Draft report of the 6th Session GRSG informal group on awareness of Vulnerable Road Users proximity in low speed manoeuvres (VRU-Proxi)

Dates: 19-21 June 2018
Venue: AstaZero (proving ground)
Hällered Göksholmen 1
S-504 91 Sandhult (Sweden)
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Chairs: Mr. Matsui (Japan) and Mr. Broertjes (EC)
Secretary: Mr. Broeders (OICA)

The meeting started with a welcome by Mr. Matsui (Chair) from Japan and Mr. Broertjes (Co-chair) from DG-Grow (European Commission).

1. Introduction AstaZero

Mr. Håkan Andersson from AstaZero welcomed the group and explained the backgrounds and realization of the AstaZero proving ground. AstaZero has special focus on testing of active safety systems and autonomous vehicles. It has facilities to react and adapt fast on market changes and customer needs. AstaZero can also act as R&D and consultancy partner on area's like ICT, cyber security, V2V, V2X and scenarios with repeatable boundary conditions such as environmental (rain, fog, tunnel), novel targets (animal, e-bike), connectivity, automated transport systems etc..

2. Adoption of the agenda

Document: VRU-Proxi-06-01 (Chair)

Some changes to the order of the agenda subjects were proposed and agreed. The Co-chair asked CLEPA if there was an update on sensor technology. As there was no update the Co-chair expressed that this input from suppliers is essential for the next meeting as it is required to gain knowledge on the capabilities of the different type of sensors for setting up these regulations. Without this information it will be difficult to ensure that requirements remain technology neutral.

3. Adoption of the report of the 5th session (Brussels, Belgium)

Document: VRU-Proxi-05-13 (Chair) Revision 1

The report was adopted "pro forma" and the Co-chair proposed to give additional 2 weeks for final comments on the agenda. This proposal was accepted by the group.

4. Outcomes of the last session of GRSG (114th session, April 2018)

Documents: ECE/TRANS/WP.29/GRSG/93
GRSG-114-21 (VRU-Proxi)

DE has presented the status of the draft regulatory proposal of BSIS in the 114th GRSG session in April 2018. There were no fundamental issues or disagreements, following remarks were stated in the GRSG session:

- UK and NL were concerned about benefit / effectiveness and asked if these studies were available as drivers may rely on the system and put less visual attention.
- OICA stated that clear accident statistics are not available yet and no proof whether systems are available that can meet the requirements of the proposed regulation.
- BE suggested that system shall also be capable of detecting child dummies. Answer was that also a reduced size of the cyclist dummy as defined by ISO was described in the document.
- UK expressed that system de-activation by the driver is not preferred.
- Submitting working document to the October 2018 session of GRSG shall be done before 13 July 2018.

5. Accidentology

Document: VRU-Proxi-05-09 (OICA)
VRU-Proxi-06-06 (OICA)

OICA presented an update of the accidentology presentation with the following additional results:

- Injury criteria added and considered;
- Distribution of vehicle categories according to accident scenarios and injury severity;
- Updated data from CAN;
- Additional data from UK.

Basically three use cases were investigated: Turn Opposite to Driver Side (TODS), Reversing manoeuvres and Straight and Taking-off manoeuvres (STO).

Conclusions:

- Still lack of accident datsa, only data available from FR, BE, CAN, JPN and NL;
- Highest TODS fatality and injury percentages (mainly bicycles) within the available data are found in JPN and NL;
- Some figures of TODS may be overestimated because different speed ranges were considered within the national statistical accident databases;
- Mainly fatal accidents for pedestrians in reversing manoeuvres;
- STO casualties mainly caused by accidents with passenger cars (M1).

Feedback from the group:

- More recent data should be available in SAFETYCUBE (**OICA** to check)
- TRL will be contracted by EC for in-depth accident data analysis on EU- and national levels, the Co-chair asked once more for other contracting parties to provide accident data.
- Focus should be on N vehicles, M1 vehicles should not be considered here.

6. Forward motion Vehicle turning - Blind Spot Information System

Documents: GRSG-114-21 (VRU-Proxi)
VRU-Proxi-06-04 (Germany)
VRU-Proxi-06-05 (Germany)

DE presented a psychological approach of the human factors on the turning information concept to emphasize the following findings:

- The natural behaviour of the driver is to look at the trajectory that will be followed. Driver prepares before turning manoeuvre and driver's eye direction moved to the mirror before even the driver turns his/her head and view in the direction of the turn.

- Information shall be in area where driver looks and in area of hazard location but shall not be disturbing when driver is looking into straight driving direction. Well balanced flashing in order to avoid disturbance. BASt performed laboratory tests concerning the behaviour of drivers on visual stimuli in 20 and 60 degrees field while looking straight forward. For both angles the misses accounted for less than 2%.

- Disturbing to be avoided by using information instead of warnings as warning creates maximum attentional focus and may lead to distraction.

NL proposed to define the required location of the information signal (e.g. near A-pillar and/or within a horizontal angle area) in order to encourage the driver to notice the information signal while looking into the mirrors. DE agreed that this could be beneficial for the effectiveness of the system.

DE guided the group through the latest version of the draft regulation for BSIS. The purpose was to achieve a common agreement on the document as input for the 115th session of GSRG (October 2018). The following subjects and requirements have been discussed:

- The approval for installation within WVTA by body builder has been discussed. From an OICA point of view this may be possible but the preferred sensor location is on chassis or cab, not on body. For buses the sensors can only be mounted on the body (not yet decided if buses will be in scope of this regulation). Proposal is to start with the level of vehicle type approval and in second stage also requirements can be added/modified for a separate technical unit (component approval).
- The BSIS Taskforce questioned whether buses should be included as well. Germany explained that accident statistics don't underpin this need but basically it can be

considered as an if-fitted regulation and EU or CP can make it mandatory. EU is targeting for making this regulation mandatory for N2 > 8t, N3, M2 and M3.

- The group has decided to reduce the delta time for the FPI in relation to LPI from 8 to 4 seconds.
- The switching-off / deactivation criteria have been discussed. In some parts of Russia there is snow and high level of darkness for the complete winter period without any presence of cyclists. The Co-chair supposed to let the system check the environmental situations and allow a relatively easy deactivation of the (acoustic) warning by the driver but keep a re-initialization of the system after a key cycle. The information signal may only be deactivated by the system itself based on self-diagnostics on proper functionality.
- The reasoning for the 3 seconds was asked: this is to take the extra time for maintaining the information signal in case the truck is first turning to the driver side before making a turn to the co-driver side. If 3 seconds seems too less it can be adapted in a later stage.
- The group decided to add the requirement for an additional warning on top of the information signal. The warning shall be given if the system detects a potential collision. OICA raised some concerns as the feasibility and proof of effectiveness is missing. **OICA** to provide feedback on this subject (within deadline of 1 week).
- The lateral separation between the vehicle and the cyclist (handle bar) has been discussed and a range between 0.9 to 4.25m was decided with an additional zone from 0.25 to 0.9m in the front wheel area as a compromise. **CLEPA and OICA** to give feedback on the feasibility of this detection area (within deadline of 1 week).
- The meaning and sense of prohibiting the information signal on a static object while the cyclist is stationary (section 6.5.8) was questioned by CLEPA and OICA. **CLEPA and OICA** were asked to study on this.
- A requirement regarding lighting conditions corresponding with 1000 lux was added based on the definition of ambient light conditions from ECE R48. Accidentology analyses show typical accidents during daylight situations, there is no justification for dark conditions. It was agreed that if the system capability is sensitive to ambient light conditions the system need to detect the performance reduction and shall activate a warning for the driver. **Mobileye** and **FR** were asked to comment on the requirement for light conditions, otherwise the GRSG will have to decide.
- The bicycle and dummy size was re-defined as up to 36% smaller than the values defined by ISO. The resulting size corresponds with a 6-years old child.
- CLEPA showed some videos to explain some issues regarding the test cases:
    - In some test cases LPI is required too early. This issue was also pointed by OICA. Germany explained that this had been moved forward because the curve is taken out of the tests. Moreover the information signal shall not be annoying for the driver. OICA was also arguing that an information signal which is given too early will lead to possible driver's misunderstandings, ignoring or rejecting the signals. OICA asked again for a demonstration by a physical test with a system that performs according the proposed regulation but there was no common consent for this within the group.
    - FPI for test case 3 and 5 not useful as the vehicle speed and bicycle speed are equal. Explanation for the 15m for dc in the other test cases was due to the opposite manoeuvre that a truck-trailer combination would possibly make before making the left turn. A justification for the 15m will be added to the document in an introduction section. This value might be reduced if sensor

capability can be proven that the cyclist is being tracked when the truck is making an initial turn to the left of about 30 degrees (CLEPA/OICA to respond).

- It was agreed that the draft will initially follow a vehicle type approval based approach and in a later phase to include component/STU approval provisions.
- Deadline for submitting this draft Regulation as Working Document to GRSG 13 July 2018.

7. Direct Vision

Documents: VRU-Proxi-06-08 (Transport for London)
VRU-Proxi-06-09 (Loughborough Design School)

Transport for London presented the current status of the Direct Vision Standard (DVS) for Heavy Good Vehicles.

- This standard is one of the measures to reduce road fatalities and serious injuries in London down to zero by 2041. In London area there seems to be an overrepresentation of HGVs and grow in the amount of cyclists.
- It is a result of a collaborative approach of different interest groups like VRU groups, Academics, Government, Vehicle Manufacturers, Trade Associations etc.
- The DVS is an objective measurement of visible "volume of space" with a 0 to 5 star rating scheme. Heavy Good Vehicles require at least 1 star as from 2020 and at least 3 stars as from 2024 for a permit to enter into the city of London.
- If a vehicle does not meet the required star rating the alternative "safe system" requirements (indirect vision devices, sensor system, audible warning, etc.) must be met.

The Loughborough Design School presented the background, definition and testing of the DVS.

- This standard is based on measuring the visible part of a defined volume around the cab of a truck by means of CAD calculation models.
- Investigation has been done on type of accidents, first point of contact, causation factors, etc.
- The definition of the assessment volume and the 1 star rating boundary are based on the visibility of the smallest European female on the outer area of the legal field of view of the mirrors.
- The driver's eye point has been defined by a fixed offset from the accelerator heel point. This was defined with agreement of the manufacturers and is a standardized eye point which can be used with any vehicle. The Accelerator Heel Point definition from SAE 1516 and SAE 1517 is used. This eliminates any benefits linked to a declared R-point with large adjustment range of the seat.
- LDS provided a protocol and reference model for vehicle manufacturers to validate the calculation.

Plenary discussion on the DVS:

- The Co-chair explained his first proposal for regulation on direct vision for trucks on EU level: a minimum requirement of 1 star for all N3 trucks.
- The in-use compliance was discussed as there is probably no useful real world test for this regulation. An option would be self-certification by the manufacturers (by using CAD) with market surveillance checks. However CAD data might not always be available for low volume series trucks. Maybe dummies can be used around the truck in a physical set-up and check the distance at which they are visible from a standardized eye point (by means of laser scanners, light sources, etc.).
- FR suggested to combine or align these requirements with ECE R125 for M1 direct vision regulation.
- The Co-chair recommended to also take light trucks N1 and buses M3 into account, TfL expressed that TRL was commissioned for a direct vision standard for buses as well.
- T&E preferred differentiate between urban trucks and non-urban trucks.
- One-size fits all requirement is preferred as differentiation to vehicle classes seem not feasible as there is no direct relation between vehicle types and applications. In addition if the direct vision requirement cannot be met maybe active safety systems would be mandatory.
- OICA stated that 1 star might not be achieved by all vehicle types (especially long haul vehicles with flat floor and high driver comfort).
- The Co-chair referred to different ways of implementation of the Direct Vision regulation after finalization towards 120th session GRSG April 2021 (as defined in the VRU-Proxi Terms of Reference).
    - In case of new regulation CP can decide to implement immediately for all registrations or a future entry into force date (not usual but possible)
    - Amendments to existing regulation: transitional provisions to be defined
- Info from European Commission: EC has proposed direct vision for all trucks and buses (N2, N3, M2, M3). Direct vision is part of the 3rd package of the revised GSR with proposed introduction dates of 2026 for new vehicle types and 2029 for all registrations. However the dates are not fixed as Parliament / Member States can finally decide otherwise.
- Actions for next meeting:
    - Vehicle manufacturers to give feedback on the 1 star, is this achievable for all trucks based on conventional cab concepts (no low entry and no best-in-class approach) – **OICA (ACEA)**
    - How to deal with differentiating between highway and urban trucks, otherwise there will be one-size fits all – **OICA (ACEA)**
    - Contracting parties for certification and test protocol (virtually or measurement) - **CP's**

8. Demonstration of AstaZero proving ground

BSIS test cases were demonstrated to the group by AstaZero on the test track by using a real truck and a dummy bicycle. AstaZero showed that they are capable of performing the different test scenarios. Test scenarios 1, 2 and 3 were demonstrated. Furthermore the group was guided by a tour around the test track and different test facilities and capabilities were shown.

9. Evaluation of Pedestrian and Cyclist Warning Systems for Trucks

Document: VRU-Proxi-06-07 (Canada)
VRU-Proxi-06-10 (Mobileye)

CAN presented an update on the research on Evaluation of Pedestrian and Cyclist Warning Systems for Trucks: Track and Field Operational Tests. In Canada a VRU Task Force was installed to discuss safety measures for VRUs accidents with heavy trucks involvement and to explore cameras, sensor systems, side guards, educational safety and awareness programs. The presentation documented as VRU-Proxi-6-07 consists of the following parts:

1. Background and updated collision data, main conclusions (based on observations of the data):
    - Based on observations on the data: commercial vehicle drivers need assistance in detecting VRUs in close proximity to the vehicle.
    - Countermeasures should be examined to improve both direct and indirect visibility in combination with detection systems that alert drivers to VRUs.
2. Track testing of VRU warning systems, main conclusions
    - Ultrasonics: if the system warned, it was too late to avoid a collision.
    - Radar: there were issues with the narrow field of view of the radar for the tests. It also did not work in straight ahead scenarios because it was dependent on turn signals.
    - Cameras with 360 display: did not provide alerts.
    - Multi-camera image recognition system: (i.e., Mobileye Shield+) performed best overall.
    - 2-staged warnings gave drivers more opportunity to respond (preliminary yellow visual information, escalates to a crash imminent red visual/ auditory warning).
3. Field operational test (FOT) of warning systems, early survey comments (from operators, not from drivers):
    - Limitations: direct sunlight, alleys, dirty cameras, fog
    - Number of warning: 2,027 warnings (44,976 detections) for 14 city trucks (garbage trucks) in two months. The average of one city truck: 72 warnings per month.
    - Overall impression: it feels safer and so far general acceptance.
    - Initial reactions to warning: look at warning, look at on-board cameras (some trucks have supplemental driving aids such as cameras), look at pedestrians.
    - Other comments: “more aware of surroundings”, “extra set of eyes”.
    - Next steps:
        - Continuation of the collection of surveys from FOTs;
        - Further break down of the observations and results to vehicle type and warnings per km per vehicle.

Mobileye has presented the results from field tests with Shield+ in Europe and real-life scenarios related to blind spot information system.

1. Alert Data Analysis
    - Information signal triggered 60% by front detection 20% by passenger side detection and 20% by driver side detection,
    - TTC-based alert for trucks substantial more % on passenger side, for buses

more alerts on front side
- Ratio TTC-based alert versus information signal at trucks is 1:10.

2. Influx of information
   - Real life scenarios were showed with examples of cyclists that might appear in less than 3 sec difference and cannot be notified by the driver
   - Movies show cyclists who overtake trucks on driver side which may not be expected by the driver
3. TTC based additional layer of alert:
   - For straight driving the TTC needs to be no more than 1 sec (both driving in parallel but by steering movement the trajectories would intersect, depending on longitudinal and lateral positions).
   - For turning manoeuvres the TTC needs to be 2.5 sec.
   - Discussion on two layer warning: broad acceptance of a two layer warning to the discretion of the manufacturer, indicate the purpose of 2nd stage warning in text.

10. State of play of close-proximity vision and detection rulemaking in the contracting parties

Document: VRU-Proxi-05-04 (France)

As discussed in 5th VRU-Proxi session feedback from experts of the group is expected on possible ways forward as follow-up on presented regulation articulation proposal from FR.

The European Commission explained the progress of work of the GSR Phase 2 in Europe. On the 17th of May the GSR proposal has been presented to the European Parliament and Council. There 3 packages defined with different time of application depending on the entry into force date of the GSR. First package contains the VRU Detection measures (front, side and rear) and the third package contains the Direct Vision requirements for trucks and buses. Feedback from European Parliament and Council is expected after Summer 2018.

11. Reversing motion

Documents: VRU-Proxi-05-02 (Japan)
VRU-Proxi-06-02 (Japan)
VRU-Proxi-06-03 (Japan)

JPN presented an updated proposal for VRU-Proxi-02-03 Class VIII Field of Vision:

- Proposal for amendments of regulation: indirect vision devices (camera or sonar) and class VIII mirror
- Additional Class VIII field of vision, 9 poles of 1m height in area behind vehicle or trailer. Any part of the poles (e.g. the top of the poles) should be visible with the mirror, the indirect vision device or detected by a sensor system
- Field of view is now based on ISO standard (3.5m behind vehicle) is shorter than the required field of view in FMVSS111 (6m).
- FR stated that current Regulation R46 also contains combination of direct vision and indirect vision devices, so this would be possible for the regulation.

- Questions from the group:
    - Should the 9 poles be detectable at the same time, or first the first row than the second row as the first row might block the view of the camera or the area of detection in case of sensors. To be clarified.
    - For all categories? Also for trailers, depends if this is adopted (by EP and member states) and also depending on accident statistics. Complication with connecting and interface etc. Exemption of categories (e.g., trailer) shall be discussed later.
- The Co-chair asked Industry and CP's to think about a possible test procedure for the next meeting (**CPs / OICA**).

12. Status and developments of detection and vision technologies

The Co-chair asked CLEPA to present the status and developments of detection and vision technologies in the next 7th meeting with special attention to the systems/deliverables of the informal working group (VRU detection capabilities, front, side and rear). Mobileye would be able to change the algorithm and learn the system to detect typical objects. It was proposed to limit to 1m (= 7 years old child), otherwise the child is accompanied by an adult.

13. Forward motion Vehicle driving straight or taking off from standstill

This topic has not been discussed will be subject for next 7th meeting as a start. The Co-chair asked the group to provide proposals or ideas as preparation for the next meeting. (All)

14. Next meeting:

7th meeting: 25-27 September 2018 in Stuttgart, Germany, [exact location TBD]
8th meeting: 5-7 February 2019 in Yokohama, Japan, [Location TBD]