Drowsy Driver Detection&lt;br&gt;• …</td>
<td>• Forward Crash Warning&lt;br&gt;• Lane Departure Warning&lt;br&gt;• Automatic Braking&lt;br&gt;• Lane Keeping&lt;br&gt;• V2V &amp; V2I&lt;br&gt;• …</td>
<td>• Advanced Airbags&lt;br&gt;• Dynamic Rollover&lt;br&gt;• Oblique/Off-set Frontal&lt;br&gt;• Adaptive Restraints&lt;br&gt;• Child Side Impact&lt;br&gt;• Elderly Occupants&lt;br&gt;• …</td>
<td>• Auto Crash Notification&lt;br&gt;• Advanced ACN&lt;br&gt;• Medical Outcome (CIREN)&lt;br&gt;• First Responder Safety</td>
</tr>
<tr>
<td><strong>Heavy Vehicles - Truck/Bus</strong>&lt;br&gt;• Driver Distraction&lt;br&gt;• Drowsy Driver Detection&lt;br&gt;• Enhanced Vision Systems&lt;br&gt;• Blind Spot Detection</td>
<td>• ESC/RSC&lt;br&gt;• Forward Collision Warning&lt;br&gt;• Lane Change Warning&lt;br&gt;• V2V &amp; V2I</td>
<td>• Underride</td>
<td>• Electronic Data Recorders&lt;br&gt;• ACN?</td>
</tr>
<tr>
<td><strong>Motorcycles</strong>&lt;br&gt;• Conspicuity</td>
<td>• ABS/CBS&lt;br&gt;• V2V</td>
<td>• Helmet Use&lt;br&gt;• Airbags</td>
<td>• ACN?</td>
</tr>
<tr>
<td><strong>Pedestrians</strong>&lt;br&gt;• Quiet Car Detection&lt;br&gt;• Lighting Systems for Peds</td>
<td>• Pedestrian Warning&lt;br&gt;• Automatic Braking&lt;br&gt;• P2V</td>
<td>• Pedestrian Impact – Hoods / Bumpers</td>
<td>• ACN?</td>
</tr>
<tr>
<td><strong>Battery Electric Vehicles</strong>&lt;br&gt;• Charging Safety&lt;br&gt;• Lithium Ion Battery</td>
<td>• Shut-Down Strategies</td>
<td>• Lithium Ion Battery&lt;br&gt;• Electrical Isolation</td>
<td>• First Responder Safety</td>
</tr>
<tr>
<td><strong>Electronics Reliability &amp; Security</strong>&lt;br&gt;• Fail-Safe Strategies&lt;br&gt;• Software Reliability&lt;br&gt;• Fault Detection &amp; Reporting &amp; HMI</td>
<td>• Control System Management Strategies &amp; HMI</td>
<td>• Control System Management Strategies</td>
<td>• Electronic Data Recorders</td>
</tr>
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</table>
Crashes of all Severities
2007 GES

Communicative Crash Avoidance Systems can address 82% of Crash Scenarios involving unimpaired drivers

- Head-on Collision Avoidance
- Curve Speed Warning
- Lane Departure Warning
- Stability Control
- Lane Keeping
- Others
- Off Roadway 23%
- Lane Change 9%
- Rear-End 28%
- Crossing Paths 25%
- Intersection Movement Assist
- Stop Sign & Signal Violation Warnings
- Lane change and merge assist
- Blind Spot Detection
- Avoidance Braking
- Forward Crash Warning
- Mitigation Braking
V2V - It’s All About Connectivity

- Opportunity for Safer Driving
- Greater situational awareness
  - Your vehicle can “see” nearby vehicles and knows roadway conditions you can’t see
- Reduce or eliminate crashes thru:
  - Driver Advisories
  - Driver Warnings
  - Vehicle Control
- Opportunity for Greater Mobility & Efficiency
- Create an information-rich environment for multi-modal transportation solutions.
- Enable environmental management through V2I capability

Vehicle Communication has the potential to address 82% of the vehicle crash scenarios involving unimpaired drivers.
NHTSA Distraction Program

Eliminate Crashes Due to Distraction

Initiative 1
Improve the Understanding of the Problem
Data Approach

Initiative 2
Reduce Workload from Interfaces
Vehicle Approaches

Initiative 3
Keep Drivers Safe

Initiative 4
Recognize Risks and Consequences
Behavioral Approach
Pedestrian Crash Avoidance Mitigation (PCAM)

- Identify the top pedestrian crash scenarios
- Assess current and near-term (within 5 years) forward-looking
- Develop objective test procedures
Research Needs

Potential Future Crash Avoidance Topics

- CA or “Near-Miss” Data Sets & Mining Tools
- Accelerated Deployment of Crash Avoidance Technologies
- Minimizing Driver Distraction & Workload
- Deployment of Connected Vehicles & Roads
- Reliability and Security of Electronic Control Systems
- Semi-Autonomous Driving
- Other ideas....
Crashworthiness – Key programs

- Low Offset/Oblique Frontal
- Dynamic Rollover
- Child Safety Side Impact
- Lithium Ion Battery Safety
- Advanced Restraints
- Countermeasures for “lightweighted” vehicles
- Advanced Automatic Crash Notification
Fatalities in Frontal Crashes Despite Seat Belts and Air Bags

2000-2007 NASS fatalities for model year vehicles 2000+ where occupant was restrained
Moving Deformable Barrier Test Procedure

**Small Overlap**
- Overlap ≈ 15%
- Angle ≈ 7 degrees
- Theoretical DV = 30 mph

Small Overlap Example

THOR-NT Dummy

NASS case

Crash Test
Advanced Restraints

- CAMP ARS demonstrated tailored restraints to occupant size and coupled with assumed pre-crash information resulted in improved overall occupant performance.

- Programmable Vent Module
- Dual stage load limiter
- Lap and shoulder belt pretensioners
Rear Seat Advanced Restraints

Load Limiter, Pretensioners and Locking Tongue

The baseline Ford Taurus rear seat evaluated using 5th percentile female and 50th percentile male ATDs.
Battery Vehicles – Research Activities

- **Lithium Ion Battery Safety Research**
  - Failure Modes and Effects Analysis
    - Identify Potential Critical Safety Issues
  - Test Procedure Development
    - Cell, Pack, Vehicle level
  - Controls Safety
    - Monitors cell/pack health, SOC, etc.
    - Hardware and software reliability
Utilize new and existing vehicle crash models to evaluate safety of future lightweight vehicles

- Vehicle-to-vehicle and vehicle-to-structure crashes
- Interaction with new and existing vehicles
- Evaluate potential countermeasures
- Develop safety estimates
- Provide direction for future safety research
Simulations for Lightweighted Safety

- Develop simulation tool to evaluate crash safety for future lightweighted vehicles
- Demonstrate safety countermeasures for lightweight vehicles for future research
- Utilize finite element models for existing and future lightweight vehicles
Biomechanics - Key Programs

- Anthropometric Test Device Research (crash dummies)
- Vulnerable Occupant Injury Analysis
- Computer Aided Engineering
- CIREN Program
THOR-NT Dummy

- THOR provides improved biofidelity and measurement capability
- Highlights:
  - Improved head/neck design allow for more biofidelic head kinematics and neck injury assessment
  - Enhanced multi-point chest and abdomen instrumentation for improved evaluations of advanced restraints and steering wheel and belt interactions
  - More biofidelic knee, femur and hip to assess lower extremity injury
WorldSID Dummy

- Conduct fleet evaluation with WorldSID
- Test Matrix consist of current MY vehicles certified to the FMVSS 214 pole
- Testing ongoing with 50%th
  - Future testing planned with WorldSID 5th
- WorldSID Dummy development
  - Ongoing as part of an international collaborative effort
  - Developing dummy family with 50th and 5%th
Older Occupant Research Efforts

- Well-established finding that older occupants have greater thoracic injury risk in frontal crash
- Analysis of NASS-CDS and CIREN data to determine effects of age on injury risk
  - In different crash modes
  - By body region and anatomical structure
Research Needs

Potential Future Crashworthiness Topics

- Accelerated dummy development
- Improved computer modeling capabilities
- Crash avoidance sensing information for adaptive restraints
- Adaptive restraints for vulnerable occupants
- Methods to improve belt use
- Other ideas....
THANK YOU
Traffic safety around the world – can polices be the same?

Dinesh Mohan

Krakow, Poland
14 September 2011
Road Traffic fatalities for 178 countries
Self Reported

Fatalities per 100,000 persons

Per Capita Income, US $

IIT Delhi 15 September 2011
WHO Estimates for Road Traffic fatalities
178 countries

Fatalities per
100,000 persons

Per Capita Income, US $

RTI need not be high at low incomes
Road traffic fatalities in Asian countries

Data collection not necessarily dependent on income

High rates possible in rich countries & low in LMIC

Proportion of RTI fatalities by road user type. Countries are arranged in increasing income from left to right.
RTI modal shares not necessarily income dependent.

Not clear why pedestrians share low in...data? than 4-wheel occupants.
Proportion of 2/3-wheelers and motor cars in vehicle fleet vs. per-capita income in Asian countries

Fatality: 15/100K

GNI per capita for 2007 (US$)

IIT Delhi September 11
Traffic fatalities by age group in Kota and Mumbai


Unexpected low rates

- Children in general and on motorcycles
- Overloaded three-wheelers
- Overloaded cycle rickshas
- Motorcycle crashes in general
- Crashes at junctions
Safety priorities for low and middle income countries

- Pedestrians and other non-motorists in urban areas
  - Separation of traffic on arterial roads and traffic calming in all other areas – clear & continuous pedestrian paths mandatory on all arterial roads
  - Speed control, use of scientifically designed roundabouts instead of traffic lights, no free left turns
    > Adaptive and generalized pre-crash braking
    > Speed limiting systems
  - Pedestrian impact standards for all vehicles

- Motorcycles and cars
  - Daytime running lights for motorcycles
  - Enforcement of motorcyclist helmet-use laws in all states
  - Mandatory airbags, ABS, alcohol interlock for all cars
Safety priorities for low and middle income countries – contd.

- Pedestrians, other non-motorists, and slow vehicles on highways
  - Highway designs to be modified to separate slow vehicles and pedestrians – service lanes all along the highway
    > Image recognition traffic control systems
  - Convenient road crossing facilities at frequent intervals
  - Speed control > vehicle-road communication systems

- Over-involvement of trucks and buses
  - Speed control > data loggers and GPS systems, alcohol interlock
  - Safer vehicle fronts and improved vehicle conspicuity
  - Research to understand the needs of local traffic and to develop standards for breaks in medians (to reduce wrong way driving)
“FUTURE ROLE OF PASSIVE AND ACTIVE SAFETY”

Adam McNeill, IRCOBI 14th September 2011, Krakow, Poland
“Future Role of Passive and Active Safety”
Vehicle Safety Performance

BMW is strongly committed to providing our customers with the highest levels of safety

BMW 5 Series has received top safety ratings worldwide
“Future Role of Passive and Active Safety”

Vehicle Safety Performance

Enormous progress has been made in improving traffic safety by all parties. Passive safety improvements have contributed significantly to achieve this.
"Future Role of Passive and Active Safety"

Integrated Safety

Collision avoidable

Collision unavoidable

Pre-Crash

Crash

Collision

Post-Crash

Rescue

Dynamic stability control DSC

Active Protection

Preventive front protection

Restraint Systems

Safety cell

Automatic emergency call

Driver in the Loop

Strengthening the driver’s accident avoidance capabilities

Collision Unavoidable

Driver is no longer able to avoid an accident

Fail-Safe Operation

Default: Basis protection with passive safety.

Focus of current BMW safety strategy.

Significant safety potential.

Lower potential for optimization.

Still many new rulemaking activities.

Potential.
“Future Role of Passive and Active Safety”
Frontal Protection – Vulnerable Road User

Vehicle Safety Performance
Integrated Safety
Preventative Front Protection
Future Rating Systems
Summary

Object Detection
- Camera
- Radar

Driver Warning
- Optical Pre-Warning
- Acoustic Acute Warning

Brake Assist

Driver in the Loop
Strengthening the driver’s own accident avoidance capabilities

Collision avoidable
Collision unavoidable
Collision

Fail-Safe Operation
Default: Basis protection by passive safety

Automatic Emergency Braking

Post-Crash
Rescue
"Future Role of Passive and Active Safety"
Effect of Impact Speed Reduction on Pedestrian Head Injury.

Reduction of HIC per 2.5 km/h speed reduction.

<table>
<thead>
<tr>
<th>$v$ [km/h]</th>
<th>Child 50°</th>
<th>Adult 65°</th>
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<tbody>
<tr>
<td></td>
<td>HIC $_{05 _08}$</td>
<td>HIC $_{03 _15}$</td>
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<tr>
<td>40.0</td>
<td>739</td>
<td>1713</td>
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<tr>
<td>37.5</td>
<td>594</td>
<td>1459</td>
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<td>35.0</td>
<td>469</td>
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<td>830</td>
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<td>27.5</td>
<td>205</td>
<td>657</td>
</tr>
<tr>
<td>25.0</td>
<td>148</td>
<td>511</td>
</tr>
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</table>

An impact speed reduction of 10 km/h has the potential to reduce the measured values by over 50%!
“Future Role of Passive and Active Safety”

Front Protection – Longitudinal Traffic

- **Pre-Crash**: Collision avoidable
- **Collision**: Collision avoidable
- **Collision**: Collision unavoidable
- **Post-Crash**: Rescue

**Object Detection**
- Camera
- Radar

**Driver Warning**
- Optical Pre-Warning
- Acoustic Acute Warning

**Brake Assist**

**Driver in the Loop**
Strengthening the driver’s own accident avoidance capabilities

**Collision unavoidable**
Driver is no longer able to avoid an accident

**Fail-Safe Operation**
Default: Basis protection by passive safety

**Enhanced Automatic Crash Notification** (eACN)
Laboratory Crash with Braking Intervention.
Significant Load Reduction by Emergency Braking
Delta V reduced by 24 km/h

**OCCUPANTS**

<table>
<thead>
<tr>
<th>Driver</th>
<th>Passenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIC 36:</td>
<td>-76%</td>
</tr>
<tr>
<td>Neck extension:</td>
<td>-36%</td>
</tr>
<tr>
<td>Neck tension:</td>
<td>-19%</td>
</tr>
</tbody>
</table>

| Neck extension: | -47% |
| Neck tension: | +34% |
| Chest acceleration: | -35% |
| Chest deflection: | -47% |

| Neck extension: | -47% |
| Neck tension: | +34% |
| Chest acceleration: | +9% |
| Chest deflection: | -45% |

Test results

In cooperation with DEKRA

Vehicle Safety Performance
Integrated Safety
Preventative Front Protection
Future Rating Systems
Summary
"Future Role of Passive and Active Safety"  
Future Rating Systems

<table>
<thead>
<tr>
<th>Current Safety Assessment</th>
<th>Future Safety Rating Systems?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consumer ratings = legal requirements + X.</td>
<td>• A balanced and comprehensive active &amp; passive safety assessment.</td>
</tr>
<tr>
<td>• High weighting of passive safety with a focus on restraint and structural performance.</td>
<td>• Weighting by real world effectiveness.</td>
</tr>
<tr>
<td>• Performance measured by dummy injuries.</td>
<td>• Goal – Promote use of systems which have the highest effectiveness.</td>
</tr>
<tr>
<td>• Mainly separate assessment of active / passive safety → Pre crash features not assessed.</td>
<td></td>
</tr>
</tbody>
</table>
“Future Role of Passive and Active Safety”

Summary

- Huge improvements have been made in traffic safety over the last years.

- Passive safety improvements are coming into the area of diminishing returns.

- Preventative systems have the potential to bring a new era of injury reduction.

- Before further legislation and consumer test ratings are developed or modified the following needs to be taken into account:
  - Overall effectiveness in injury reduction.
  - A good balance need to be found utilising both active and passive systems.