Putting the Connectivity in C-ITS - Investigating pathways to accelerate the uptake of road safety and efficiency technologies

Stakeholder Interviews

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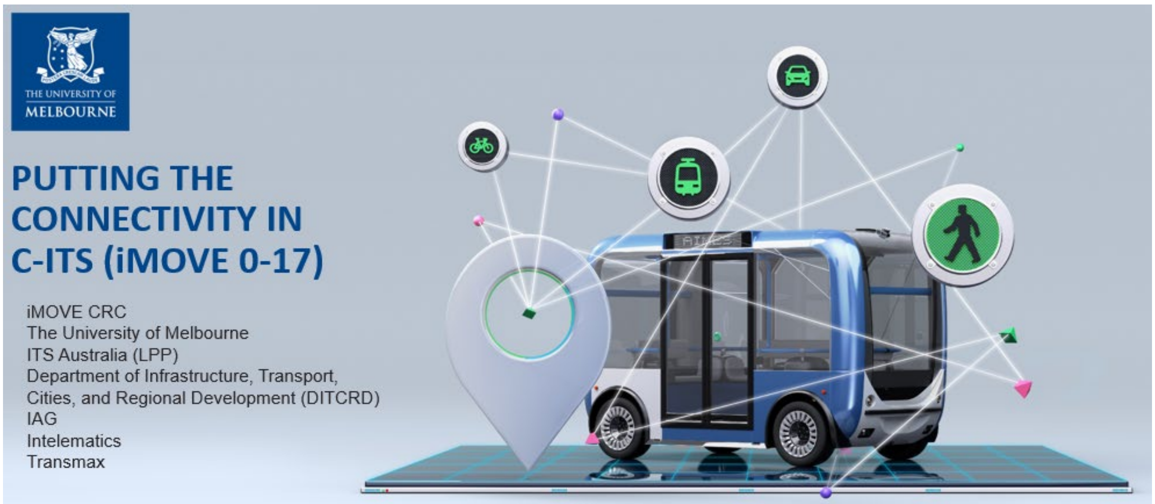

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Stakeholder Interviews

Eighteen stakeholder interviews were conducted in order to gain an understanding of the existing research and development of V2X (Vehicle-to-Everything communication) technologies, use cases being trialled, expert opinions on penetration and uptake of these technologies, and the challenges faced by different stakeholder groups. Participants included transport agencies, associations, and operators, specialised technology providers, mobile network providers, state level government, policy agencies, insurance agencies, and academics. A portion of the stakeholders interviewed are active in areas related to transport operations efficiency, others were concerned with transport safety, while some were involved in a more wholistic sphere of activities. This diversity of roles and perspectives allowed for a comprehensive overview of the current mindsets and future direction for C-ITS technology implementation in Australia and worldwide. Specifically, specialised technology providers and mobile network providers brought valuable knowledge of the performance and functional aspects of V2X technology as well as the current state of infrastructure and further improvement requirements. Government agencies provided insights into regulatory and standardisation challenges, while also reflecting on current initiatives and large-scale implementation.

1 V2X Technologies

The two predominant technologies discussed in the stakeholder interviews were DSRC (Dedicated Short-Range Communication) and C-V2X (Cellular network based V2X). While the two technologies were noted to operate on different "systems of systems" in wireless connectivity by stakeholders, many were agnostic towards the uptake and use of DSRC and/or C-V2X in road safety and productivity and acknowledged that the hybrid DSRC short-range direct communication with cellular long-range communication will likely become the norm. V2X, in general, was noted to be an additional form of data acquisition and seen as an augmentation to existing in-car sensors, which can allow the improvement of current ADAS (Advanced Driver Assistance Systems). This view is reflected in the use cases which have been identified and trialled by key stakeholders.

A difference between cellular and DSRC technologies that was identified in the discussions was that the DSRC standards base may be more stable given that the technology has existed for a longer period and has been tested more extensively. Regarding performance, DSRC can provide an advantage in road safety use cases because of its low latencies, although some stakeholders have noted that with human factors involved, this benefit may be less significant. Discussion of cellular technology and its future with 5G noted that this form of communication may provide a broader range of applications for road safety and efficiency, although this is scenario dependent, especially when adequate coverage and reception are required. In this sense, specialised technology providers indicate that they are likely to produce hardware that can operate with both technologies, either simultaneously or alternatively. Some interviewees representing agencies note that different regions may have pushed for the uptake of one or the other technology, but again, all recognise that there is the potential for both technologies to operate concurrently to support different road safety and productivity functions. Stakeholders are also aware that significant standardisation and regulation is required, as well as a unified national approach toward C-ITS communications.

Another V2X communication technology discussed in these interviews is RDS-TMC (Radio Data System Traffic Message Channel), a traffic message channel which has historically been used to allow vehicles to receive safety and traffic information. However, only a limited number of vehicles have access to this service, and those that have access are not required to use and subscribe to it.

2 Road Safety and Traffic Efficiency

2.1 Use Cases and Benefits

Interviewees identified a number of key cases where connectivity may act to improve upon safety and traffic efficiency (productivity) outcomes for road users. Some of the major recurring use cases identified include:

- Connected Signal Phasing/Intelligent Signal Optimisation
- Freeway On and Off Ramp Metering
- Variable Speed Limits
- Emergency Vehicle Prioritisation
- Vehicle Platooning, particularly of heavy vehicles
- Work-zone Safety
- Cross Traffic Alerts
- Rail Crossing Safety
- Road and Infrastructure Management
- Curve Ahead Warning
- Overhead Bridge Warning, particularly for large vehicles
- Extreme Weather Event Warning
- Driver Fatigue Warning for fleet operations

Many stakeholders noted the potential for connectivity to act as an augmentation to traditional ADAS applications and automated vehicle (AV) functionality. Stakeholders were largely in agreement in regard to the potential for connectivity to improve safety and productivity outcomes for traffic networks. Whilst no specific numbers were used, most stakeholders agreed that connectivity may improve safety and mobility by creating opportunities to address issues and implement transport policies which are currently impractical. Interviewees who focused on safety outcomes assert that connectivity will not only reduce the likelihood of crashes but also reduce the severity of crash outcomes. These stakeholders also acknowledge that benefits become increasingly significant at higher levels of penetration. However, a number of interviewees who viewed C-ITS as a support to ADAS functions stated that the benefits provided by the additional connectivity element may be outweighed by the costs of implementation and deployment, especially during the transition period. Furthermore, upgrading the necessary infrastructure to accommodate connectivity in rural areas has been identified as a major challenge by stakeholders, due to the sheer cost and scale of such a task. Some stakeholders also raised concerns over the immaturity of the technology, claiming issues such as reliability and cybersecurity may threaten to subvert the initial intentions of the application and even exacerbate existing traffic problems.

2.2 Trade-off between Road Safety and Efficiency

A common theme brought up by interviewees when asked about the impact of connectivity on road safety and productivity was the likely trade-off between the two outcomes. This is due to the relative novelty of the technology and the lack of accurate data available to make informed and effective policy decisions. A lack of data and understanding of connected technology presents the challenge of accurately measuring the impacts of policy implementation, as policies which aim to improve mobility may create unintended safety risks and vice versa. As such, these stakeholders preach caution when tackling the issue of implementation and deployment, insisting that a comprehensive understanding of the wider impacts of policies should be made to avoid trade-offs in outcomes. This idea is not agreed upon by all stakeholders however, with some asserting that mobility is directly influenced by safety, and an improvement to safety should lead to an increase in mobility in tandem.

3 Human-Machine Interaction

3.1 Equipment and Devices for Communication

Communication equipment identified mostly represent in-vehicle messaging systems, which include a Human-Machine Interface (HMI). At the OEM level, the HMI is considered proprietary and represents an important interface with the customer – the driver. Aftermarket devices tend to have less sophisticated interfaces. The predominant communication tool identified was a retrofitted tablet system or analogous HMI with audio and visual functions. The use of visual or audible messaging may depend on the situation and alert level. Other communication methods located away from the main centre of control may include haptic feedback and warning lights. Some stakeholders have also worked on communication solutions for vulnerable road users by developing a smart phone application with alert capabilities.

The design of the HMI has been widely investigated. Stakeholders have suggested that visual communication should be provided in the line-of-sight of the driver to avoid the need to take attention away from the road, but not so direct that it may act as a distraction. Experiments around audible alerts have suggested that some alert methods, such as beeps, are less effective than other methods, such as spoken warnings. As optimal communication method for different hazard scenarios is yet to be created and further research has been recommended.

3.2 Human Factors

A number of key concerns related to human factors have been highlighted by stakeholders. Connected applications are advisory, and the driver must still take appropriate action to avoid a crash or maintain traffic flow. When it comes to safety warnings, it is important that false positives are minimised in order that the system continues to have credibility with the driver. Other concerns are summarised below:

- ***Trust:*** As CAV technologies are relatively new, a lack of trust of the technology may cause drivers to ignore or contradict potentially important warnings. As such, the effectiveness of the technology is hampered not by its own capabilities but by human intervention. The contrary is also true in the sense that overreliance on the technology may also cause drivers to lose concentration, ignore clear hazards or adopt a riskier driving style.
- ***Loss of skill:*** A product of overreliance, loss of driving skill has also been a concern amongst stakeholders. By relying on warnings and automated interventions, drivers may experience a decline in driving skills, which could be potentially dangerous during a technology transition period.

4 Challenges and Opportunities

4.1 Technology Acceptance

Some stakeholders have suggested that the reliability of the external data communicated is a challenge that may translate to users who are more likely to trust information delivered from sensors on a vehicle (e.g. cameras), than data communicated from an external source. With this in consideration, the full benefits of connectivity may not be realised if users are unwilling to use/enable available connectivity technology. The acceptance of V2X technology is noted by stakeholders to be an important factor in deployment. Along with this, there are privacy and cybersecurity concerns which may limit uptake and acceptance, so, even with effective communication methods, uptake and resulting benefits might be lower than predicted.

4.2 Deployment and Penetration

Stakeholders have noted that along with user acceptance, achieving penetration rates that will enable safety and traffic benefits to be fully realised is expected to depend heavily on investment in infrastructure. The costs of implementing roadside units to support connectivity functions is expected to be significant, along with the costs of upgrading existing cellular infrastructure. Several stakeholders have contemplated the "chicken and egg" scenario and are of the view that no one wants to be the first to invest as benefits will not be seen until after the uptake of technology is significant. On the vehicle implementation side, the type of technology integration must be appealing to users so that they will invest their time and money into using the connectivity features. This is a particularly important consideration when attempting to achieve critical mass in uptake. One such example of vehicle connectivity implementation is connectivity that is provided via smartphone applications, where the user can readily access the technology rather than rely on vehicle retrofitting methods.

From the vehicle owner's and driver's perspective, the selection of connected applications is an important consideration. The deployment of applications that avoid crashes is critically important for safety improvement, but crash warnings will be rare events. Drivers need to receive day-to-day value from connected systems, and therefore more informational, less time-critical applications need to be included in a commercial connected vehicle system.

In Victoria, it is noted that the existing fleet has an average age of approximately 10 years, with penetration of connectivity technologies in the market currently limited. Taking into account the fact that fleet age and rate of change are highly variable, as are the number of manufacturers and models of vehicles available to Australian consumers, stakeholders have provided estimates for significant fleet penetration range from a few years, to a few decades for the technology to be commonplace. However, interviewees have noted that benefits to traffic flow and productivity may be seen at penetration rates below 50% which may be achieved in a reduced amount of time.

One stakeholder identified that Australia has one of the lowest fuel quality regulations and as a result, does not receive latest engine technology for the portion of the fleet imported from Europe. Due to the low fuel standards, it is likely that OEM vehicles will not have the latest connectivity technology either. In order to address this issue, changes in fuel requirements and insurance may need to be made to support newer European vehicles.

Other factors which are expected to have a role in determining the deployment and estimated penetration rates include regulation and the type of solution deployed.

4.3 Aftermarket and OEM Technology

There has been some debate surrounding the use of aftermarket solutions versus OEM technology. Some stakeholders note that aftermarket penetration will be difficult to achieve with challenges arising in retrofitting vehicles, including the need for powering the devices and fitting antennas, as well as integrating into the vehicle's data systems. This may not be an economical solution for deployment in large volumes. Some existing devices in the aftermarket sector require an OBD2 port which some manufacturers may no longer provide in the future. This port is the third-party connectivity link which allows the vehicle's safety data (e.g. brake wear and tear) to be diagnosed and communicated. For aftermarket devices used in real-world trials, the installation of antennas requires time whereas OEM equipment is factory fitted into vehicles.

A number of stakeholders believe that aftermarket devices may be a viable option for penetrating the market, particularly given the age of the existing fleet in Victoria. OEM fitment is generally the preferred option. On the other hand, tests have found that there is currently no significant difference between choosing an aftermarket solution or OEM solution. However, looking towards the future with 5G networks, there may well be a difference between aftermarket devices and OEMs in terms of quality, liability, and operability. Specifically, the quality of the aftermarket solution cannot be guaranteed and may present a challenge for the insurance industry. Stakeholders also noted that OEMs have previously experienced the unsuccessful installation of aftermarket solutions in their vehicles.

4.4 Standards, Regulation, and Stakeholders

The interoperability of the technology presents a challenge requiring cooperation between regulators, OEMs, and other relevant stakeholders. Stakeholders note that they are waiting for certainty on regulation, standards, and spectrum allocations from government and regulation bodies. This is particularly important for facilitating the deployment and uptake of technologies.

An opportunity for transport planners and operators identified in interviews is the ability for C-ITS implementation to support the creation of unique policies which may not have been viable for in traditional transport networks. For example, authorities may be able to deliver a prioritised traffic network in response to real-time data, realised with the use of smart intersections and V2I.

5 Conclusion

The stakeholder interviews conducted provided valuable insight into current expert thinking and the future direction for C-ITS technology implementation in Australia and worldwide. It was found that many stakeholders were agnostic towards the uptake and use of DSRC and/or C-V2X and were more interested in the potential for connectivity to provide road safety and traffic efficiency benefits. Several challenges in C-ITS deployment were identified, including user acceptance, and achieving penetration rates that would enable safety and productivity benefits to be realised. Specifically, the availability of infrastructure investment, difficulty in achieving sufficient penetration rates from retrofitting vehicles, and the need for interoperability were of concern. Despite these issues, stakeholders viewed C-ITS technology – deployed in vehicles at both the OEM and aftermarket levels – as an exciting opportunity to improve road safety outcomes.