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MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE

SUBMISSION TO THE NATIONAL TRANSPORT COMMISSION ON THE ISSUES PAPER: DEVELOPING TECHNOLOGY-NEUTRAL ROAD RULES FOR DRIVER DISTRACTION

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PREAMBLE

This submission is provided in response to the National Transport Commission's Issues Paper on developing technology-neutral road rules for driver distraction.

The submission focusses on distracted driving research conducted by MUARC; however, where relevant, research conducted by other organisations is used to confirm and corroborate MUARC's research findings or provide supporting evidence for statements made. The opinions of, and the recommendations made, derive from the authors' own research and their understanding of the broader distracted driving literature and the wider fields of human factors and transport psychology.

This submission addresses the following five questions from the Issue Paper for which MUARC has conducted relevant research:

2. Does the proposed definition capture all the behaviours that lead to driver distraction and a reduction in driving performance?

3. How could a distinction between manageable and unmanageable levels of driver distraction be used to inform the way distraction is regulated? What evidence-based distinctions could be considered?

4. Should conventional and technology-based causes of distraction be treated equally in the Australian Road Rules? Why?

5. Can you provide examples of effective non-regulatory approaches to driver distraction that assist drivers to self-regulate their behaviour in a dynamic driving environment?

7. Are there other parties besides the vehicle driver who can influence the risk of driver distraction? If so, are there mechanisms to ensure those parties are doing all that is reasonably practicable to ensure safety?

A Common Definition of Driver Distraction

2. Does the proposed definition capture all the behaviours that lead to driver distraction and a reduction in driving performance?

"*Driver distraction is the voluntary or involuntary diverting of attention, in a visual, manual, auditory or cognitive sense, away from the driving task to focus on a competing secondary activity.*"

The definition proposed in the Issues Paper has a number of positive attributes. It is encouraging that the definition captures that the diversion of attention can be either voluntarily or involuntarily and that distraction can involve a number of different resources: visual, cognitive, auditory and manual.

The definition does not include a statement regarding the outcomes of distraction, such as its impact on specific driving measures. Defining distraction in terms of an outcome can be problematic because the judgement of distraction then depends on drivers displaying degraded performance on one or more of a vast number of driving or behavioural measures (Lee, Young & Regan, 2009). These performance degradations may be present (or have the potential to develop), but not actually manifest to measureable levels unless a certain combination of roadway events occurs.

Although discussed in the proceeding text of the Issues Paper, the definition itself does not capture that driving-related tasks can be a form of distraction. The potential for driving tasks to pose a distraction will become more important as Advanced Driver Assistance Systems (ADAS) become more prevalent in vehicles. If not designed in an optimal way, ADAS that provide assistance in time sensitive situations, such as collision warning systems, may be even more likely to distract drivers if multiple warnings occur at the same time, if the warning is poorly timed or if drivers are not aware of the meaning of the warning (e.g. Campbell et al., 2007; Lee et al., 2004; Wogalter et al., 2002). In the definition of distracted driving developed by Lee, Young and Regan (2009), the words "*diversion of attention away from activities critical for safe diving*" were included to capture that drivers could be distracted from driving-related tasks. Similar wording could be considered for inclusion in the definition proposed by the NTC.

Drivers can and do engage in multiple competing tasks at once while driving. Recent findings from the Australian Naturalistic Driving Study (ANDS) reveal that it is not unusual for drivers to engage in multiple tasks at once. Approximately 20 percent of the secondary task events identified in this study involved the driver engaging in multiple non-driving tasks at once (Young et al., In Press). Based on this, we suggest deleting the word 'secondary' from the proposed definition and consider changing the wording of the definition to "*…to focus on one or more competing activities*".

Therefore, MUARC proposes the definition be modified to:

"*Driver distraction is the voluntary or involuntary diverting of attention, in a visual, manual, auditory or cognitive sense, away from activities critical for safe diving to focus on one or more competing activities.*"

Types of Driver Distraction

3. How could a distinction between manageable and unmanageable levels of driver distraction be used to inform the way distraction is regulated? What evidence-based distinctions could be considered?

Determining what are manageable (safe) and unmanageable (unsafe) levels of distraction is difficult. The risk associated with engaging in secondary tasks while driving varies as a function of the attentional demands of driving and how drivers distribute their attention across the driving and the competing tasks (Lee, Young, & Regan, 2009). Secondary task engagement becomes particularly risky when there is a temporal overlap between driver engagement in the task and a high workload segment of driving (see Figure 1 taken from Lee,

Young & Regan, 2009). Risk increases because the added attention demanded by the roadway exceeds the amount of attention that the driver is devoting to it, placing them at greater risk of a distraction-related incident. Of course, driving demand is dynamic and often unpredictable, making it difficult to develop criteria that distinguishes manageable from unmanageable levels of distracted driving.

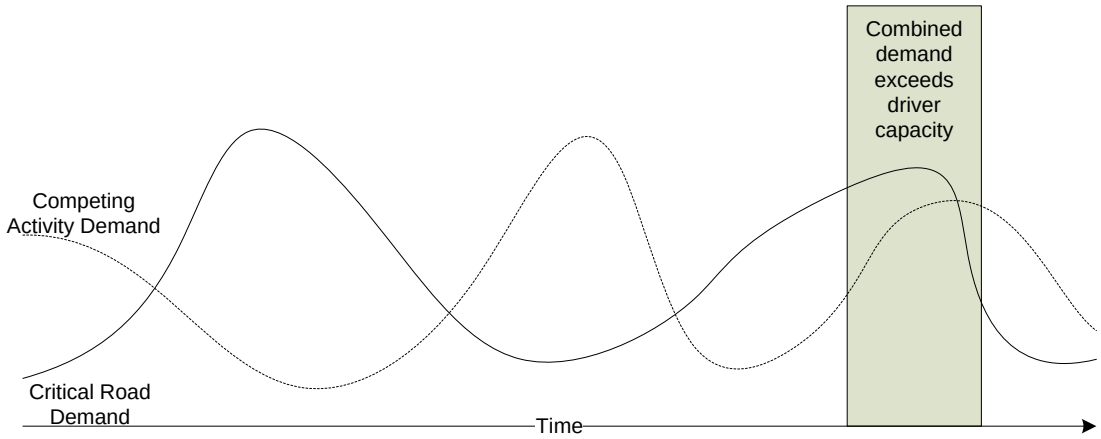

Figure 1 Competing tasks can lead to distraction-related incidents when the demands of the roadway and the competing task combined exceed the capacity of the driver to respond. Source: Lee, Young & Regan (2009).

Any criteria used to distinguish between manageable and unmanageable tasks should be technology/task independent. Currently, one of the most well-supported, task neutral criterion used to distinguish between manageable and unmanageable levels of distraction is the 2.0 seconds individual off-road glance criterion proposed by the US National Highway Traffic Safety Administration in their Phase I (NHTSA, 2013) and Phase II (NHTSA, 2016) guidelines. This criterion is supported by the findings of the US 100-car naturalistic driving study, which found that glances greater than 2.0 seconds away from the roadway were associated with a 2.2 times increase in crash/near-crash risk compared to normal baseline driving (Klauer et al., 2006).

While this NHSTA criterion was originally proposed as a design guideline, specifying that in-vehicle systems should be designed so that all functions and tasks can be completed by drivers using off-road glances of 2 seconds or less, it could also be adapted into a road rule whereby any task that requires drivers to remove their eyes off the road for 2 seconds or more is deemed illegal to perform while driving. Indeed, MUARC completed distraction regulatory reform work for VicRoads in 2011-2012 where we proposed a general distraction road rule (Fitzharris et al., 2012; Young & Lenné, 2011). This proposed rule would prohibit drivers from engaging in a range of activities while driving. Example wording of the rule was provided:

'*Drivers must not, while the vehicle is moving or is stationary but not parked, engage in activities that:*

- *removes the driver's eyes from the road for more than 2 seconds at a time; or*
- *reduces the driver's ability to control the vehicle in a safe manner (reduced control should then be further defined as reduced speed control, poor lateral control, etc.)'.*

The difficulties in enforcing such a rule were noted because it would require police to detect the driving or eyes off road behaviour and link it to a particular activity being performed by the driver. To this end, the use of in-vehicle driver monitoring systems and workload managers could help to manage and/or advise drivers when they are breaching the 2.0 second criterion (or any other criteria adopted). Driver monitoring systems are being increasingly introduced into vehicle fleets, especially for heavy vehicles. They can be either from the Original Equipment Manufacturer (OEM) or purchased as an aftermarket system (such as the Guardian system from Seeing Machines). Systems typically focus on driver fatigue, workload and/or distraction. They generally display in-cabin warnings to the driver in real time, and potentially may pass the warning information to other stakeholders (such as vehicle fleet managers). Workload managers are designed to minimise the likelihood of drivers becoming distracted by providing real-time support to manage driving and

non-driving demands from in-vehicle and paired portable systems. Workload managers, or adaptive integrated interfaces as they are sometimes referred, control or alter the availability of multiple in-vehicle information and warning system functions based on an estimation of current driver workload or distraction levels.

Clear and consistent approach in the Australian Road Rules

4. Should conventional and technology-based causes of distraction be treated equally in the Australian Road Rules? Why?

Recent data from the Australian Naturalistic Driving Study (ANDS) has revealed that drivers engage in conventional, or non-technology based, tasks more frequently than technology-based tasks (Young et al., in press; Young et al., under review). Table 1 displays the number (and percentage) of secondary tasks (both legal and illegal) that drivers were observed engaging in during 186 coded trips. Of the 1,620 secondary tasks observed, just over 80 percent involved conventional, non-technology-based tasks. Overall, drivers spent 36 percent of their total driving time engaging in conventional secondary tasks, compared with 8 percent for technology-based tasks.

Table 1 Number (%) of secondary tasks in each coding category and percentage of total driving time engaged

Secondary Task	N (%)	% of driving time
All tasks	*1,620*	*44.4*
Adjusting vehicle devices (e.g. seatbelt, mirrors)	307 (19.0)	0.57
Adjusting centre stack controls	263 (16.2)	0.69
Looking at object/event OUTSIDE vehicle	200 (12.3)	1.44
Personal Hygiene	142 (8.8)	0.96
Reaching for object/phone (includes moving)	117 (7.2)	0.54
Interacting with passengers	113 (7.0)	24.92
Talking/Singing to self	101 (6.2)	2.00
Looking at object INSIDE vehicle (not reaching/touching)	66 (4.1)	0.20
Phone, manipulating (hand-held)	55 (3.4)	0.94
Adjusting steering wheel buttons	55 (3.4)	0.07
Manipulating object (other than phone)	37 (2.3)	0.50
Drinking	28 (1.7)	1.17
Holding object (other than phone)	28 (1.7)	1.03
Eating	18 (1.1)	3.00
Phone, manipulating (hands-free)	18 (1.1)	0.24
Phone, holding	17 (1.0)	1.22
Phone, talking (hands-free)	16 (1.0)	3.24
Phone, talking (hand-held)	7 (0.4)	1.34
Reading and/or writing	3 (0.2)	0.04
Other	29 (1.8)	0.25

Note: Conventional secondary tasks highlighted in blue

Another naturalistic driving study conducted by MUARC that examined older driver engagement in distracting behaviours (secondary tasks) at intersections also confirms the prevalence of driver engagement in conventional tasks. The most frequently observed secondary tasks engaged in by older drivers while negotiating intersections were conventional tasks: scratching/grooming (42.5%) and talking/singing (30.2%). Technology-based tasks were observed less frequently, with manipulating the control panel (12.2%) and mobile phone use (1.4%) the most common (Charlton et al., 2013).

In a smaller scale NDS with parents (n=19) and child passengers (n=25), 92 journeys were analysed for engagement in secondary tasks. The most common potentially distracting activities were grooming-related (37%), followed by those that involved some kind of in-vehicle adjustment (e.g., to the seat, seatbelt, or rearview mirror) (13%). Interactions with children accounted for 12% of the potentially distracting activities, while interactions with technologies and mobile phones accounted for 2% and 1% of all activities, respectively (Rudin-Brown et al, 2012).

In addition, some conventional tasks have been found to be just as risky, if not more risky, than technology-based tasks. Data from the Second Strategic Highway Research Program Naturalistic Driving Study (SHRP2) revealed that, while dialling a mobile phone was associated with the highest odds of crashing (12.2), a number of conventional tasks also had high crash odds. Reaching for an object (not a phone) was associated with a 9.1 times higher odds of crashing than normal baseline driving, while taking an extended glance to an external object had a crash odds 7.1 times higher than baseline (Dingus et al., 2016).

The ANDS also examined safety-related incidents occurring while drivers were engaged in secondary tasks (Young et al., in press). Safety-related incidents involved driving errors (e.g. failing to indicate), unsafe driving behaviours (e.g. swerving in lane) and conflicts with other road users (e.g. failing to yield to pedestrians). Engagement in conventional tasks was associated with a high percentage of the observed safety-related incidents: 20% of incidents occurred while the driver was engaging in personal hygiene tasks, 10.5% occurred when drivers were reaching for an object or phone and 9.5% occurred when drivers were holding or manipulating an object other than a mobile phone (e.g. sunglasses).

Taken together, the prevalence and crash/incident risk data highlight that conventional tasks should be treated equally in the development of distraction-based road rules. To this end, the NTC should be aiming to develop '*task*-neutral road rules' rather than '*technology*-neutral road rules'.

Responsibility for distraction

5. Can you provide examples of effective non-regulatory approaches to driver distraction that assist drivers to self-regulate their behaviour in a dynamic driving environment?

There are a number of non-regulatory approaches that can assist drivers to self-regulate their engagement in distracting activities. These include:

- **Vehicle and technology design.** The design and placement of technology within the vehicle can have a large impact on the level of demand/distraction that devices place on drivers. The design of in-vehicle and portable devices can impact a driver's ability to effectively regulate how they share attention across the driving and secondary tasks because poor design can force drivers to interact with technology for longer, not allow them to easily interrupt and resume interaction with a device, or require drivers to take longer glances towards devices than they otherwise might. A number of design characteristics have been shown to minimise the level of distraction imposed by technology and can assist drivers to use the devices in a more effective and less distracting way:
    - ***Device placement* –** Good device placement can help drivers to better regulate how they share their visual attention across the device and the road. Research and a number of automotive HMI guidelines suggest that in-vehicle devices should be located as closely as

possible to the forward view in order to reduce glance times required to extract information and allow drivers to use their peripheral vision to monitor the roadway (e.g. Alliance of Automobile Manufacturers, 2006; Campbell et al., 1997; European Commission, 2005).

- **Design of visual displays** – Optimal design of visual displays, in terms of text legibility, easily-recognisable icon/symbol design and simple menu layouts, can assist drivers to interact with devices faster, make fewer errors, and take shorter glances and, thus, better regulate their attention (Alliance of Automobile Manufacturers, 2006; Campbell et al., 1997; European Commission, 2005).

- **Design of device controls** – Ensuring that the manual controls used on devices are compatible with, or suitable for, the task being performed can minimise task completion times and the number of errors made. Work by Rogers et al. (2005) has found, for example, that using pushbuttons for discrete tasks such as turning a device on/off or making a single selection and using rotary dials for precision or repetitive tasks such as scrolling through and selecting items from a long list results in faster task completion times and fewer errors. Research by MUARC found that touch screens are not a suitable input device for navigating long scrollable lists such as lists of songs or phone numbers, despite being commonplace in vehicles (Williamson, Young, Navarro & Lenné, 2011). Using a touch screen to select items from scrollable lists increased drivers' subjective workload and degraded lane keeping performance.

- **Workload managers and Driver monitoring systems.** Workload managers are systems that control or alter the availability of multiple in-vehicle information and warning system functions based on an estimation of current driver workload or distraction levels. Their aim is to prevent drivers from becoming distracted or overloaded by supporting the driver, in real-time, to manage the demands from in-vehicle technology (Green, 2004; Zhang, Smith, & Witt, 2009). There have been a number of large-scale projects that have focused on designing and evaluating workload managers, such as the European DRIVE, COMUNICAR and AIDE projects and the SAVE-IT project in the United States. Workload managers have been implemented in a small number of production vehicles (e.g. the Volvo Intelligent Driver Information System); however, they have not yet been implemented on a wide scale in the vehicle fleet.

  Driver monitoring systems collect observable information about drivers and assess their capacity to perform the driving task in a safe manner. These systems generally monitor behaviours such as eyes-off-road time, pupil diameter, steering behaviour and vehicle position in lane, among others to make an assessment about the driver's current level of fatigue and/or distraction and provide alerts to encourage drivers to reorient their attention back to the road. Thus, driver monitoring systems can help drivers to regulate their engagement in distracting tasks by alerting them when they need to disengage form a secondary task and re-engage in the driving task. A large range of DSM systems are available or are in development by companies such as Seeing Machines, Aptiv, Continental AG, Tobii Technology, Visteon Corporation and Denso Corporation. Research by MUARC has found that driver monitoring systems are effective for reducing fatigue, with a 66% reduction in fatigue events when in-cabin warnings were provided to drivers when a fatigue event was detected (Fitzharris et al., 2017). MUARC, in conjunction with Seeing Machines and Ron Finemore Transport, are also currently conducting a study to develop effective warnings and other interfaces for the next generation of driver monitoring systems (https://www.business.gov.au/assistance/cooperative-research-centres-programme/cooperative-research-centres-projects-crc-ps/customer-stories/seeing-machines).

- **Smartphone Apps.** Smartphone applications are designed to block certain phone functions from being accessed while driving. A large number of these apps exist, including the 'Do not disturb while driving' app on Apple devices, VicRoads' Road Mode, AT&T DriveMode and Lifesaver (see Oviedo-Trespalacious et al., 2019). These apps can help drivers strategically regulate their exposure to phone-based distractions by restricting their use of certain distracting functions while driving.

However, these apps are voluntary and, hence, rely on drivers to activate (and not deactivate) the app to be effective. A number of smartphone apps also still allow certain high-risk phone functions, such as text messaging, to be accessed (Oviedo-Trespalacious et al., 2019). To our knowledge, the effectiveness of voluntary smartphone applications in reducing mobile phone use while driving has not been evaluated.

- **Distractions outside the vehicle.** In addition to the above-mentioned in-vehicle approaches, assisting drivers to self-regulate their behaviour by means of managing the external driving environment is another approach that can have either a regulatory or non-regulatory focus. Perhaps the most obvious example here is billboard advertising near highways - including both electronic/digital and traditional static advertising signage (Horberry, Regan and Edquist, 2013). Research findings have generally found that such advertising in the road environment has negative safety effects including increasing driver distraction (Edquist, Horberry, Hosking and Johnston, 2011). However, there is still a lack of conclusive research evidence upon which to form comprehensive guidelines, standards or non-regulatory codes of practice about how much distraction from advertising is 'safe' (Horberry et al, 2013).

The concept of chain of responsibility

7. Are there other parties besides the vehicle driver who can influence the risk of driver distraction? If so, are there mechanisms to ensure those parties are doing all that is reasonably practicable to ensure safety?

Past and current driver distraction countermeasures and policies place a strong emphasis on the driver to remain vigilant and not engage in distracting activities when driving. In reality, the driver is just one of many actors (e.g. organisations and individuals) involved in the distracted driving system.

In 2015, MUARC published a journal article describing the distracted driving system and presented an Actor map (see Figure 2) of the actors involved, ranging from the Government at the top through to roadway equipment and surroundings at the bottom (Young & Salmon, 2015). The Actor map is based on the Victorian road network and places various actors at one of six levels of the distracted driving system. The map indicates that a mix of organisations and individuals play a role in both the creation of distracted driving and its mitigation. Adding to the complexity is that there is little or no of what is called vertical integration of some of the actors. That is, decisions and policies made by actors at the higher levels do not always filter down to relevant actors at the lower levels. For example, driver distraction regulation and standards often have little bearing on the developers of portable devices, such as smartphones, because these actors typically do not design their devices specifically for in-vehicle use. A key theme in the Actor map is that there is a shared responsibility for distracted driving in that multiple actors have a role to play in both creating an environment where distraction occurs and also in helping to manage the problem.

A range of automotive Human Machine Interface (HMI) guidelines exist for use by vehicle manufacturers (e.g. Alliance of Automobile Manufacturers (AAM) Guidelines; European Statement of Principles (ESoP); Japanese Automobile Manufacturers Association (JAMA) Guidelines for In-Vehicle Display Systems; NHTSA Phase I and II Guidelines); however, these are not mandatory and, thus, their use is at the manufacturer's discretion. There are also a number of issues with the current HMI guidelines which limits their utility:

1) The HMI guidelines are largely focused on in-vehicle infotainment systems (IVIS). Guidelines for the design of Advanced Driver Assistance Systems (ADAS) and aftermarket and portable devices are very limited. It is not clear to what extent the manufacturers of portable and aftermarket devices such as smartphones, tablets, satellite navigation systems, etc. follow HMI or human factors guidelines when designing their devices.

2) Many of the HMI guidelines are based on general human factors and psychological principles and

have not been fully validated or evaluated for their effectiveness in improving device usability or reducing driver distraction.

3) With the exception of the NHTSA Phase I and II guidelines, current HMI guidelines are general design guidelines and have not been developed to specifically address distracted driving. Therefore, many principles of device design known to reduce distraction (e.g. the timing of device timeouts and the ability to interrupt and resume interaction with devices (i.e. 'chunking') are not included in the guidelines.

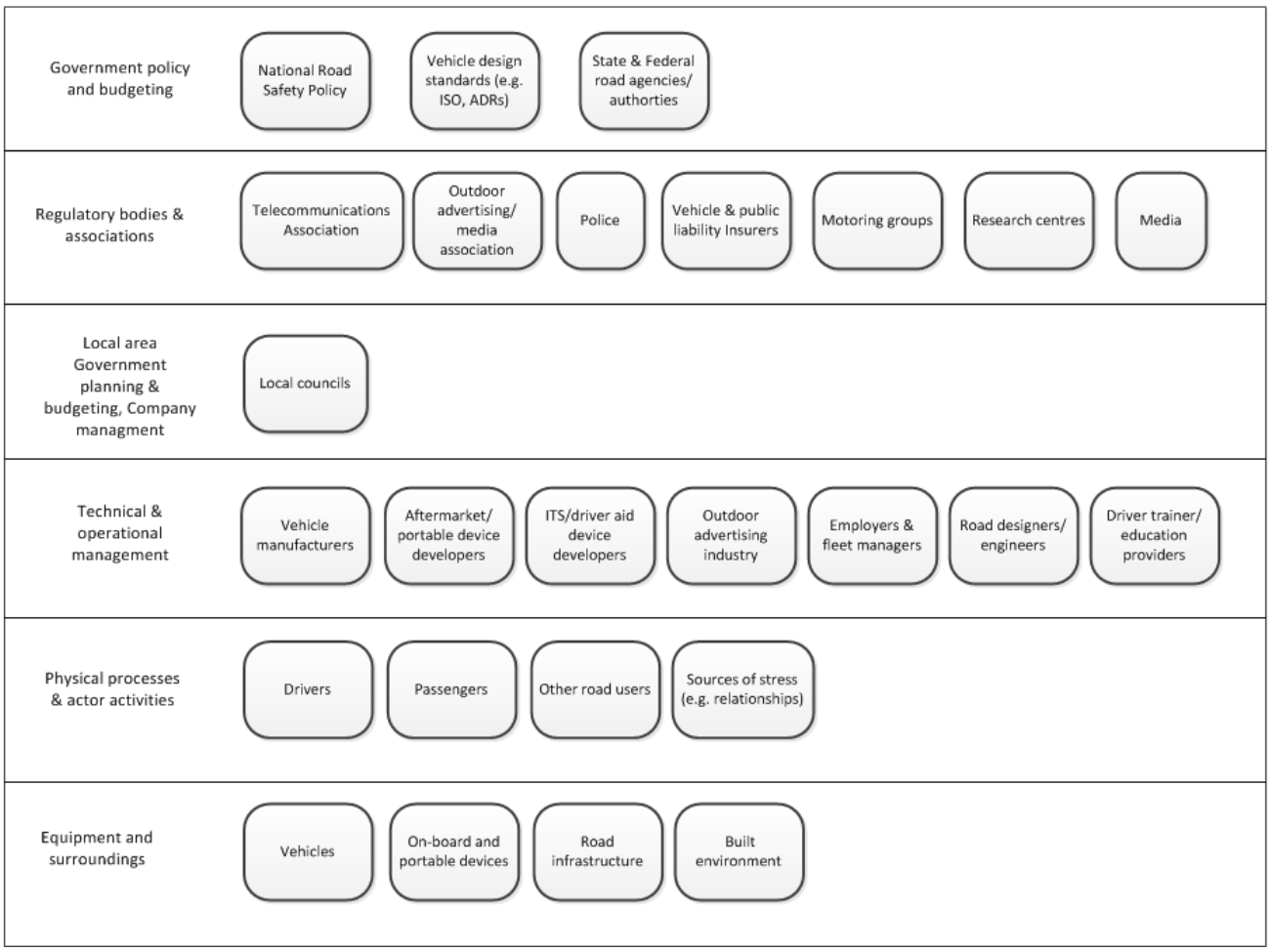

Figure 2 Actor map of the key organisations and individuals involved in the distracted driving system. Source: Young and Salmon (2015).

There is a reasonable assumption made by drivers that if technology is available in the vehicle, then it should be safe and legal to use while driving. To this end, a more effective means of managing distracted driving would be to not allow into vehicles, any OEM and aftermarket devices that are unsafe to use while driving, rather than prohibiting drivers from using part or all of these devices through the road rules. MUARC therefore suggests that, in addition to amending the road rules, that effort is also devoted to amending the Australian Design Rules and other mechanisms that can be used to prevent distracting technology from being fitted to vehicles, at least the OEM level.

Correction

We wanted to note an error on page 22 of the Issue Papers, regarding Sweden's mobile phone legislation. On 1 February 2018, Sweden introduced a new regulation banning hand-held phone use while driving.

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