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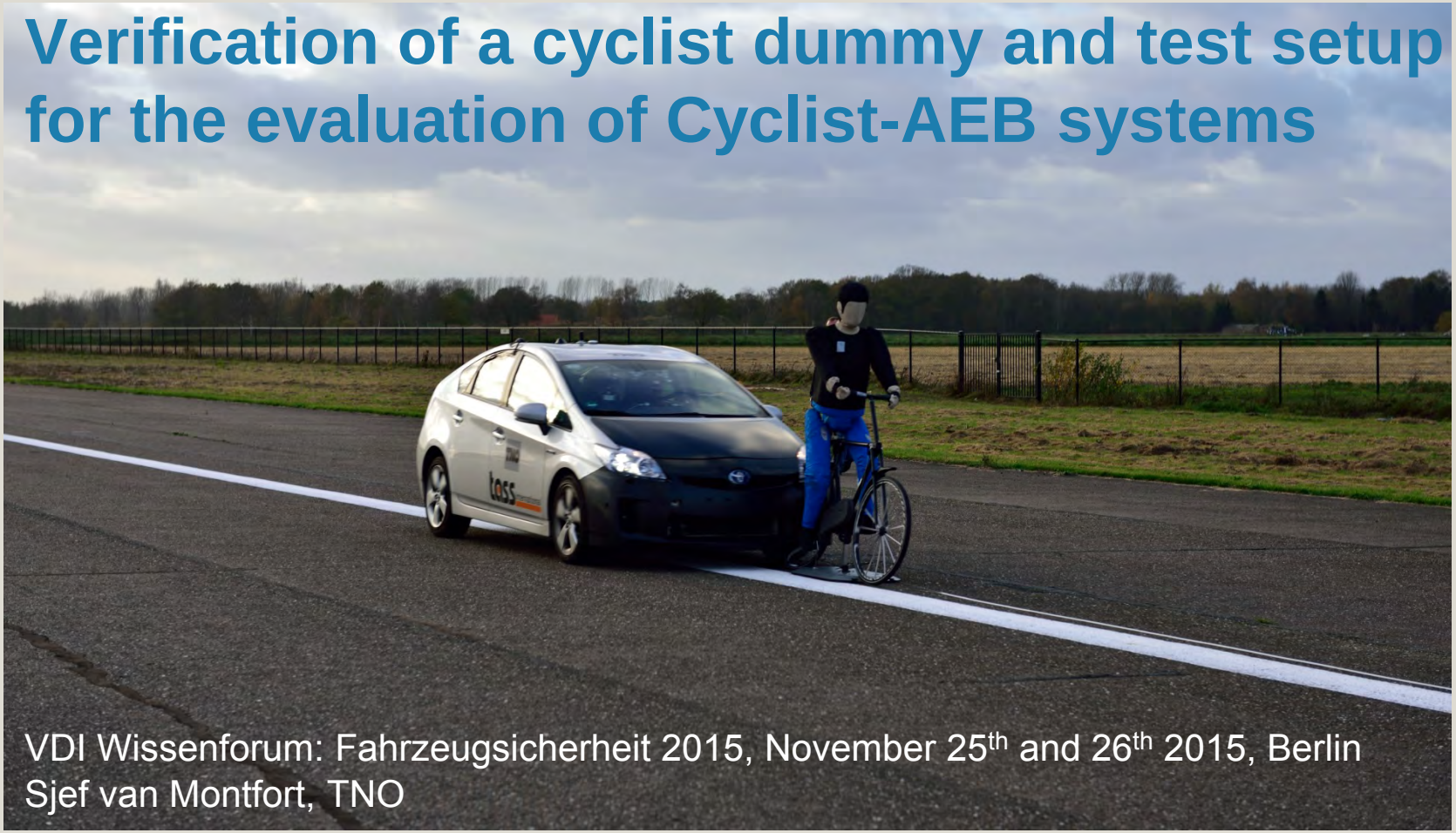
CATS: CYCLIST-AEB TESTING SYSTEM

Verification of a cyclist dummy and test setup for the evaluation of Cyclist-AEB systems



VDI Wissenforum: Fahrzeugsicherheit 2015, November 25th and 26th 2015, Berlin

Sjef van Montfort, TNO

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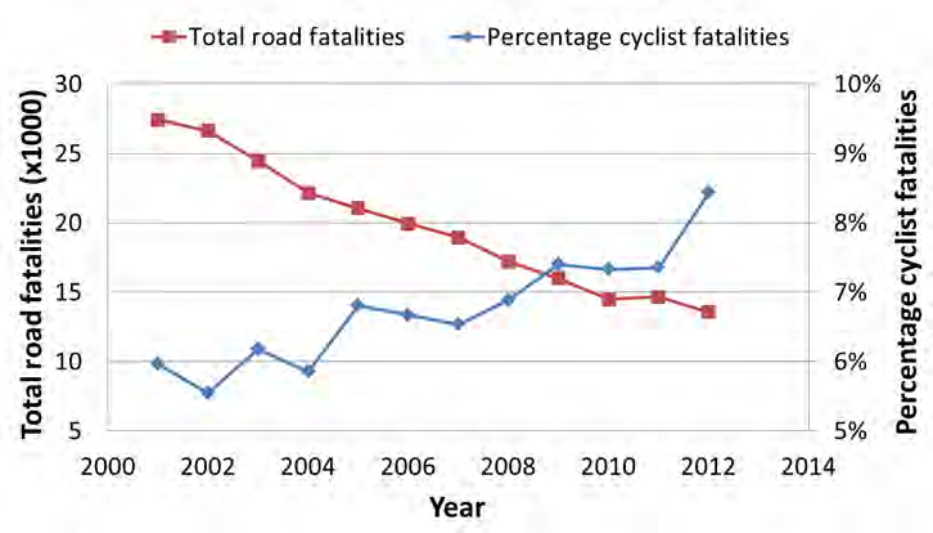
CATS: BACKGROUND

Cyclist safety growing issue in Europe:



Total number of road fatalities and cyclist fatalities over the period of 2001 to 2012 for: France, Germany, Italy, the Netherlands, Sweden and the UK

FOR SAFER CARS EURO NCAP

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CATS: OBJECTIVES & TIMING

Objectives CATS project:

- Prepare the introduction of a protocol for consumer tests of cyclist-AEB systems on board passenger cars.
- Propose a test setup (incl. hardware) and test protocol for cyclist-AEB systems based on technical/scientific considerations.
- Base the tests on analysis of most relevant cyclist accident scenarios in EU countries (with check to US and Japan).

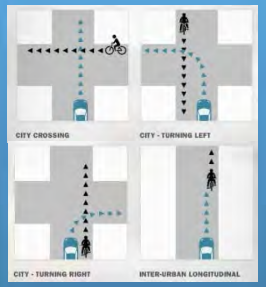
Timing:

- Start : 2014 Q2
- Finish : 2016 Q1

CATS: APPROACH

1 Accident Analysis

2 Test scenario definition



3 Dummy development

4 Propulsion system development

5 Verification & Testing

A: Partners

B: Test-houses

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CATS: WP1 ACCIDENT ANALYSIS

- Study databases for 6 European countries;
- Select severe car-to-cyclists accidents → fatalities and seriously injured;
- Provide overview of distinguished accident scenarios;
- Determine the distribution of scenarios in the different countries;
- Prioritize scenarios & indicate how many fatalities and seriously injured are covered.

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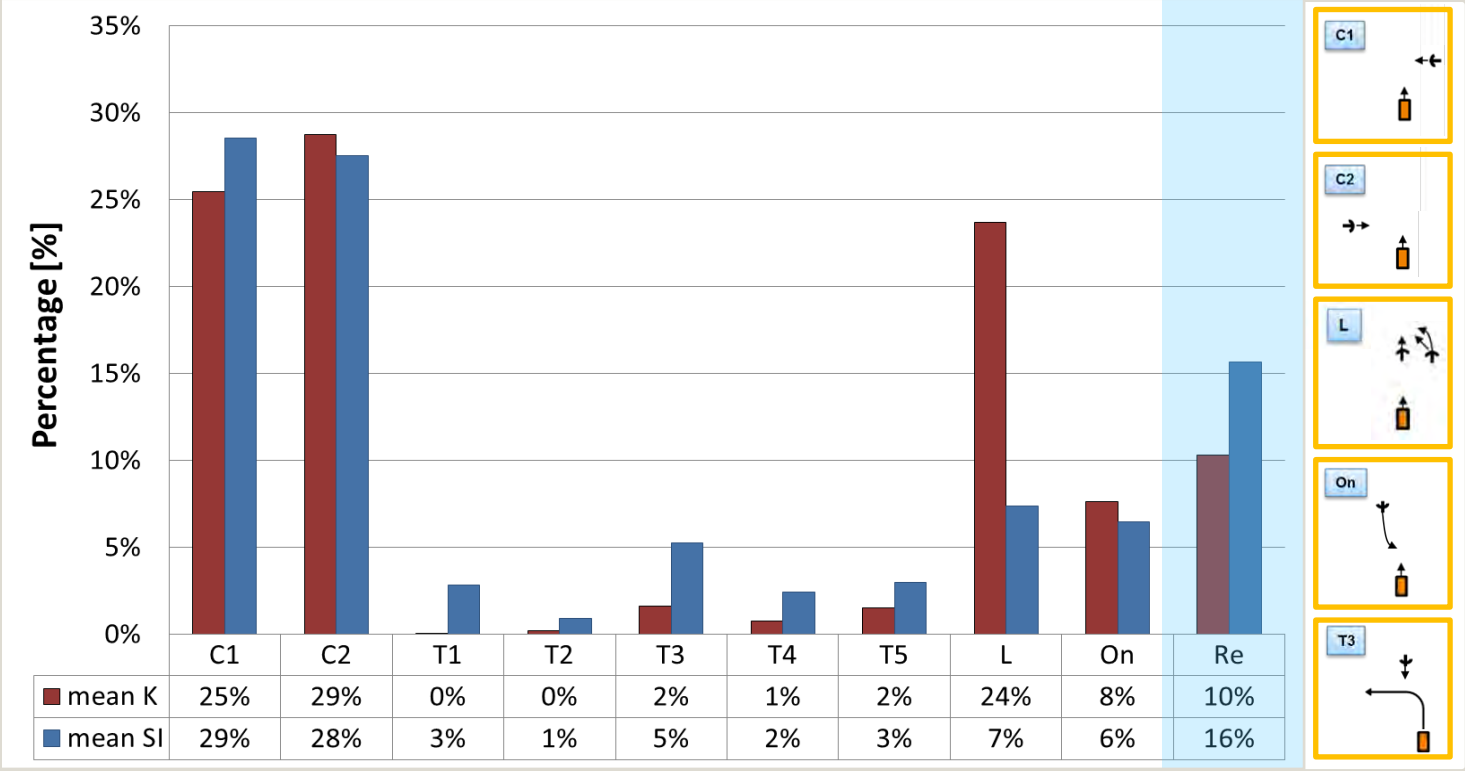
CATS: WP1 ACCIDENT ANALYSIS

Prioritization of scenarios:
Weight the results according to # cyclist fatalities per million inhabitants*:



	C1	C2	T1	T2	T3	T4	T5	L	On	Re
mean K	25%	29%	0%	0%	2%	1%	2%	24%	8%	10%
mean SI	29%	28%	3%	1%	5%	2%	3%	7%	6%	16%

Note: Italy not included due to limited amount data sets not being representative.

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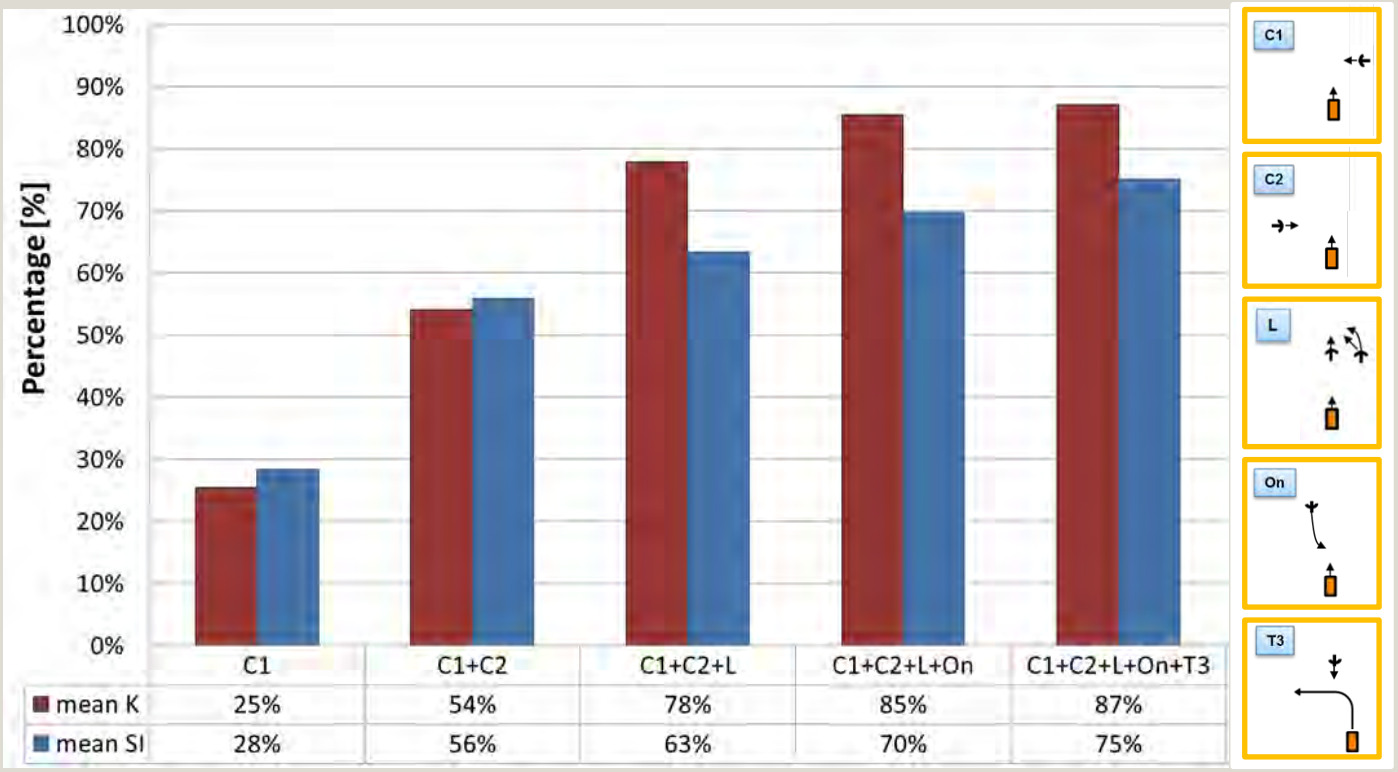
CATS: WP1 ACCIDENT ANALYSIS

Conclusion:
C1, C2 and L in all countries dominant.
The scenarios C1, C2 and L together cover already between 78% and 63%.



	C1	C1+C2	C1+C2+L	C1+C2+L+On	C1+C2+L+On+T3
mean K	25%	54%	78%	85%	87%
mean SI	28%	56%	63%	70%	75%

Note: Italy not included due to limited amount data sets not being representative.
More detailed information on accident analysis results can be found on www.tno.nl/cats

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CATS: WP2 TEST SCENARIO DEFINITION

Relevant accident parameters for C1, C2 and L.
Various available data sources are considered, including; accidentology, observation study and simulations.

Topics considered:

Accident scene	Accident partners
Precipitation	Cyclist speed
Lighting conditions	Cyclist age
Location	Cyclist size
Road layout, obstruction	Helmet use
Speed limit	Cyclist gender
Season	Vehicle speed
	Vehicle braking
	Hit point

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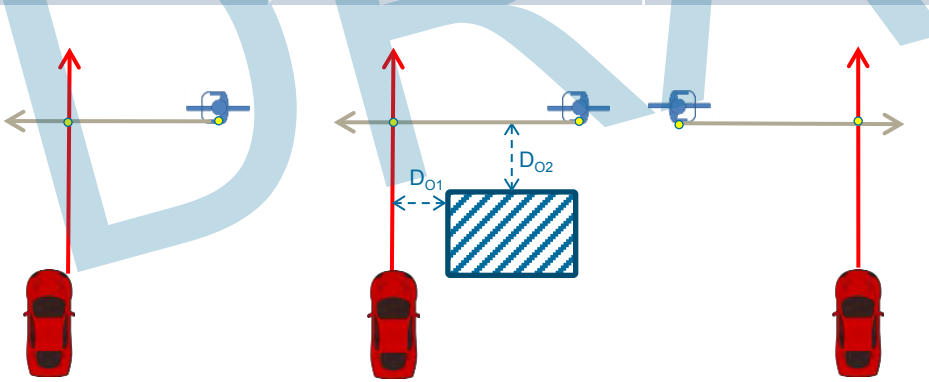
CATS: WP2 TEST SCENARIO DEFINITION (DRAFT MATRIX JUNE 2015)

	CVNBU	CVNBO	CVFB	CVLB*	
Scenario	Near side	Near side	Far side	Longitudinal	Longitudinal
Vehicle speed	20 – 60 km/h	10 – 40 km/h	20 – 60 km/h	30 – 60 km/h	65 - 80 km/h
Cyclist speed	15 km/h	10 km/h	20 km/h	15 km/h	20 km/h
Obstruction	Without	With D1=3.55m, D2=4.80m	Without	Without	Without
Overlap hitpoint	0 %	50 %	50 %	50%	20%
AEB / FCW	AEB	AEB	AEB	AEB	FCW
# tests [36]	9	7	9	7	4
Layout sketch					

* To be eligible for scoring points in AEB VRU Cyclist Longitudinal, the AEB system must reduce speed in CVLB - [?30-60?] km/h scenario with 20 % overlap.

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CATS: WP3 DUMMY DEVELOPMENT

4active SYSTEMS

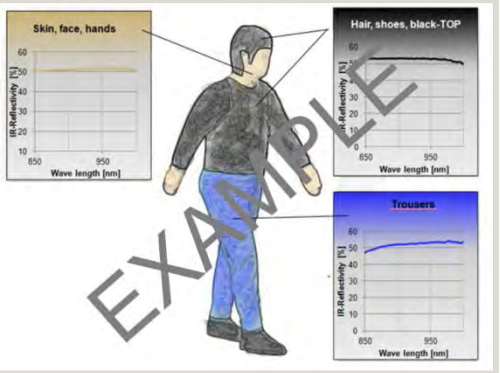
CATS specifies requirements on bicyclist and bike target wrt:

- Dimensions
- Features
- Sensing properties (camera, LIDAR, radar)
- Impactability/durability

More details on target definition can be found in VDI paper.

4activeSystems develops bicyclist and bike target meeting requirements.

	The Netherlands	Germany	UK	Spain	Sweden	France	Italy	EU	CATS (proposed)
Front reflector	-	Yes, white	-	-	Yes, white, only at night	Yes, white	Yes	-	√
Rear reflector	Yes, red (0,35-0,9 m from ground)	Yes, one red and one wide-angle	Yes, red	-	Yes, red (could be combined with the rear light), only at night	Yes, red	Yes	Yes, red	√
Pedal reflectors	Yes, yellow at front and rear	Yes, yellow at front and rear	Yes, amber	-	-	Yes, orange at front and rear	Yes, both sides	-	√
Wheel reflectors	Yes, white or yellow	Yes, at least 2 yellow or a white stripe	-	-	Orange or white side reflectors, only at night	Yes, orange	Yes	-	√
Front light	Yes, white, only at night/dark weather	Yes, white	Yes, only at night	-	Yes, fixed white or yellow light, only at night	Yes, yellow or white, only at night/dark weather	Yes, yellow or white	Yes, white or yellow	√
Rear light	Yes, red, only at night/dark weather	Yes, red (at least 250 mm from ground)	Yes, only at night	-	Yes, fixed red Light, only at night	Yes, red, only at night/dark weather	Yes, red	Yes, red	√



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CATS: WP3 DUMMY DEVELOPMENT

Various development sessions with CATS partners

Target Bike and Byciclist target vs. Real Bike and Bicyclist

	Static RCS							Dynamic RCS		Dynamic Micro-Doppler		Optical Representation		
	270.0	90.0	112.5	135.0	157.5	180.0	0.0	90.0	0.0	90.0	0.0	0.0	90.0	180.0
CATS partner 1	⇘	✓	⇘	⇘	✓	✓	✓	⇗		✓	✓		✓	✓
CATS partner 2	✓	✓				✓	✓	✓		✓	✓			
CATS partner 3												✓	✓	✓
CATS partner 4	⇘	✓	✓	✓	✓	✓	✓	⇗	✓			✓	✓	✓
CATS partner 5	✓	✓	⇘	⇘	✓	✓		✓	⇘	⇘	⇘	✓	✓	✓
....														

Example

⇧	much to high
⇩	much to low
⇗	bit to high
⇘	bit to low
✓	OK
✖	nOK

Definition: Real bike is the reference e.g. in this case the dummy RCS is bit to low compared to the Holland bike

CATS: WP3 DUMMY DEVELOPMENT

- Impactability/durability: Crossing at 30km/h

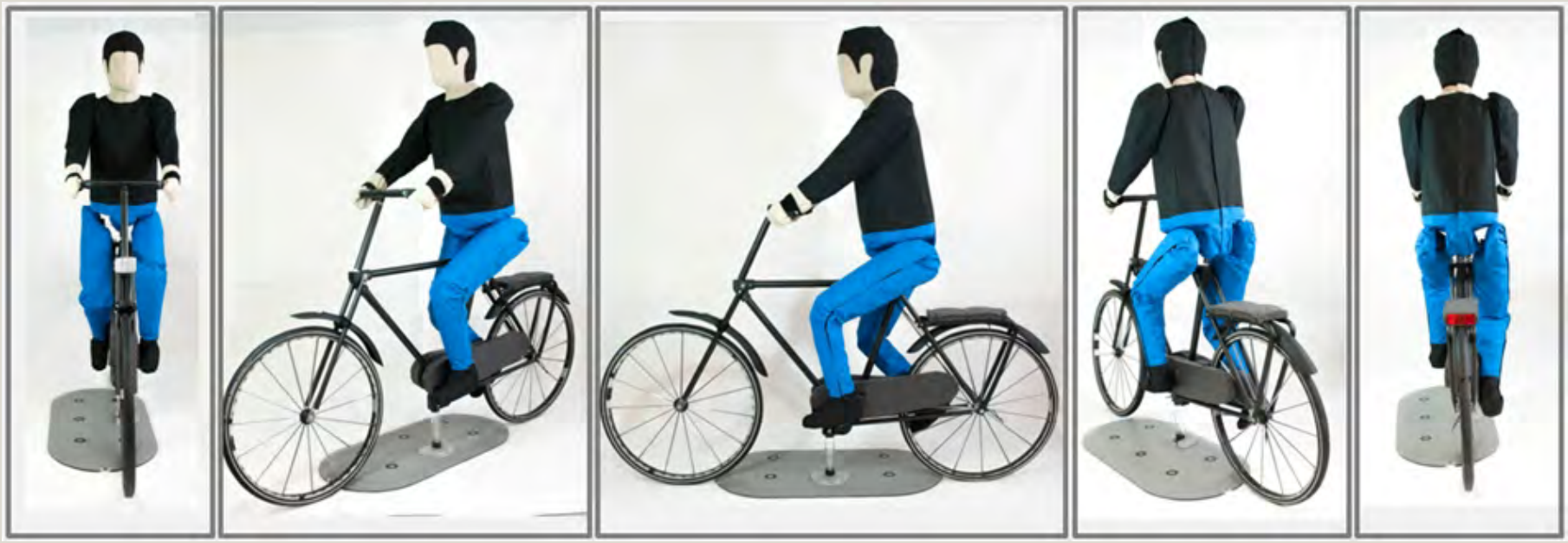
CATS: WP3 DUMMY DEVELOPMENT

- Impactability/durability: Longitudinal at 40km/h

CATS: WP3 DUMMY DEVELOPMENT

4a bicyclist and bike target v5

More details on target specifications can be found in VDI paper.

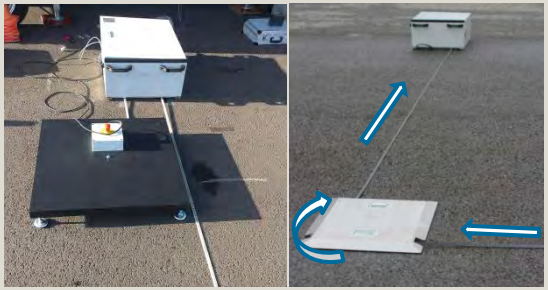


CATS: WP4 PROPULSION SYSTEM DEVELOPMENT

CATS specifies requirements on:

- General requirements
- Dimensions
- Dynamic properties

4activeSystems develops propulsion systems meeting requirements.



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CATS: WP5 VERIFICATION & TESTING

Various verification test sessions are being performed to verify both target and complete test protocol to ensure realistic representation of target and feasibility of test protocol.

Also impactability/durability has been assessed.

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CATS: WP5 VERIFICATION & TESTING

Crossing

Note: specially prepared vehicle that brakes at fixed TTC, no vehicle controlled AEB

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CATS: WP5 VERIFICATION & TESTING

Longitudinal

Note: specially prepared vehicle that brakes at fixed TTC, no vehicle controlled AEB

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CATS: NEXT STEPS

Next steps:

• November-December	Verification tests with bicyclist target to test feasibility of protocol and target performance.
• January-February	Final verification testing by CATS partners.
• March	CATS agreement on final CATS test matrix and final CATS target definition.
• End Q1 2016	Delivery of final CATS protocol including test matrix and target definition.

CATS: INFO


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CATS: INFO


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