



# **Forward Motion: Moving-Off Information Signal and/or Motion Inhibit Systems Regulation (MOIS)**

Overview of Potential Regulatory Approaches

VRU-Proxi-10-05

June 2019

# Potential Collision Characteristics to be Addressed

## Characteristics of [Low-Speed] Forward Motion Collisions

- VRU Crossing in Front of [Slow] Moving Ahead Heavy Vehicle

Data	Source
[30]% of EU HGV-VRU KSI – mainly pedestrians	(Volvo Safety report 2017)
[30]% of London HGV-VRU fatalities – mainly pedestrians	(Knight et al, 2018)
[36]% of London Bus-VRU fatalities – mainly pedestrians	(Edwards et al, 2018)



- VRU Crossing in Front of Stationary Heavy Vehicle that Moves Off from Rest

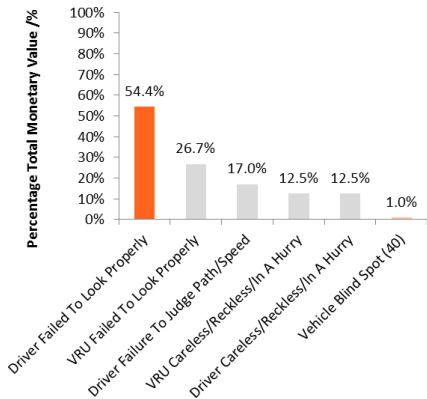
Data	Source
5% of EU HGV-VRU KSI – mainly pedestrians	(Volvo Safety report 2017)
32% of London HGV-VRU fatalities – mainly pedestrians	(Knight et al, 2018)
12% of London Bus-VRU fatalities – mainly pedestrians	(Edwards et al, 2018)



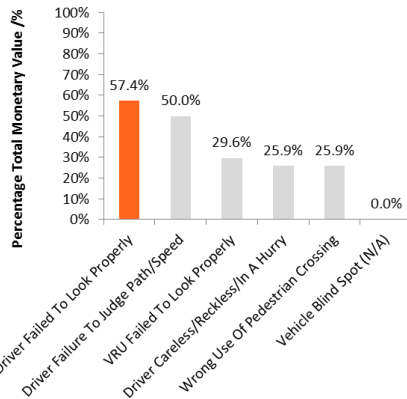
# Identifying Key Contributory Factors #1

## Leading Contributory Factors for MOIS casualties (EU28)

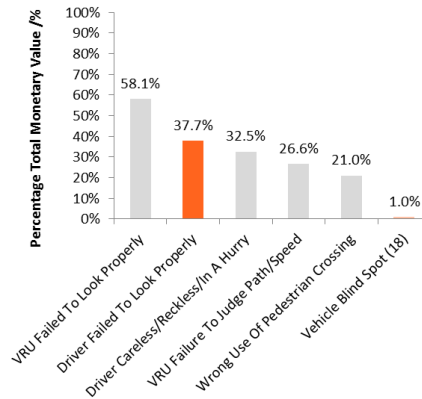
M1



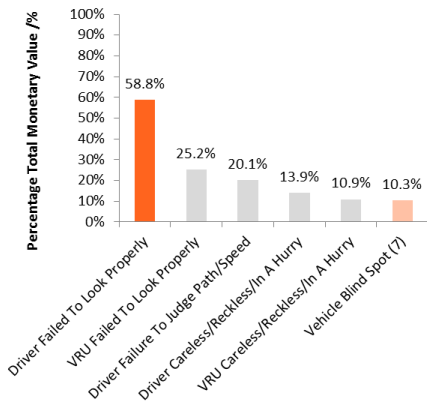
M2



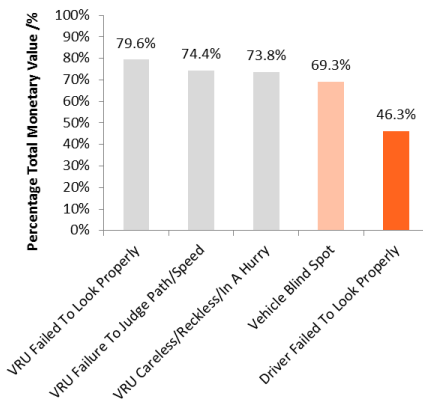
M3



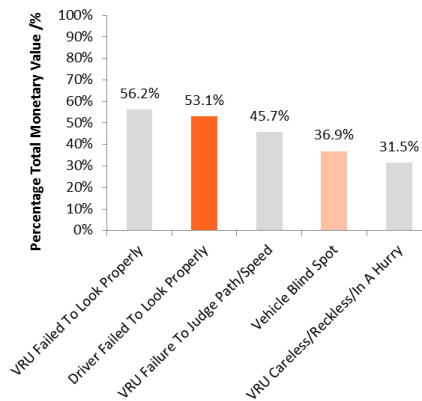
N1



N2



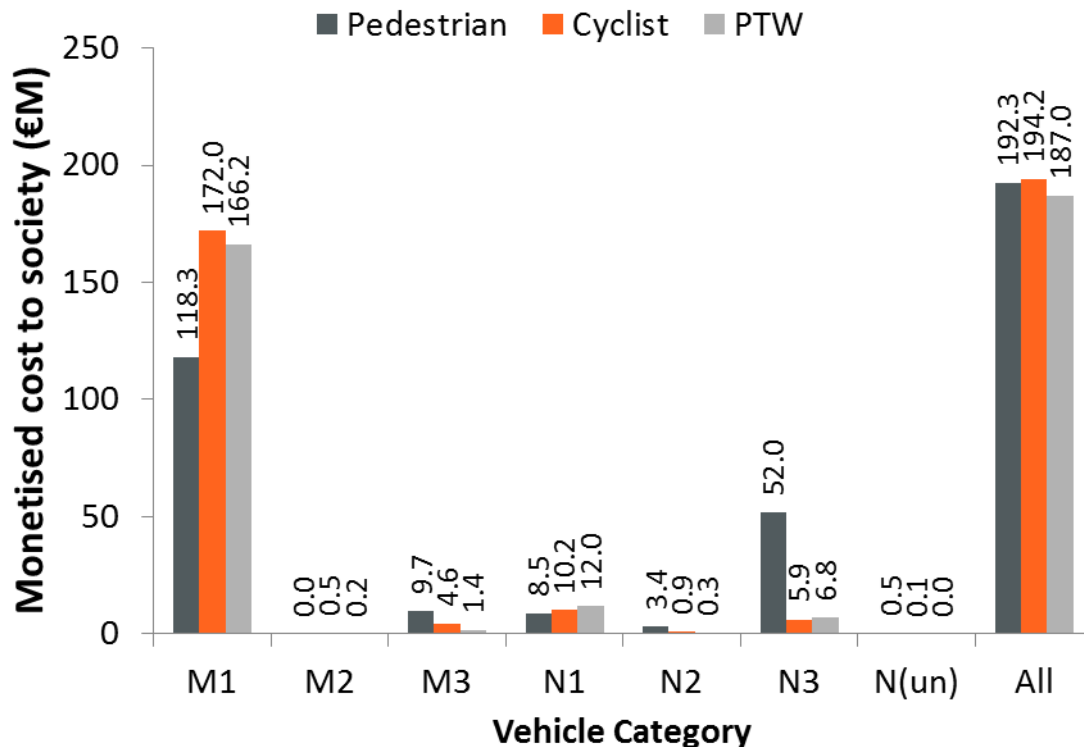
N3



# Identifying Key Contributory Factors #2

## VRU Casualty Share for MOIS casualties (EU28)

- MOIS Target Population
- Collisions between M1 vehicles and VRUs have highest societal costs
  - M3/N1/N3 also have significant societal cost
- VRU casualty share:
  - Pedestrians greater share for M2/M3/N2/N3 (particularly for N3)
  - Pedestrians/cyclists relatively equivalent share for M1/N1



# Identifying Key Contributory Factors #3

## Leading Contributory Factors for MOIS casualties (EU28): Conclusions

- “Vehicle Blind Spot (710)”
  - 35-70% of total societal costs associated with N2/N3 moving-off collisions
    - Means that, without improvements in direct/indirect vision, MOIS may be less effective in these cases
  - Very little effect on M1/M2/M3/N1(?) vehicle categories
- “Driver Failed To Look Properly (405)”
  - Leading CF for M1/M2/N1 vehicle categories
    - Also key CF for M3/N2/N3 vehicle categories
  - Broadly 35-60% of total societal costs associated with moving-off collisions
- VRU casualty share:
  - Pedestrians greater share for M2/M3/N2/N3 – particularly for N3
  - Pedestrians/cyclists relatively equal share for M1/N1

# Informing the Design of Regulatory Solutions

## Blind Spots During Low Speed/Moving-Off Manoeuvres

- When cause of collision strongly linked to blind spot...
  - VRUs close to front of vehicle
- Very little time between vehicle starting to move and collision occurring
- Collision warning has low effectiveness
- Forward VRU close-proximity information signal
  - May improve outcomes
  - Requires balance of alert effectiveness and intrusiveness of false positives
  - Detection range/direction & HMI will be key
- Moving-off motion inhibit
  - Potential to virtually eliminate collision
  - False positives or pedestrian reaction may cause problems with HMI/driver acceptance, but driver override could be provided

# Informing the Design of Regulatory Solutions

## Driver Failed to Look Properly During Low Speed/Moving-Off Manoeuvres

- When cause of collision strongly linked driver failing to look properly...
  - VRUs may be further away from front of vehicle *(NB: how far is not quantifiable in S19)*
- Greater time between vehicle starting to move and collision occurring
- Collision warning signal
  - Much more likely to be effective due to greater driver reaction times
- Forward VRU close-proximity information signal
  - Balance of alert effectiveness and intrusiveness of false, and even true, positives may be more challenging (as driver will be able to see VRU when alerted to proximity in most cases)
- Moving-off motion inhibit
  - Inappropriate due to pedestrian behaviour and steered path being a factor as well

# Key Questions on Regulation Philosophy

## Key Questions

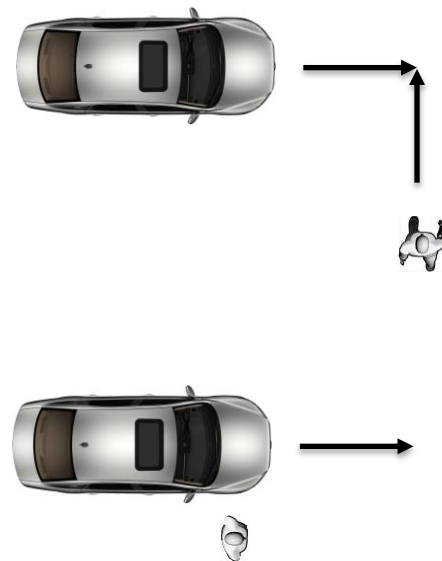
- Scope of regulation?
  - Vehicles: M2/M3/N2/N3; M1/N1
  - VRUs: Pedestrians/Cyclists
- Functionalities to be regulated?
  - Moving-off information signal; Moving-off collision warning signal; Moving-off motion inhibit
- Vehicle Movement?
  - Straight ahead/steering input; Moving-off from rest/moving ahead at low speed
- Regulation principles?
  - Test approaches: True-positive detection performance; False-positive performance; HMI
  - Test variables: Near/far; Crossing/stationary; Pedestrian/cyclist target; Clutter/hidden target/no confounding



# Regulatory Precedence for Draft MOIS Regulation #1

## Draft AEB Regulation for M1/N1 Detection of Pedestrians/Cyclists during Forward Motion

- Scope of regulation
  - Vehicles: M1/N1; VRUs: Pedestrians/[Cyclists]
- Test Scenarios
  - TP test: Forward VUT motion in straight line, at 20-60 kph speeds, with 6yo pedestrian target crossing at 5 kph from nearside with collision point at longitudinal centreline of VUT front end
    - Tested at 3 different specified speeds (+ other speeds at TS discretion)
  - FP test: As above, with pedestrian target stationary, facing VUT direction of travel and 1 m away from VUT nearside
    - Tested at 1 speed at TS discretion



# Regulatory Precedence for Draft MOIS Regulation #2

## Draft AEB Regulation for M1/N1 Detection of Pedestrians/Cyclists during Forward Motion

- **Functionality**
  - Collision warning signal/~~Emergency braking~~ functions
    - Collision warning signal phase shall be triggered before emergency braking phase
- **Requirements**
  - Specified maximum impact speed requirements, relating to initial vehicle speed
    - Can be used to back-calculate “last point of information” for collision warning signal
  - Collision warning signal HMI requirements
    - Two modes of information signal + other requirements
  - No signal/activation for FP test
- **Proposal for Consideration:**
  - Harmonise with functionality/requirements of draft AEB reg. re: collision warning signal?
  - Scope: M2/M3/N2/N3; Speed range: 5-20 kph; Test scenarios: Appropriate for far located VRUs only/include cyclist tests/stationary target in VUT path/near VRU tests/motion inhibit

# Regulatory Precedence for Draft MOIS Regulation #3

## Draft BSIS Regulation for N3 Detection of Cyclists during Nearside Turns

- Scope of regulation
  - Vehicles: N2>8T/N3 (Optional for M2/M3/N2<8T; VRUs: Cyclists)
- Test Scenarios
  - Dynamic tests: Forward VUT motion in straight line, at 5-30 kph speeds, with cyclist target moving alongside at speeds of 5-20 kph and distances of 0.9-4.25 m from VUT nearside, with timing to ensure both reach predefined collision point in foremost 6 m of VUT nearside
    - Tested at 7 different vehicle/cyclist speed combinations (+ other speed combinations at TS discretion)
  - Static tests: VUT at standstill with cyclist target crossing from nearside (perpendicular) 1.15 m in front of VUT and moving along the nearside (parallel) 2.75 m away from VUT nearside
    - Static scenario of cyclist crossing from nearside may perhaps conflict with MOIS regulation
- Functionality
  - Proximity information signal/Collision warning signal

# Regulatory Precedence for Draft MOIS Regulation #4

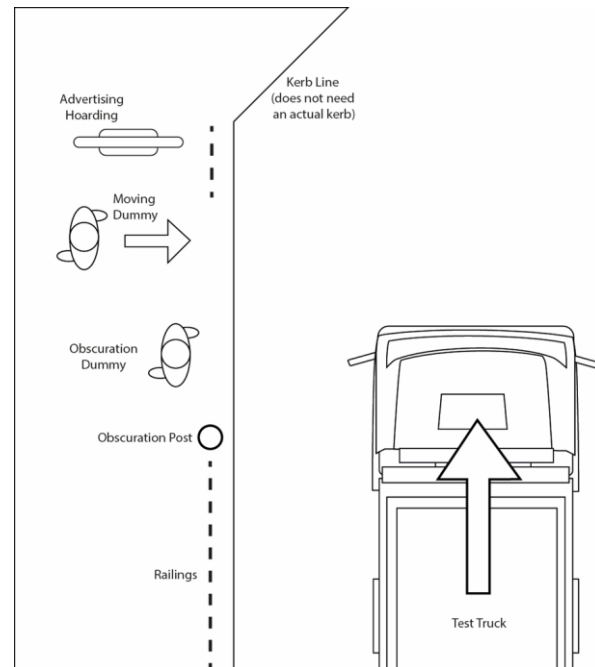
## BSIS Regulation for N3 Detection of Cyclists during Nearside Turns

- Requirements
  - Specified first and last points of information requirements
    - Related to vehicle/VRU speeds and the range of possible turn radii and impact points
    - Specified maximum detection boundaries for all tests
  - Collision warning signal performance requirements not defined
  - HMI requirements
    - Defined for both proximity information and collision warning signals
- **Proposal for Consideration:**
  - Harmonise with functionality/requirements of draft BSIS reg. re: static test 1?

# Regulatory Precedence for Draft MOIS Regulation #5

## TfL Blind Spot Warning Standards for M3/N3 Detection of Pedestrians during Forward Motion

- Scope of standards
  - Vehicles: M3/N3; VRUs: Pedestrians
- Test Scenarios
  - Proximity tests: Stationary VUT with pedestrian target crossing at 3-5 kph starting 2.2 m from nearside of VUT
    - Tested at combination of 2-3 VRU-VUT distances (0.3 m, [2.5] m & 4.0 m) and pedestrian targets (6yo and adult)
  - Collision warning/motion inhibit tests: Forward VUT motion in straight line from 0 to 10 kph with pedestrian target stationary in front of VUT between 25-75% width
    - Tested at combination of 2-3 VRU-VUT distances (0.3 m, [2.5] m & 4.0 m) and pedestrian targets (6yo and adult)
  - FP test: As above for proximity test, with pedestrian targets stationary prior to movement



# Regulatory Precedence for Draft MOIS Regulation #6

## TfL Blind Spot Warning Standards for M3/N3 Detection of Pedestrians during Forward Motion

- **Functionality**
  - Proximity information signal/Collision warning signal/Motion inhibit functions
- **Requirements**
  - Proximity information signal
    - Signal shall be available for when the pedestrian traverses at least the VUT forward motion path
  - Collision warning signal
    - Signal shall be available from start of motion to at least 0.75 TTC
  - Motion inhibit – requirement to inhibit motion before impact with pedestrian
  - HMI requirements on signal
  - No signal/activation for FP test
- **Proposal for Consideration:**
  - Harmonise with functionality/requirements of draft TfL standard esp. motion inhibit?
  - Scope: M2/M3/N2/N3; VRU type?

# Key Questions on Regulatory Precedence

## Key Questions

- Scope of regulation?
  - Vehicles: M2/M3/N2/N3; M1/N1
  - VRUs: Adult Pedestrians/Child Pedestrians/Cyclists
- Basis for drafting regulation
  - Draft AEB for pedestrians [and cyclists] regulation
  - Draft BSIS regulation
  - TfL standards for blind spot warning



# Questions?

**Dr Phil Martin**  
Head of Biomechanics

[pmartin@trl.co.uk](mailto:pmartin@trl.co.uk)  
+44 [0]1344 770 326

TRL | Crowthorne House | Nine Mile Ride | Wokingham  
Berkshire | RG40 3GA | United Kingdom