AEB at Thatcham Research and in Euro NCAP

Colin Grover
Principal Engineer – ADAS & Automated Driving

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Introduction

Introduction to Thatcham

AEB test development leading up to 2014 Euro NCAP implementation

Developments for 2018 AEB testing

Future Euro NCAP road map AEB developments
About Thatcham...
...“Safer cars, fewer crashes”

- Formed in 1969
- Funded by UK Motor Insurers
- Annual turnover £16m, not for profit
- Helping insurers control the cost of claims
- More recently, understanding risk
Thatcham and AEB
10+ year relationship

- UK Government challenge to insurers – control cost of insurance
- Personal injury (whiplash) claims ever increasing despite great seat improvements
- AEB prevents collision and catalyst for insurance claim
“To design and implement test procedures reflecting real world data that can encourage the development of autonomous braking technology that can help prevent or mitigate the effects of car-to-pedestrian and car-to-car crashes”

• Analyse real world accident data to define test scenarios
• Define and specify test methods and measurement equipment
• Define test metrics and rating process
• Publish results/ratings to inform consumers/stakeholders of technology capability
• Integrate into existing consumer test programs (RCAR)
• Offer to Euro NCAP PNCAP for consideration for future test program
REAL WORLD DATA

LOUGHBOROUGH STUDY OF ALL UK CRASHES

Unique in-depth study commissioned by Thatcham investigating real world crashes and their causation factors to formulate realistic test scenarios that drive AEB functionalities suitable for Euro NCAP and Insurers

- 11,192 STATS19 CCR cases analysed
- 10,574 STATS19 CP cases analysed
- 50 OTS CCR cases analysed
- 175 OTS CP cases analysed

Aim for 4-6 clusters
≥75% of cases

Example
Cluster 1
- 30% of cases
- Lower speeds
- At junction
- Daylight
- Fine weather
- Vehicle A going ahead
- Vehicle B stop/starting
- Following traffic
### UK ACCIDENT CLUSTERS:
**WIDE VARIETY OF ACCIDENT TYPES**

<table>
<thead>
<tr>
<th>Car to Car Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction, static target</td>
</tr>
<tr>
<td>Roundabout, static target</td>
</tr>
<tr>
<td>Junction, both cars turning</td>
</tr>
<tr>
<td>Going ahead, dark</td>
</tr>
<tr>
<td>Roundabout, both cars turning</td>
</tr>
<tr>
<td>Roundabout, static target, dark</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static target</td>
</tr>
<tr>
<td>Moving target</td>
</tr>
<tr>
<td>Slowing target</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Car to Pedestrian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unobstructed near side, walking child</td>
</tr>
<tr>
<td>Obstructed near side, walking child</td>
</tr>
<tr>
<td>Unobstructed near side, walking adult, dark</td>
</tr>
<tr>
<td>Unobstructed far side, running adult, dark</td>
</tr>
<tr>
<td>Near side walking adult, turning car</td>
</tr>
<tr>
<td>Adult walking along road, dark</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unobstructed near side, running child</td>
</tr>
<tr>
<td>Obstructed near side, running child</td>
</tr>
<tr>
<td>Near side walking adult, turning car, dark</td>
</tr>
<tr>
<td>Unobstructed far side, walking adult, dark</td>
</tr>
<tr>
<td>Far side running child, turning car</td>
</tr>
<tr>
<td>Unobstructed near side, running child</td>
</tr>
</tbody>
</table>

**REAL WORLD DATA**

- Car to Pedestrian Car to Car Rear
- Statistics 19
### UK Accident Clusters: Wide Variety of Accident Types

<table>
<thead>
<tr>
<th>Car to Car Rear</th>
<th>Stats 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junction, static target</td>
<td>Roundabout, static target</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTS</th>
<th>Static target</th>
<th>Moving target</th>
<th>Slowing target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too many scenarios to be feasible for testing, so select scenarios based on real world frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Car to Pedestrian</th>
<th>Stats 19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unobstructed near side, walking child</td>
<td>Obstructed near side, walking child</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OTS</th>
<th>Unobstructed far side, running adult, dark</th>
<th>Near side walking adult, turning car</th>
<th>Adult walking along road, dark</th>
</tr>
</thead>
</table>
### REAL WORLD DATA

**TEST SCENARIOS SELECTED TO REPRESENT GREATEST FREQUENCY OF REAL WORLD CRASHES**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>UK</th>
<th>UK</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combining accident data from other international sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CITY &amp; URBAN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car drives into stationary vehicle</td>
<td>61%</td>
<td>56%</td>
<td>52%</td>
</tr>
<tr>
<td><strong>URBAN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car drives into slower moving vehicle</td>
<td>30%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td><strong>URBAN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car drives into braking vehicle</td>
<td>14%</td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

In addition to real world data scenarios, engineering judgements are also selected. CCR 2 is a scenario noted from track testing where some AEB systems appear to fail. This scenario is under investigation, not yet tested due to limitation of 3D appearance of target.
## REAL WORLD DATA

### TEST SCENARIOS SELECTED TO REPRESENT GREATEST FREQUENCY OF REAL WORLD CRASHES

<table>
<thead>
<tr>
<th>PEDESTRIAN</th>
<th>UK</th>
<th>UK</th>
<th>Germany</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian walks from nearside</td>
<td>51%</td>
<td>59%</td>
<td>32%</td>
<td>27%</td>
</tr>
<tr>
<td>Pedestrian walks out from behind obstruction</td>
<td>14%</td>
<td>7%</td>
<td>28%</td>
<td>9%</td>
</tr>
<tr>
<td>Pedestrian runs out from the far side</td>
<td>9%</td>
<td>37%</td>
<td>28%</td>
<td>-</td>
</tr>
<tr>
<td>Pedestrian walks along in the dark</td>
<td>3%</td>
<td>5%</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Pedestrian walks out into the path of turning car</td>
<td>6%</td>
<td>Overall: going ahead 87%, Turning 13%</td>
<td>18%</td>
<td>-</td>
</tr>
</tbody>
</table>

Combining accident data from other international sources:
- **STATS 19**: n=10,574 cluster analysis frontal collisions
- **OTS**: n=175 cluster analysis frontal collisions
- **UDV**: n=234 (N=18,571) 3rd party vehicle claims 2002-2006 frontal collisions
- **IIHS**: 1997-2006 FARS & GES all car-pedestrians

Pedestrian walks from nearside:
- UK: 51%
- Germany: 32%

Pedestrian walks out from behind obstruction:
- UK: 14%
- Germany: 7%
- USA: 27%

Pedestrian runs out from the far side:
- UK: 9%
- USA: 28%

Pedestrian walks along in the dark:
- UK: 3%
- USA: 9%

Pedestrian walks out into the path of turning car:
- UK: 6%
- USA: 18%

Overall: going ahead 87%, Turning 13%.
**INTERNATIONAL ACCIDENTOLOGY**

**FURTHER INTERNATIONAL CP STUDIES**

Overall the clusters derived from STATS 19 and OTS data for both CP and CCR data appear to be reasonably representative of other international accident distributions.

Scenarios were therefore considered to be globally representative.

<table>
<thead>
<tr>
<th>Vehicle Maneuver</th>
<th>Pedestrian Scenario</th>
<th>Passenger car to pedestrian collisions</th>
<th>Passenger car to pedestrian collisions Excluding Reversing</th>
<th>Vehicle to pedestrian collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight</td>
<td>Cross from near side</td>
<td>45.0%</td>
<td>50.0%</td>
<td>45.7% on roads and at junctions</td>
</tr>
<tr>
<td>Straight</td>
<td>Cross from near side - obscured</td>
<td>29.3%</td>
<td>32.6%</td>
<td>12.4% near and far side combined</td>
</tr>
<tr>
<td>Straight</td>
<td>Cross from far side</td>
<td>84.2% on straight roads</td>
<td>82.1% crossing road arbitrarily</td>
<td>26.5% on roads and at junctions</td>
</tr>
<tr>
<td>Straight</td>
<td>Cross from far side - obscured</td>
<td>3.3%</td>
<td>3.7%</td>
<td>12.4% near and far side combined</td>
</tr>
<tr>
<td>Straight</td>
<td>Walking along or in road</td>
<td>7.9%</td>
<td>8.8%</td>
<td>10.8% on crossroads</td>
</tr>
<tr>
<td>Turn to far side</td>
<td>Cross from near side</td>
<td>10.8% on crossroads</td>
<td>82.1% crossing road arbitrarily</td>
<td>Collisions at junctions not specifically identified</td>
</tr>
<tr>
<td>Turn to far side</td>
<td>Cross from far side</td>
<td>9.9%</td>
<td>8.8%</td>
<td></td>
</tr>
<tr>
<td>Turn to near side</td>
<td>Cross from near side</td>
<td>8.8%</td>
<td>8.7%</td>
<td></td>
</tr>
<tr>
<td>Turn to near side</td>
<td>Cross from far side</td>
<td>8.8%</td>
<td>8.7%</td>
<td></td>
</tr>
<tr>
<td>Reversing</td>
<td></td>
<td>10.0%</td>
<td>10.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>2.2%</td>
<td>1.3%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
REAL WORLD DATA

INITIAL SPEEDS AT START OF COLLISION

Initial speed prior to braking was below 50km/h for 78% of cases.

93% of all accidents had a delta-v of less than 20km/h.

Initial speed prior to braking was below 60km/h for majority of cases.
REAL WORLD DATA

BRAKING LEVELS DURING COLLISION

86% of drivers braked before the accident

- Majority of drivers did not brake hard enough

**Mean braking in CCR crashes**

- 0-2 m/s²: 25%
- 2.4 m/s²: 35%
- 4-6 m/s²: 20%
- 6-8 m/s²: 5%
- 8-10 m/s²: 5%

**OTS case reconstructions – UK**

- Moving Traffic (n=9): 33% took evasive action, 67% did not
- Slowing Traffic (n=18): 39% took evasive action, 61% did not
- Stationary Traffic (n=23): 38% took evasive action, 62% did not

**EDR data – AXA Switzerland**

- 86% of drivers braked before the accident
- Majority of drivers did not brake hard enough
Dynamic Brake Support (DBS)
In conjunction with Forward Collision Warning (FCW)

Mean deceleration in rear end crashes
62 to 86% of drivers brake, but only moderately

DBS boosts driver braking response in emergency situations
# AEB Test Scenarios

## Car & Pedestrian

<table>
<thead>
<tr>
<th>Car-to-Car Rear (CCR)</th>
<th>Car-to-Pedestrian CP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CITY</strong></td>
<td>CP1 Unobscured nearside walking pedestrian</td>
</tr>
<tr>
<td>Lead Vehicle Stopped &lt;50km/h</td>
<td></td>
</tr>
<tr>
<td><strong>INTER-URBAN</strong></td>
<td>CP2 Obscured walking nearside pedestrian</td>
</tr>
<tr>
<td>Lead Vehicle Stopped 30-80km/h</td>
<td></td>
</tr>
<tr>
<td><strong>INTER-URBAN</strong></td>
<td>CP3 Unobscured farside pedestrian</td>
</tr>
<tr>
<td>Slower Lead Vehicle Target 20km/h Test 30-80km/h</td>
<td></td>
</tr>
<tr>
<td><strong>INTER-URBAN</strong></td>
<td></td>
</tr>
<tr>
<td>Lead Vehicle Decelerating 50km/h</td>
<td></td>
</tr>
</tbody>
</table>
WHAT TARGET?

COMPARISON OF DIFFERENT TEST TARGETS

RADAR and Camera Systems

Car
Assessor - Tyres
Assessor - Ground
Balloon Car

Rabbit & Assessor
Rabbit & Suzuki
ABsessor

Adult
Pedestrian target

Rabbit (Landrover Discovery with radar shielding) is not acquired as a target by the system.
**CAR & PEDESTRIAN TEST TARGETS**

**COMPARISON AT APPROACH SPEED \(\approx 20\text{KM/H}\)**

<table>
<thead>
<tr>
<th>Distance from target m</th>
<th>Avoidance distance m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golf</td>
<td>60.2</td>
</tr>
<tr>
<td>Balloon Car</td>
<td>52.5</td>
</tr>
<tr>
<td>Assessor</td>
<td>15.7</td>
</tr>
<tr>
<td>Assessor tyres</td>
<td>22.7</td>
</tr>
<tr>
<td>Rabbit &amp; Assessor</td>
<td>64.4</td>
</tr>
<tr>
<td>Rabbit &amp; Suzuki</td>
<td>50.6</td>
</tr>
<tr>
<td>ABsessor</td>
<td>78.8</td>
</tr>
<tr>
<td>Walking Man Target</td>
<td>7.8</td>
</tr>
<tr>
<td>Adult walking</td>
<td>20.7</td>
</tr>
</tbody>
</table>

- System outputs confidence level of an object based on radar and visual attributes
- Scored on a scale of 0-5 with 5 being the higher confidence (green)
- Score of 0 indicates insufficient visual detail to confirm the object (red)
Euro NCAP Vehicle Target

EVT

<table>
<thead>
<tr>
<th>Avoidance distance m</th>
<th>Match</th>
<th>Distance from target m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touran</td>
<td>0-4</td>
<td>98.2</td>
</tr>
<tr>
<td>AEB target</td>
<td>2.6</td>
<td>95.5</td>
</tr>
</tbody>
</table>
2014 City AEB Test
Car to car stationary

• Stationary target
• Test speeds 10 to 50km/h in 5km/h steps
• Preconditions:
  • Front seat whiplash score: ≥1.5 points (good)
  • Full avoidance at 10, 15 and 20km/h
• Reward for AEB only (FCW not considered)
• Full points for avoidance
• Mitigation rewarded proportionally to speed reduction

• Precondition: AEB system default ON at start of every journey
• Points awarded if deactivation NOT possible with a single button push
2014 City AEB Test
Car to car stationary

Mazda 6 CCRs AEB 20k  run 2
2014 Inter-urban AEB Test
AEB & FCW

- Stationary target
- Test speeds ranging from 30 to 80km/h
- Reward for Forward Collision Warning (FCW)
- No reward for AEB
- Mitigation rewarded proportionally to speed reduction

- Moving target 20 km/h
- Test speeds AEB 30 to 70 km/h
  FCW 50 to 80 km/h
- Reward for AEB and FCW
- Mitigation rewarded proportionally to speed reduction
- Maximum points awarded for AEB avoidance

- Test target and test vehicle initially driving at 50km/h
- 12m and 40m headways, target deceleration 2 and 6m/s²
- Reward for AEB and FCW
- Mitigation rewarded proportionally to speed reduction

- Precondition: AEB and/or FCW operate up to at least 80km/h
2014 Inter-urban AEB Test
Car to car stationary FCW
2014 Inter-urban AEB Test
Car to car moving

Mercedes E250 CCRm AEB 70k
2014 Inter-urban AEB Test
Car to car braking
## Inter-urban HMI points

Pre-conditions – no one button off switch, FCW must be ‘loud and clear’

<table>
<thead>
<tr>
<th>Activation</th>
<th>Supplementary Warning for FCW</th>
<th>Reversible pre-tensioning of belt (pre-crash phase)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points awarded if deactivation NOT possible with a single button push</td>
<td>e.g. head-up display, brake jerk, other haptic feedback</td>
<td>Belt is pre-tensioned if critical crash situation detected</td>
</tr>
<tr>
<td>2 points</td>
<td>1 point</td>
<td>1 point</td>
</tr>
</tbody>
</table>

[Image of HMI points]

[Image of warning display]

[Image of seat belt tensioning]
Modern AEB Performance
AEB City

Euro NCAP see a 38% overall reduction in real-world, rear-end crashes

- Volvo
- Mercedes
- VW/Audi/Skoda/Seat
- BMW
- Toyota/Lexus
- Nissan/Infiniti
- Alfa Romeo
- Mazda
- Honda
- Peugeot
- Opel/Vauxhall
- Jaguar/Land Rover
- Hyundai/Kia
Modern AEB Performance
Cars achieving 50km/h AEB City collision avoidance

- Alfa Romeo Giulia, Stelvio
- Audi Q2, A4 Q7 & A8
- BMW X3, 5 Series & 6 Series
- Honda Civic
- Hyundai i30, Ioniq, Tucson, Jonathan
- Infiniti Q30, QX30,
- Jaguar XF, F Type, XJ , E-Pace,
- Kia Moro, Picanto, Stinger, Stonic, Sportage
- Range Rover Evoque, Velar
- Mazda 3, CX3, CX5
- Mercedes GLA, CLS, E-Class
- Nissan Micra
- Opel Grandland X
- Peugeot 3008, 5008
- Seat Arona, Ateca, Ibiza, Karoq, Kodiaq, Octavia
- Toyota Yaris, Prius, CHR, RAV4, Verso, Pro Ace Verso, Hilux
- VW Polo, Passat, Arteon, Tiguán, T-Roc, Crafter
- Volvo XC60, XC90, S90, V90
AEB Effectiveness
Test performance & claims data

Testing

Low Speed

Volvo XC60
VW Golf

High Speed

Volvo XC60
VW Golf

Real-world insurance analysis

<table>
<thead>
<tr>
<th></th>
<th>Own Damage</th>
<th>Third Party Damage</th>
<th>Third Party Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volvo XC60</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>2%</td>
<td>-3%</td>
<td>7%</td>
</tr>
<tr>
<td>Cost</td>
<td>-9%</td>
<td>-8%</td>
<td></td>
</tr>
<tr>
<td>Third Party Injury</td>
<td>-26%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Own Damage</th>
<th>Third Party Damage</th>
<th>Third Party Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volkswagen Golf</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>-10%</td>
<td>-11%</td>
<td>-1%</td>
</tr>
<tr>
<td>Cost</td>
<td>-24%</td>
<td>-20%</td>
<td></td>
</tr>
</tbody>
</table>
AEB Effectiveness

City safety reduces insurance claims

Updated study of US insurance claims by Insurance Institute for Highway Safety (IIHS)

Weighted averages applied to US findings to represent UK market:
- Injury reduction 26%
- Damage reduction 15%

Summary of studies:

- Insurance claims study from Switzerland; 31% reduction in 3rd party rear-end claims
- Insurance claims study from Germany; 9% reduction in all claims
- Tristar worldwide (chauffeur fleet standard fit); 27% reduction rear impacts
- Volvo study of real world crashes in GIDAS; 19% were avoidable with City Safety

TREND: AEB is reducing collisions in the real world
AEB availability on new cars

New cars launched in...

Early 2020s - AEB mandated by regulation
AEB on Other Vehicle Types

HGV

EU Regulation No. 347/2012 - All vehicles > 8000 kg
Vulnerable Road Users
Pedestrian 2016 Implementation

13% of all road casualties

<table>
<thead>
<tr>
<th>Test scenarios based on top 3 pedestrian collisions</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Unobscured nearside walking adult" /></td>
</tr>
<tr>
<td><img src="image2" alt="Obscured running nearside child" /></td>
</tr>
<tr>
<td><img src="image3" alt="Unobscured farside adult" /></td>
</tr>
</tbody>
</table>

Many VRU systems only work in daylight
Day light testing Euro NCAP in 2016, Night testing likely 2018
Vulnerable Road Users
Cyclist 2018 Implementation

Cyclists 11% of all road casualties
Pedal cycle traffic increasing: 13% higher than 2005-9 average

The future: cyclist test 20km/h
2018 Euro NCAP AEB Testing
Additional tests and new target
2018 Euro NCAP AEB Testing
Additional tests and new target

City & Inter-Urban with 100, 75 and 50% overlap
## 2018 Euro NCAP AEB Testing

Additional tests and new target

UK insurance claims data analysis

<table>
<thead>
<tr>
<th></th>
<th>3rd party rear damage</th>
<th>1st party striking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>~50% stationary, 40% up to 30km/h</td>
<td>More than 90% up to 50km/h</td>
</tr>
<tr>
<td>Direction</td>
<td>More than 95% 6 o’clock, remainder 5 and 7</td>
<td>More than 95% 12 o’clock, remainder 11 and 1</td>
</tr>
<tr>
<td>Overlap</td>
<td>2/3 central or full width, 1/6 half to two thirds, 1/6 less than one third</td>
<td></td>
</tr>
</tbody>
</table>
## AEB Offset Testing

Additional tests and new target

<table>
<thead>
<tr>
<th>Make &amp; Model</th>
<th>Sensor technology</th>
<th>Target</th>
<th>Overlap</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercedes E-Class</td>
<td>Radar &amp; camera</td>
<td>GST</td>
<td>100%</td>
<td>Avoid</td>
<td>Avoid</td>
<td>Avoid</td>
<td>Avoid</td>
<td>Avoid</td>
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Vehicle Testing Targets

**Current vehicle testing targets**

**Representation**
- Suitable for full overlap rear end only

**Manoeuvrability**
- Straight line driving only

**Impactability**
- Low to moderate speeds, full overlap only

**Different designs**
- Increases development and confirmation workload

**New target requirements**

**Representation**
- Full 360° perimeter representation – radar, camera, lidar

**Manoeuvrability**
- Use stationary and travelling at speed – stability

**Impactability**
- Impactable at speed – minimal damage

**Different designs**
- Compatible with multiple carrier devices

**Economical**
- Durable or disposal

Euro NCAP Vehicle Target (EVT)

NHTSA Strikeable Surrogate Vehicle (SSV)
GVT Development Process

Achieving appropriate RCS
- Minimising platform effect – 22°edges, bulkheads and skirts
- Internal reflections – enclosing target
- dB return – increasing reflection whilst maintaining GPS
- Wheel well and wheels – separate wheel blocks

Visual representation
- Surface wrinkling – stiffeners added
- Repeatable construction – telltale circles/windows

Light reflective elements
- Applied to lights and licence plate
GVT Construction
Global Vehicle Target

Global Vehicle Target (GVT)
Target Interoperability

GVT

DRI Soft Car 360

DRI Low Profile Robotic Vehicle (LPRV)
ABD Guided Soft Target (GST)

DSD Ultraflat Overrunable robot (UFO)

ISO WG developing target attributes specification – referenced by Euro NCAP
2018 Inter-urban AEB
Car to car moving
Lane Support Systems
Emergency Lane Keeping
2020 Junction Collision Protection
Crossing and Turning

3/4 of all injurious accidents involving a car and another vehicle occur at junctions
2/3 occur where the vehicle fails to give way to vehicles approaching from the right

Mercedes E-Class
Cross Traffic Function
Up to 22mph

Volvo XC90 S90 V90 XC60
City Safety including braking in intersection
Up to 31mph
Example Junction Test Scenarios

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<th>Crossing Traffic</th>
<th>Pedestrian</th>
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Junction Collision Protection
Volvo XC90
Junction Collision Protection
Mercedes E-Class
2020 Reversing Pedestrian AEB Proposal

- ~1 in 6 pedestrian collisions are reversing
- ~1 in 3 MAIS 3+ injuries – upper leg and head
- Typically collisions with elderly pedestrians and children
- Speeds <10km/h
- Drivers rarely brake
AEB at Thatcham Research and in Euro NCAP

Colin Grover
Principal Engineer – ADAS & Automated Driving

November 2017