Identifying the risks associated with automated vehicles across the system lifecycle

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Abstract

Advanced automated vehicles (AVs) are expected to enter the Australian road transport system imminently. This study aimed to conduct an initial proof of concept study to identify risks across the entire AV system lifecycle. The Networked-Hazard Analysis and Risk Management System method (NET-HARMS), a recently developed approach for systemic risk identification, was applied. The results map out the lifecycle for AVs, and identify a set of task and emergent risks, and concomitant risk control measures. The findings can assist to support road transport stakeholders to understand the systemic risks associated with the introduction of advanced AVs.

Background

While predictions vary, it has been suggested that advanced automated vehicles (AVs), that do not require human driver input into the driving task for at least part of the journey, are expected to enter the Australian road system from around 2020 (NTC, 2018). While automation will create safety and efficiency benefits, it also poses risks (Stanton & Marsden, 1996). For example, skill degradation can leave drivers unprepared to intervene in emergencies, software design failures can lie latent, and little is known about how AVs will interact with other road users (e.g. cyclists, pedestrians). Given that road transport as it stands today is a complex sociotechnical system (Larsson et al., 2010; Salmon et al., 2012; Salmon, Read & Stevens, 2016), it is suggested that systems-based methods can assist in identifying and managing the risks posed by these disruptive technologies.

Governments worldwide have begun to respond to the challenges. In Australia, a safety certification process has been adopted for the regulation of AVs which includes safety assessment criteria covering a range of requirements around design and validation processes, the human–machine interface, interaction with enforcement and emergency services, system upgrades, cybersecurity, training and education (NTC, 2018). The motivation for the current study was to provide further insights on what risks are associated with these various systemic factors, and how risks might combine in unanticipated ways.

Method

The Networked-Hazard Analysis and Risk Management System method (NET-HARMS; Dallat, Salmon & Goode, 2018) was applied. NET-HARMS is a methodology for systemic risk identification. It uses a four-step process:

1. Hierarchical Task Analysis (HTA) is applied to the system of interest. HTA describes the goals, tasks, operations and plans associated with the system.

2. A taxonomy for system risk assessment is applied to sub-tasks of the HTA. Credible risks for each sub-task are documented, along with risk control measures.

3. A task network is created of the sub-tasks from Step 2, defining relationships between sub-tasks (i.e. which are associated with, or dependent on one another).

4. Identification of emergent risks. Emergent risks are additional risks that arise because of interactions between risks identified during Step 2. This involves identifying risks that arise when a task is impacted by a risk that has occurred during a related task. The underlying principle around exploring linked tasks is that risks will interact and, if initial task risks identified are not managed appropriately, additional emergent risks arise.

Results

The HTA contains nine key high-level tasks that are undertaken in the road transport system – including design (of AVs, other vehicles and road infrastructure), testing and approval activities, operations (including incident response and enforcement), maintenance and upgrade (including software upgrade), and management of the road system overall (including setting of strategies, performance reporting and securing funding). Task and emergent risks were identified for sub-goals, along with potential risk control measures.

Conclusions

The findings from this study can support road transport stakeholders to understand the broad set of systemic risks facing the road transport system associated with the introduction of advanced AVs.

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