



## **Consequences for Human Competencies of Regulations regarding the Introduction of Automated Lane Keeping Systems: an Inventory and Critical Note**

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### *Introduction*

In 2021, the UNECE published Regulation 157 (UN Regulation No 157, 2021), paving the road for the type approval of Automated Lane Keeping Systems (ALKS) on highways during traffic jams up to 60 km/h, the first to be formally seen as an Automated Driving System (ADS) reaching level 3 autonomy as per SAE (SAE, 2018). With SAE level 3, an ADS takes over the entire dynamic driving task, meaning that the human driver could technically be out of the loop of the driving task. Which consequences this has for the competencies required from this human driver depends partly on the rules laid down by Regulation 157. Henceforth, an inventory has been made of the rules that (could) have consequences for the human driver, and consequently an overview and flowchart have been made that quickly depicts what an ALKS entails in terms of operational design domain (ODD). From this, a variety of ambiguities, open norms, and inaccuracies are critically discussed, and reflected against human capabilities.

### *Method*

Regulation 157 has been updated four times, with the fourth update (version 157.01), in contrast to the previous three (version 157.00), allowing a maximum speed of 130 km/h as well as automated lane changes. Since vehicle manufacturers can apply for a type approval of an ALKS ranging up to version 01, it sets version 00 as a basis. Hence, this inventory is based on the third update of Regulation 157.00 (dd. Sept 29<sup>th</sup> '22). Of this version, its chapters were first scanned for its relation with human competencies. Of the 14 chapters and 5 appendices, 4 chapters were deemed relevant for this research. The content of these 4 chapters were then summarized and grouped as a second step in the process. As a third step, the rules were visually represented for its ODD as well as put into a flowchart to visualize the modes, events, and consequences thereof. Additionally, a visual representation of the rules regarding the Driver Monitoring System (DMS) and dashboard notifications were developed.

### *Results*

From the inventory it became clear that a single, all-encompassing figure depicting the entire ODD would become cluttered and too detailed to easily comprehend. However, a global representation of the ODD of an ALKS (v. 00) combined with a flowchart describing how each mode could be followed by another together paint a relatively clear picture of what Regulation 157 entails for a human driving/being driven by an ALKS-equipped vehicle. Moreover, practicing step 2 of the methodology, various issues arose, which were consequently discussed. A visual representation of the ODD details five modes the vehicle could be in: in automated mode (AUTO), a transition demand, or: take-over request (TOR), an emergency manoeuvre (EM), a minimal risk manoeuvre (MRM), or in manual mode (Off). Each mode is accompanied



with some main, but not all, rules defining restrictive conditions, such as speed limit, specified environmental- and traffic conditions, and minimal detection range. A flowchart also depicts the modal flow depending on the relevant conditions the ALKS is in, plus to which conditions it then should adhere to, allowing for easier comprehension. A final figure gives a rudimentary understanding of what the DMS should be able to detect, and what information should minimally be presented to the human behind the steering wheel, as per Regulation 157 dictation.

### *Discussion*

Inventorying Regulation 157 based on human competencies-relevant rules was not as clear-cut as expected. The rules allow at times open norms for vehicle manufacturers to apply to their vehicles, which leaves much open for debate and interpretation. These open norms could potentially lead to confusion of consumers, when every vehicle is designed differently following these open norms, and not a human-centred design approach is taken (see e.g. Martens & van den Beukel, 2013; Yang, Han, & Park, 2017). Furthermore, the Regulation contains several ambiguous terms which opens up debate on how to interpret such terms. Examples are ‘logical’, ‘intuitive’, and ‘unambiguously’, which ironically in itself is ambiguous. Moreover, such ambiguity in terminology allows, as a possible consequence, proliferation, causing more issues (Maggi et al., 2022; see also Heikoop et al., 2016). A call for uniform definitions and approaches of these ambiguous terms that are within the boundaries of human competencies is therefor warranted. Lastly, several inaccuracies lead to confusion or apparent impossibilities, which could be avoided by different phrasing.

### *Conclusion*

Regulation 157 allows Automated Lane Keeping Systems (ALKS) to see the light of day. The rules contained by this regulation have several consequences to humans driving or being driven by such ALKS. The results of this inventory research allow for easier grasping of all things related to ALKS, but also stresses the complexity of it, questioning its comprehensibility for potential consumers. Finally, it highlights various issues concerning the rules in this Regulation.

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