Deliverable 4.3

Car to PTW Assessment Protocol

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Executive Summary

The road map of Euro NCAP for 2020-2025 (Euro NCAP, 2017) foreseen the inclusion of Car to PTW scenarios for 2022. In the Euro NCAP Rating Revision (Euro NCAP, 2018) nine points are attributed to Car to PTW scenarios, given to PTW VRU the same weight that for the current pedestrian and bicyclist scenarios.

The objective of this report is to make a proposal for the distribution of points taking into account the results of the accidentology, the technical feasibility to address the different scenarios and the individual characteristics of each scenario. The proposal expressed within this report is strongly based in the existent assessments of Euro Ncap (Euro NCAP, 2019) (Euro NCAP, 2019).

The final proposition of MUSE is 3 points for Front Turn Across Path and Front Straight Cross Path respectively; 1 point for Front to Rear; 1 point for Emergency Lane Keeping Oncoming and 1 point for Blind Spot.

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1 Introduction

1.1 MUSE project

Despite representing a small part of the road users (e.g. 2% of the traffic in France) the percentage of motorcyclists in the total deaths is the highest of the VRUs (World road deaths in 2010: 23% PTWs, 22% pedestrian and 5% Cyclist). A motorcyclist is between 9 to 30 times more likely to be killed in a traffic crash than a driver (OECD, 2015).

In recent years, we have observed a decrease in the number of deaths on the roads. However, this reduction is not equal for all the different road users. If we take a look at the evolution of the mortality depending of the type of road user we see that, while in the case of cars it has been reduced by 50%, in the case of the motorcyclist this reduction it has been only of the 30%. (European Comission, Directorate General for Transport, 2016)

Concerned by this problematic, the French Government decide in 2015 to perform a study in collaboration with UTAC to evaluate the accidentology of the motorcyclists and the possibility of avoiding them or mitigating the consequences using the new ADAS systems. Knowing the importance of Euro NCAP in motivating the OEMs to invest in safety, in May 2016 the Interior Minister Mr. Bernard Cazeneuve and the Transport Minister Mrs. Ségolène Royal write a letter to Euro NCAP claiming for a safety rating involving PTWs. At the beginning of 2017 Euro NCAP includes the scenarios with motorcycles in their Roadmap 2020/2025 and the possibility of start to assess the presence of security systems in motorcycles.

However, how will it be possible to evaluate the systems without the necessary tools to do so? At the beginning of the project it did not exists the testing equipment who will allow us to evaluate the systems, not even a protocol in which the main scenarios and their characteristics are defined.

Furthermore, which will be the best systems to avoid the accidents? Will it generate new accidents? What about ADAS systems in the motorcycle? Is it feasible to perform real test to assess the systems?

The aim of this project was to answer these issues and to provide the OEMs and TIERs1 the tools that will enable them to develop and evaluate their systems. A first task consisted in studying the main accident scenarios and possible systems that could help to avoid them or, at least, reduce their consequences. Simultaneously, tools enabling to improve these systems and to evaluate their performances were developed.

1.2 Objectives of this report

The objective of this report is to make a proposition for the distribution of points proposed in the Euro NCAP rating revision of 2018 (Euro NCAP, 2018). For this proposal the results of WP1, that has identified the most important scenarios, and the discussions of WP5, in which the potential to address these scenarios with the current technologies were studied, has been considered. Furthermore, the special characteristics of each scenario regarding the severity of the injuries of the riders has been taken into account for asking full avoidance or a gradual rating considering the impact speed.

2 Definitions

Emergency Lane Keeping (ELK) – default ON heading correction that is applied automatically by the vehicle in response to the detection of the vehicle that is about to drift beyond the edge of the road or into oncoming or overtaking traffic in the adjacent lane.

Lane Keeping Assist (LKA) – heading correction that is applied automatically by the vehicle in response to the detection of the vehicle that is about to drift beyond a delineated edge line of the current travel lane.

Lane Departure Warning (LDW) – a warning that is provided automatically by the vehicle in response to the vehicle that is about to drift beyond a delineated edge line of the current travel lane.

Vehicle under test (VUT) – means the vehicle tested according to this protocol with a Lane Keep Assist and/or Lane Departure Warning system.

Time To Collision (TTC) – means the remaining time before the VUT strikes the GVT, assuming that the VUT and GVT would continue to travel with the speed it is travelling.

Lane Edge – means the inner side of the lane marking or the road edge

Distance To Lane Edge (DTLE) – means the remaining lateral distance (perpendicular to the Lane Edge) between the Lane Edge and most outer edge of the tyre, before the VUT crosses Lane Edge, assuming that the VUT would continue to travel with the same lateral velocity towards it.

Peak Braking Coefficient (PBC) – the measure of tyre to road surface friction based on the maximum deceleration of a rolling tyre, measured using the American Society for Testing and Materials (ASTM) E1136-10 (2010) standard reference test tyre, in accordance with ASTM Method E 1337-90 (reapproved 1996), at a speed of 64.4km/h, without water delivery.

Autonomous Emergency Braking (AEB) – braking that is applied automatically by the vehicle in response to the detection of a likely collision to reduce the vehicle speed and potentially avoid the collision.

Forward Collision Warning (FCW) – an audio-visual warning that is provided automatically by the vehicle in response to the detection of a likely collision to alert the driver.

Dynamic Brake Support (DBS) – a system that further amplifies the driver braking demand in response to the detection of a likely collision to achieve a greater deceleration than would otherwise be achieved for the braking demand in normal driving conditions.

Autonomous Emergency Steering (AES) – steering that is applied automatically by the vehicle in response to the detection of a likely collision to steer the vehicle around the vehicle in front to avoid the collision.

Emergency Steering Support (ESS) – a system that supports the driver steering input in response to the detection of a likely collision to alter the vehicle path and potentially avoid a collision.

Car-to-Motorbike Rear Stationary (CMRs) – a collision in which a vehicle travels forwards towards a stationary motorbike and the frontal structure of the vehicle strikes the rear structure of the motorbike.

Car-to-Motorbike Rear Braking (CMRb) – a collision in which a vehicle travels forwards towards a motorbike that is travelling at constant speed and then decelerates, and the frontal structure of the vehicle strikes the rear structure of the of the motorbike.

Car-to-Motorbike Front Turn-Across-Path (CMFtap) – a collision in which a vehicle turns across the path of an oncoming motorbike travelling at constant speed, and the frontal structure of the vehicle strikes the front structure of the motorbike.

Car-to-Motorbike Front Straight-Cross-Path Left (CMFscp-L) – a collision in which a vehicle travels straight across the path of a motorbike travelling in perpendicular direction, coming from his left at constant speed, and the frontal structure of the vehicle strikes the front structure of the motorbike.

Vehicle width – the widest point of the vehicle ignoring the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mud-guards and the deflected part of the tyre side-walls immediately above the point of contact with the ground.

Global Motorbike Target (GMT) – means the motorbike target used in this protocol as defined in the deliverable D2.1 of the MUSE project (Fritz & Wimmer, 2019).

T_{AEB} – means the time where the AEB system activates. Activation time is determined by identifying the last data point where the filtered acceleration signal is below -1 m/s^2, and then going back to the point in time where the acceleration first crossed -0.3 m/s^2.

T_{FCW} – means the time where the audible warning of the FCW starts. The starting point is determined by audible recognition.

Vimpact – means the speed at which the VUT hits the GMT.

Vrel_impact – means the relative speed at which the VUT hits the GMT by subtracting the velocity of the GMT from Vimpact at the time of collision.

3 Euro NCAP:

3.1 Road Map:

In the road map of Euro NCAP for 2020-2025 (Euro NCAP, 2017) is proposed for the first time the inclusion of PTW scenarios in the new Euro NCAP assessments. In this road map, Euro NCAP talks about the possibility of including from 2022 the assessment of AEB systems dealing with PTW in junction scenarios as Straight Crossing or Turning Across Path, or furthermore, for Head On scenarios.

Moreover, the potential of V2V communication between passenger cars and motorcycles and the will to promote this kind of systems in both, passenger vehicles and PTWs, is exposed. As analysed in WP5 the potential of V2V communication in complex accident scenarios by increasing the range of detection of passenger cars seems evident. Meanwhile their use to act directly in the car by themselves, without the validation of physical sensors seems at this moment uncertain.

3.2 Euro NCAP Rating Review 2018

Euro NCAP goes a step further giving more details about the scenarios that they imagine for 2022 in the Euro NCAP Rating Review of June 2018 (Euro NCAP, 2018). PTW scenarios enter in the box dedicated to VRUs with the same weight that the active safety systems for pedestrians or bicyclists.

The document proposes for 2022/2023 the inclusion of intersection scenarios with Turn Across Path and Straight Crossing Path manoeuvres. Furthermore, the inclusion of an assessment of Lane Support Systems considering PTW is suggested in a similar way to the current Emergency Lane Keeping assessment for C2C with overtaking and oncoming configurations.

The proposed distribution of points for 2022 is summarized in the table 3 of the Euro NCAP Rating Review (Euro NCAP, 2018):

AOP (40%)		COP (20%)		VRU (20%)		SA (20%)	
8	Front MPDB	16	Dynamic front	6	Adult head form[c]	3	Occupant Status[h]
8	Front FW	8	Dynamic side	6	Child head form[c]	3	SAS
6	Side AMDB	12	CRS installation	6	Cyclist head form[c]		
6	Side pole	13	Vehicle based[b]	18	Leg form[c]	3	AEB/AES Head-on[i]
4	Far side			3	*LSS PTW[d]	3	LSS C2C
4	Whiplash F/R			6	*AEB JA PTW[e]	3	AEB JA C2C[j]
				7	*AEB/AES Pe[f]	3	AEB/AES CCR[k]
4	Rescue[a]			2	*AEB Reverse Pe[f]		
				9	*AEB/AES Cy		
40	**Total AOP**	**49**	**Total COP**	**63**	**Total VRU[g]**	**18**	**Total SA**

Table 1 2022/2023 Points Allocation Euro NCAP Rating Review 2018

4 Results from WP1 and WP5:

4.1 Main accident scenarios in Europe:

In WP1 (Brookes, et al., 2019) were identified the main accident configurations between car passengers and motorcycles across Europe as shown in Table 2:

Accident Group	Weighted Percentage
Left Turn Across Path - Opposite Direction Conflict	22.58%
Straight Crossing Path - Right Direction Conflict	18.09%
Left Turn Across Path - Left Direction Conflict	15.91%
Follow-up Driving	8.13%
Straight Crossing Path - Left Direction Conflict	8.21%
Left Turn Across Path - Same Direction Conflict	7.06%
Parallel Driving	4.96%
Lane Change - Same Direction Conflict	4.51%
On Coming - Straight Driving	3.38%
Lane Change - Opposite Direction	2.85%
On Coming – Turning	1.83%
Left Turn Into Path - Rigth Direction Conflict	1.72%
Right Turn Into Path - Left Direction Conflict	0.49%
Reverse Across Path - Right Direction Conflict	0.28%
Reverse Crossing Path - Left Direction	0.00%
Parallel Turn - Same Direction	0.00%
Reverse Driving - Opposite Direction	0.00%
Right Turn Across Path - Right Direction	0.00%

Table 2 Rankig of scenarios

Over the half of the 62% of identified car to motorcycle accident scenarios occur at junctions, the most frequent accident group is Left Turn Across Path – Opposite Direction Conflict (16.03%), typified by the GDV accident scenario 211, followed by Straight Crossing Path – Right Direction Conflict (12.84%), GDV accident scenario 321, Left Turn Across Path – Left Direction Conflict (11.29%), GDV accident scenario 302 and then Straight Crossing Path – Left Direction Conflict (5.83%), GDV accident scenario 301. The next most frequent accident type is front to rear (5.77%) where the car is the rear impacting vehicle against a slower moving or stationary motorcycle. Renaming accident scenarios are head on conflicts either while both vehicles are traveling straight or cornering, lane change conflicts in the same or opposite directions of travel and variations on the car turning or travelling straight across the path of the motorcycle at junctions. A notable accident group, that although not as frequent as others but worthy of consideration as it potentially has similar sensing requirements as lane change manoeuvres, is Left Turn Across Path – Same Direction Conflict, GDV accident scenario 202 and 721.

4.2 Further clustering:

In WP1 trajectories and impact points were the main variables considered in order to generate the different accident configurations. From the point of view of the sensors and ADAS systems further cluster could be done. This clustering between different accidents scenarios is explained and justified in detail in WP5 (Núñez Miguel, D5.2 Potential Of ADAS Systems to Avoid PTW Accidents, 2019). After this process we identified seven main accident configurations:

Cluster	WP1 % of accidents
Crossing Left Direction	24,61%
Left Turn Across Path Opposite Direction	22,58%
Crossing Right Direction	19,81%
Blind Spot	16,53%
Follow up Driving	8.13%
Head On	8.06%

Table 3 Further Cluster of accidents scenarios, first version.

5 MUSE proposition for 2022:

5.1 Scenarios selected for 2022:

Considering the results it was decided to propose as scenarios for 2022: Rear stationary, Rear Braking, Front Turn Across Path, Front Straight Cross Path Left Direction, Emergency Lane Keeping Oncoming and Blind Spot. In the case of Blind Spot scenarios, it was decided to consider independently Left Trun Across Path Same Direction scenarios and let them out of the proposal for 2022 (Núñez Miguel, D5.2 Potential Of ADAS Systems to Avoid PTW Accidents, 2019):

Cluster	WP1 % of accidents
Crossing Left Direction	24.61%
Left Turn Across Path Opposite Direction	22,58%
Blind Spot (W/o LTAP-SD)	9.47%
Follow up Driving	8,13%
Oncoming	8.06%

Table 4 Further cluster of accident scenarios, final version.

Giving a percentage of potential accident configurations covered by the systems of almost the 70% of the accident configurations between a passenger car and a motorcycle. It is important to notice that the final configurations and ranges of speeds defined in the protocols doesn't cover the totality of the accidents but those that, at this moment, could be potentially addressed by ADAS.

If we compare the scenarios selected in MUSE with those proposed in the *Euro NCAP Rating Review 2018* (Euro NCAP, 2018) we found that they are similar. Just the Follow Up Driving scenario was not considered initially by Euro NCAP.

5.2 MUSE points distribution proposition:

Looking at the points proposed by Euro NCAP for the PTW, the selection done in the MUSE project and the different weight of those scenarios; the consortium decided to make the following proposition of distributions of points.

For Junction Assist we propose to pass from six to seven points to include Follow up Driving scenarios. These points will be distributed between Crossing Left Direction, Left Turn Across Path Opposite Direction and Follow up Driving, including this last one Car to Motorbike Rear Stationary and Car to Motorbike Rear Braking scenarios. Proposed distribution:

Junction Assist	WP1 % of accidents	Points
Crossing Left Direction	24,61%	3
Left Turn Across Path Opposite Direction	22,8%	3
Follow up Driving	8,13%	1

Table 5 Junction Assist scenarios.

For Lane Support Systems we propose to distribute two points equal distributed between overtaking and oncoming scenarios:

Lane Support Systems	WP1 % of accidents	Points
Blind Spot (W/o LTAP-SD)	9.47%	1
Oncoming	8,06%	1

Table 6 Junction Assist scenarios.

6 Scenarios Scoring

6.1 Car to Motorbike Front Straight Cross Path Left

A maximum of 3 points is available for AEB CMFscp-L. A normalised score is calculated based on the number of scenarios (out of 9) where the vehicle itself avoided the collision. This normalised score is multiplied with the available points for CMFscp-L.

Test Speed	CMFscp-L		
	GMT @ 30 km/h	GMT @ 40 km/h	GMT @ 50 km/h
10 km/h	1.000	1.000	1.000
15 km/h	1.000	1.000	1.000
20 km/h	1.000	1.000	1.000
TOTAL	9.000		
Scenario Points	3.000		

Table 7 Points distribution CMF-scp-L

6.1.1 Scoring example:

Test Speed	CMFscp-L		
	GMT @ 30 km/h	GMT @ 40 km/h	GMT @ 50 km/h
10 km/h	1.000	0.000	0.000
15 km/h	1.000	1.000	0.000
20 km/h	1.000	1.000	1.000
TOTAL	9.000		
Scenario Points	3.000		

Table 8 Points distribution example CMF-scp-L

$$TOTAL\ CMFscp - L = \%CMFscp - L * 3 = \left(\frac{1+1+1+1+1+1+0+0+0}{9}\right) * 3 = 2$$

6.2 Car to Motorbike Front turn across path

A maximum of 3 points is available for AEB CMFtap. A normalised score is calculated based on the number of scenarios (out of 9) where the vehicle itself avoided the collision. This normalised score is multiplied with the available points for CMFtap.

Test Speed	**CMFtap**		
	GMT @ 30 km/h	GMT @ 40 km/h	GMT @ 50 km/h
10 km/h	1.000	1.000	1.000
15 km/h	1.000	1.000	1.000
20 km/h	1.000	1.000	1.000
TOTAL	9.000		
Scenario Points	3.000		

Table 9 Points distribution CMFtap

6.2.1 Scoring example:

Test Speed	**CMFtap**		
	GMT @ 30 km/h	GMT @ 40 km/h	GMT @ 50 km/h
10 km/h	0.000	0.000	1.000
15 km/h	0.000	1.000	1.000
20 km/h	1.000	1.000	1.000
TOTAL	9.000		
Scenario Points	3.000		

Table 10 Points distribution example CMFtap

$$TOTAL\ CMFtap = \%CMFtap * 3 = \left(\frac{1+1+1+1+1+1+0+0+0}{9}\right) * 3 = 2$$

6.3 Car to Motorbike Rear Scoring

For Follow Up Driving, here considered as Car to Motorbike Rear (CMR), two different configurations are proposed: Car to Motorbike Rear Stationary (CMRs) and Car to Motorbike Rear Braking (CMRb). A maximum of 1 point is available. The scoring is based on normalized scores of the AEB and FCW functions, assessed in CMRs and CMRb scenarios. In the case of CMRb scenarios the use of a DBS or an ESS is open to discussion.

The assessment criteria used for this scenario is the relative impact speed Vrel_impact. The reasons for not asking for full avoidance in this scenario and to propose a gradual rating are related with the severity of the injures versus the relative impact speed and explained in detail in WP5 (Núñez Miguel, D5.2 Potential Of ADAS Systems to Avoid PTW Accidents, 2019). From Vrel_impact equal to 20 km/h not point is given independently of the speed as the risk of serious injures of the rider increase considerably.

6.3.1 Car to Motorbike Rear stationary:

For this scenario, we have six different tests covering the range between 10 and 60 km/h in steps of 10 km/h as defined in WP4 (Núñez Miguel, D4.1 Car To PTW AEB Test Protocol , 2019). The total score is calculated as a percentage of the maximum achievable, which is then multiplied by the points available for this scenario, in this case 0.5 points. The weight of each test speed is equally distributed.

The points available and the colour distribution for the different test speeds for CCRs and CCRb (50 km/h only) are detailed in the Figure 1:

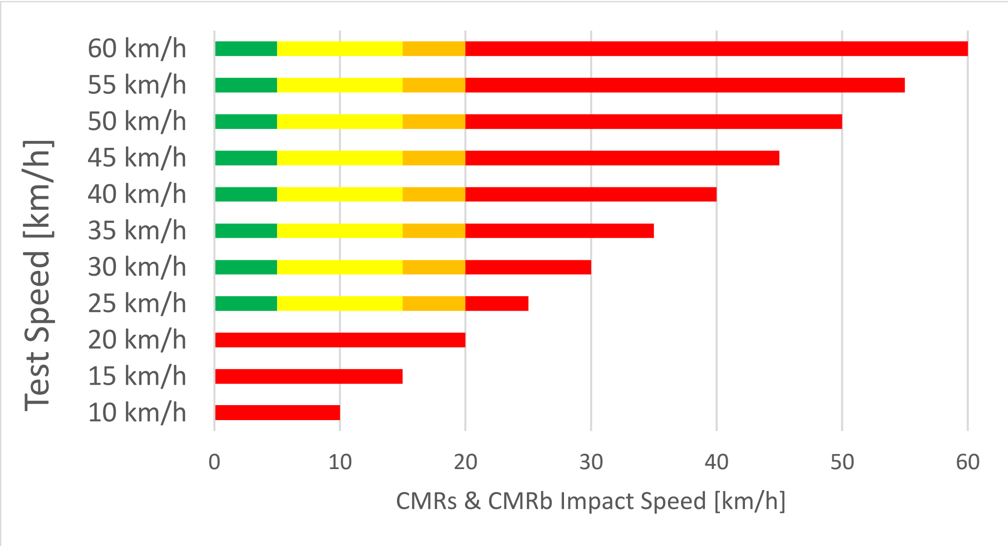

Figure 1 Colour distribution Impact Speeds

For each colour the following scaling is applied to the grid point:

Green	*1.000*
Yellow	*0.750*
Orange	*0.500*
Red	*0.000*

As the total number of tests is just six all tests are performed.

6.3.2 Car to Motorbike Rear braking:

For this scenario are defined four different tests at 50km/h and at inter distances of 12 and 40 m. Just one motorcycle deceleration of -4m/s² as defined in WP4 (Núñez Miguel, D4.2 Car To PTW LSS Test Protocol, 2019) is considered. The total score is calculated as a percentage of the maximum achievable for each function, which is then multiplied by the points available for scenario and function. A total of 0.5 points are given to this scenario, 0.3 for AEB and 0.2 for FCW functions.

For the colour distribution for the different test speeds for CCRb (50 km/h only) see Figure 1.

6.3.3 Points available for CMR scenarios:

The total score in points is the weighted sum of the CMR scores for AEB and FCW as shown below:

$$(CMRs\ AEB\ score\ x\ 0.5)$$

$$+(CMRb\ AEB\ score\ x\ 0.3)$$

$$\underline{+(CMRb\ FCW\ score\ x\ 0.2)}$$

$$\boldsymbol{AEB\ CartoMotorbike\ Rear\ total\ score}$$

6.3.4 Scoring example:

CMRs:

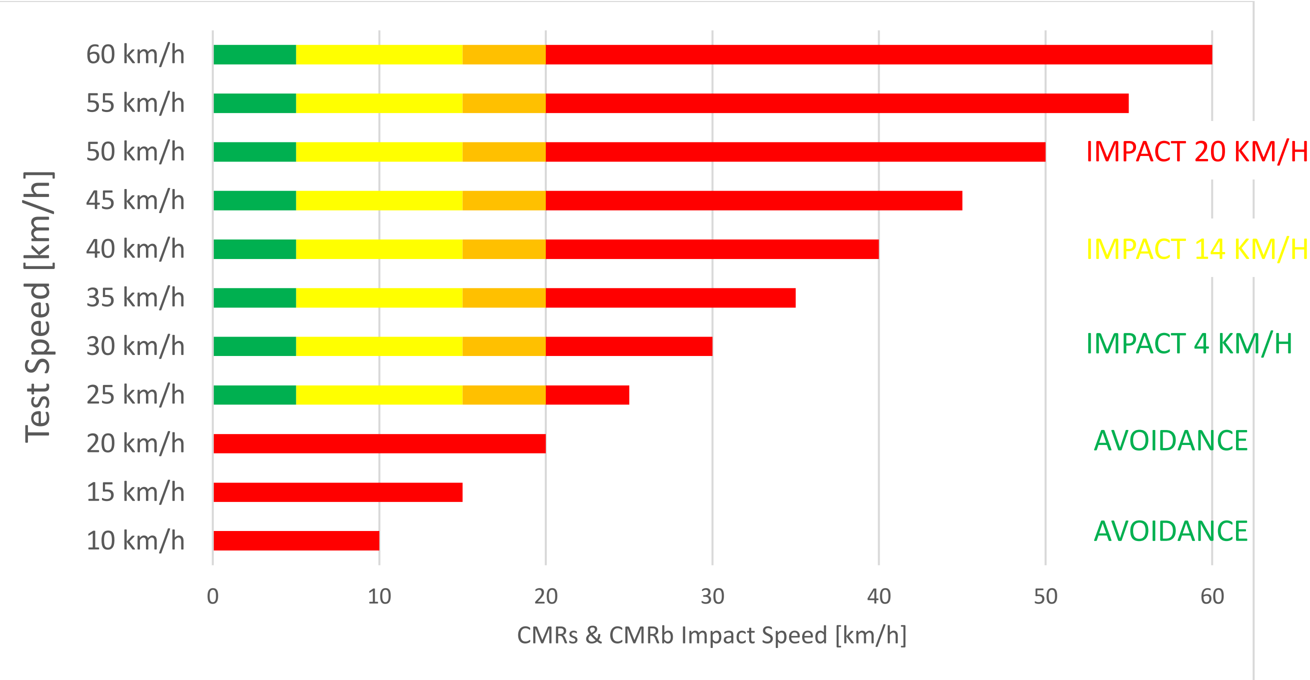

Figure 2 CMRs Example

$$CMRs\ AEB\ score = \frac{(1 + 1 + 1 + 1 + 0.75 + 0)}{6} = 79.17\%$$

CMRb:

AEB/FCW		Inter-distance		Inter-distance	
		AEB		FCW	
		12m	40m	12m	40m
Deceleration	0,4g	25Km/h	0km/h	10km/h	0km/h

$$CMRb\ AEB\ score = \frac{(0+1)}{2} = 50\%$$

$$CMRb\ FCW\ score = \frac{(0.75+1)}{2} = 87.5\%$$

TOTAL Car to Motorbike Rear:

$(CMRs\ AEB\ score\ x\ 0.5)$	$(79.17\%\ x\ 0.5)$
$+(CMRb\ AEB\ score\ x\ 0.3)$	$+(50\%\ x\ 0.3)$
$+(CMRb\ FCW\ score\ x\ 0.2)$	$+(87.5\%\ x\ 0.2)$
$\boldsymbol{AEB\ CartoMotorbike\ Rear\ total\ score}$	$\mathbf{0.7209}$

6.3.5 Impact speed tolerance

As test results can be variable between labs and in-house tests and/or simulations a 2 km/h tolerance to the impact speeds of the verification test is applied. The tolerance is applied in both directions, meaning that when a tested point scores better than predicted, but within tolerance, the predicted result is applied. The tolerance only applies to verify whether the predicted colour of the tested verification point is correct. When, including tolerance, the colour is not in line with the prediction, the true colour of the test point will be determined by comparing the actual measured impact speed with the colour band in section **Erreur ! Source du renvoi introuvable.** without applying a tolerance to the impact speed. As an example the accepted impact speed ranges for the 50km/h CCRs and CCRb tests are as follows:

Prediction	*Impact speed range [km/h]*	*Accepted range [km/h]*
Green	$0 \leq v_{impact} < 5$	$0 \leq v_{impact} < 7$
Yellow	$5 \leq v_{impact} < 15$	$3 \leq v_{impact} < 17$
Orange	$15 \leq v_{impact} < 30$	$13 \leq v_{impact} < 32$
Red	$40 \leq v_{impact}$	*excluded*

6.4 Emergency Lane Keeping Oncoming

In WP4 (Núñez Miguel, D4.2 Car To PTW LSS Test Protocol, 2019) is defined that in the case of ELK Oncoming it will be tested the unintentional change of lane of a car in the range of lateral speeds from 0.3-0.6 m/s.

For this scenario was decided to adapt the assessment of Euro NCAP for ELK Oncoming scenarios for C2C (Euro NCAP, 2019)

6.4.1 To be eligible for scoring points in ELK, the ELK part of the LSS system needs to be default ON at the start of every journey and deactivation of the system should not be possible with a momentary single push on a button.

6.4.2 For ELK tests with oncoming motorcycles, the assessment criteria used is no impact, meaning that the VUT is not allowed to contact the oncoming vehicle target at any time during the test.

6.4.3 The available points per test are awarded based on a pass/fail basis where all tests within the scenario need to be a pass. The points available for the ELK oncoming scenario is 1 point.

6.4.4 Scoring example:

If the car fails the lowest of the lateral speeds, it doesn't get any point independently of its performance in the rest of scenarios:

	Oncoming vehicle	
	0,3 m/s	FAIL
	0,4 m/s	PASS
	0,5 m/s	PASS
	0,6 m/s	PASS
ELK Oncoming vehicle assessment		**0,000**

Table 11 Points distribution Example for ELK oncoming

A car which attempt pass in the whole scenarios gets one point.

	Oncoming Motorcycle	
	0,3 m/s	PASS
	0,4 m/s	PASS
	0,5 m/s	PASS
	0,6 m/s	PASS
ELK Oncoming motorcycle assessment		**1,000**

Table 12 Points distribution Example for ELK oncoming

6.5 Blind Spot

In WP4 (Núñez Miguel, D4.2 Car To PTW LSS Test Protocol, 2019) is defined that in the case of Blind Spot it will be tested the intentional change of lane of a car in the range of lateral speeds from 0.6-0.9 m/s.

For this scenario was decided to adapt the assessment of Euro NCAP for ELK overtaking scenarios for C2C (Euro NCAP, 2019):

6.5.1 To be eligible for scoring points in Blind Spot, the Blind Spot part of the LSS system needs to be default ON at the start of every journey and deactivation of the system should not be possible with a momentary single push on a button.

6.5.2 For Blind Spot tests with overtaking motorcycles, the assessment criteria used is a latest time to collision for the TFCW.

6.5.3 Two different warnings, haptic, visual or acoustic are requested. Being the latest time for the second of them defined at a TTC of 1,2s. In case of systems providing no warnings or at lower TTCs the avoidance of the accident by correcting the trajectory of the car is requested.

6.5.4 The available points per test are awarded based on a pass/fail basis where all tests within the scenario need to be a pass. The points available for the Blind Spot scenario is 1 point.

6.5.5 Scoring example:

If the car fails the lowest of the lateral speeds, it doesn't get any point independently of its performance in the rest of scenarios:

ELK Oncoming vehicle assessment			
	Overtaking vehicle (GVT @ 50 km/h)		**Intentional**
		0,6 m/s	FAIL
		0,7 m/s	PASS
		0,8 m/s	PASS
		0,9 m/s	PASS
ELK Overtaking vehicle assessment			**0,000**

Table 13 Points distribution Blind Spot

A car which attempt pass in the whole scenarios gets one point.

ELK Oncoming vehicle assessment			
	Overtaking vehicle (GVT @ 50 km/h)		**Intentional**
		0,6 m/s	PASS
		0,7 m/s	PASS
		0,8 m/s	PASS
		0,9 m/s	PASS
ELK Overtaking vehicle assessment			**1,000**

Table 14 Points distribution Blind Spot

7 Références

Brookes, D., Padovan, G., Pasecnika, K., Fiorentino, A., Busiello, M. R., & Robescu, O. (2019). *D1.1 Accident Data Study.*

Euro NCAP. (2017). *Euro NCAP 2025 Roadmap, In pursuit of vision zero.*

Euro NCAP. (2018). *Euro NCAP Rating Review 2018.*

Euro NCAP. (2019). *Assesment Protocol - PP.*

Euro NCAP. (2019). *Assesment Protocol - SA.*

Euro NCAP. (2019). *Euro NCAP LSS Test Protocol v3.0.1.*

European Comission, Directorate General for Transport. (2016, June). Traffic Safety Basic Facts On Motorcycles & Mopeds.

Fritz, M., & Wimmer, T. (2019). *D2.1 Global Motorbike Dummy Specifications.*

Núñez Miguel, R. (2019). *D4.1 Car To PTW AEB Test Protocol .*

Núñez Miguel, R. (2019). *D4.2 Car To PTW LSS Test Protocol.*

Núñez Miguel, R. (2019). *D5.2 Potential Of ADAS Systems to Avoid PTW Accidents.*

OECD. (2015). *Improving Safety for Motorcycle, Scooter and Moped Riders.*

8 Acknowledgements:

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