Centre for Accident Research & Road Safety - Queensland

Ipswich Connected Vehicle Pilot

Summary of the Subjective Evaluation Study Findings

Milestone MV32
iMOVE Project: 1-002, Cooperative Intelligent Transport Systems (C-ITS) Pilot – Field Operational Test (FOT) and Evaluation

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BRIEF OVERVIEW OF THE IPSWICH CONNECTED VEHICLE PILOT

The Ipswich Connected Vehicle Pilot (ICVP), a pilot of Cooperative Intelligent Transport System (C-ITS) technology, produced positive results regarding user experience and perceptions of the technology. Overall, participants perceived the technology as beneficial to safety and reported that they would be interested in adopting the technology in the future when it is more mature.

Through the ICVP, the Department of Transport and Main Roads (TMR) aimed to build public awareness of C-ITS technology, as well as understand how to encourage uptake of C-ITS. Strategically, the pilot enabled TMR to grow organisational readiness for future widespread deployment in Queensland.

C-ITS technology allows vehicles to 'talk' with other vehicles, roadside infrastructure, and transport management systems in real-time. This provides road users with information or visual warnings, on a dedicated display (i.e., a Human Machine Interface [HMI] as shown in

Figure 1: A Human Machine Interface (HMI) used in the ICVP (Image source: Queensland Government).

Figure 1), relevant to their current situation.

To understand the impacts, and gather public perspective of the technology, the ICVP ran between September 2020 and September 2021, involving 355 public participants in Ipswich driving their own vehicles retrofitted with C-ITS technology for a period of nine months.

Data were collected and transmitted directly through the Vehicle Intelligent Transport System Station (V-ITS-S) installed in participant's vehicles, to estimate the likely impacts on driving behaviour and crashes[1].

This report summarises the ICVP subjective evaluation study which comprised self-report data studies based on questionnaires, interviews, and focus groups occurring over various data collection time points. The subjective evaluation study, in comprising these three self-report study methods conducted over different times, offered a robust, mixed methods approach whereby the findings from one study could be used to both support or verify findings as well as extend or further clarify findings emerging from another method.

[1] The results of the C-ITS impact on crashes will be reported in the *ICVP Safety Evaluation Report* in early 2022.

TYPES OF SAFETY INFORMATION AND WARNINGS

Participants experienced safety information or warnings based on six different use cases as outlined in Table 1.

Safety information was shown on the HMI only when relevant to the driver (except for in-vehicle speed [IVS], which was always shown).

For example, drivers were shown advanced red-light warnings only if they are driving too fast to stop at an upcoming traffic light (see Figure 2). If the driver was driving at a slower speed, they did not receive this safety warning.

Figure 2: Example of ARLW message shown before a red light (Image source: Queensland Government).

Table 1: Safety use cases[2]

Safety information		Purpose	Display icon	Audio alert
ARLW	Advanced red-light warning	Alerts the driver that they are likely to violate the red-light at a signalised intersection.	Red Light; Stop!	Yes – three quick "beeps"
BoQ	Back of queue	Alerts drivers there is a risk they are travelling at an unsafe speed for an upcoming traffic queue.	Congestion	No
IVS	In-vehicle speed	Provides drivers with information about the current speed limit.	60	No
RHW	Road hazard warning	Alerts drivers that there is a risk they are travelling at an unsafe speed for a hazard up ahead, such as water on the road, road closures or a crash.	Hazard	No
RWW	Road works warning	Alerts drivers there is a risk they are travelling at an unsafe speed for upcoming road works, giving them time to slow down or change lanes. It also alerts drivers if they exceed the speed limit within the road works.	Road Work; Reduce Speed	Yes – single soft "boop"
TWVR	Turning warning vulnerable road-user	Alerts drivers to pedestrians or bicycle riders potentially crossing at an upcoming signalised intersection.	Pedestrian Crossing	Yes – single soft "boop"

The subjective evaluation study of the ICVP was guided by two primary research questions:

(i) Is the system acceptable to all users and what is their willingness to use it? and
(ii) What are user perceptions of its impacts on safety?

[2] Two vehicle-to-vehicle (V2V) use cases (warnings) were developed (i.e., Emergency Electronic Brake Light [EEBL] and Slow/stopped vehicle [SSV]). These use cases were not investigated in the ICVP Field Operational Test but were examined in separate studies using the CARRS-Q Advanced Driving Simulator. The results of these studies are summarised in the "**Ipswich Connected Vehicle Pilot Simulator Studies Summary Report: EEBL and SSV Use Cases**".

STUDY METHODOLOGY

Participation Criteria

To participate, individuals were required to meet participant- and vehicle-related criteria as outlined in Table 2.

Table 2: Participant and vehicle-related criteria

Participant criteria	
☑	Hold a valid Queensland Provisional 2 or Open Driver Licence (or an Interstate or International equivalent)
☑	Drive a minimum of 3 hours per week in the vehicle to be equipped with the C-ITS technology in the ICVP area (i.e., in and around Ipswich and the Ipswich Motorway)
☑	Intend to keep using/have access to the vehicle to be equipped with the C-ITS technology during the ICVP (i.e., plan not to sell or replace the vehicle for 9 months)
☑	Are contactable via mobile phone and email
☑	Are in sufficient good health to see the HMI device screen and hear the alerts (i.e., you are able to see what is on a standard mobile phone screen at arm's length)
☑	Are able to speak, read, and understand English
☑	Are the owner of the vehicle to be equipped with the C-ITS technology and willing to have the technology installed and remain in your vehicle for the length of the ICVP, or have permission from the vehicle owner to have the vehicle equipped and used throughout the ICVP
Vehicle criteria	
☑	Is comprehensively insured with an insurer that TMR had established agreement with including RACQ, Suncorp, Allianz, QBE, AAMI, APIA, Bingle, Shannons, Vero, NRMA, Budget Direct, QANTAS, ING, Australia Post, Virgin Money, or Youi
☑	Held valid Queensland vehicle registration for the duration of the ICVP
☑	Is a light passenger or commercial vehicle (for example, not a motorcycle or heavy vehicle)
☑	Meets the requirements for having the C-ITS equipment installed (e.g., vehicle make and model)

Brief justification of participation and vehicle criteria

Much consideration was given to the development of the study's participation and vehicle criteria. Although some criterion may be self-explanatory (e.g., retaining the vehicle with the equipment fitted for the duration of the pilot), others were due to specific considerations and requirements. For instance, the decision not to include drivers with a Learner or Provisional 1 licence was because such drivers, under Queensland legislation, must not use hands-free devices, wireless headsets or a mobile phone loudspeaker function (see https://www.qld.gov.au/transport/safety/road-safety/mobile-phones).

The requirement of driving a minimum of 3 hours per week in the Ipswich area was to ensure sufficient data for analysis. Participants being contactable via mobile phone and email as well as being able to speak, read, and understand English related to the need for the QUT research team to maintain contact with participants over the nine months of the pilot as well as to ensure participants were clear on project requirements (which were all provided in English). Vehicle-related criteria related to the type of vehicles which the equipment could be retrofitted. As noted in Table 2, there were several comprehensive insurers with whom TMR had agreements with prior to study commencement ensuring the insurers were aware of the ICVP, including confirming their clients' participation in the ICVP would not void their insurance cover.

ICVP Subjective Evaluation Study: Study Methods and Design

As a longitudinal study extending over nine months (of driving) and featuring various data collection points and methods, sample sizes did vary as a function of these aspects. As Figure 3 shows, the subjective evaluation comprised self-report data collection throughout the Field Operational Test (FOT) of the ICVP in the form of four questionnaires as well as individual interviews. At the conclusion of the FOT, once the C-ITS equipment had been removed from all participants' vehicles, focus groups were conducted.

Although the questionnaires were a study requirement and completed by most ICVP participants at each time (refer to Figure 3), the interviews and focus groups were optional and based on a subsample of the total sample. As Figure 3 shows, N = 53 and N = 47 participants completed the interviews and focus groups, respectively.

Figure 3 also highlights participants were randomly assigned into either of two groups; Treatment, that had an active HMI (received warnings), and Control, that had an inactive HMI. As Figure 3 shows, ICVP Treatment participants were counterbalanced into baseline- or intervention- first conditions. The numbers of participants cited in these conditions (as denoted by the numbers within the red dotted circle shown in Figure 3) reflect those who participated for the duration of the FOT (i.e., nine months). Driving (objective) and self-reported (subjective) data were collected over nine months regardless of experimental group. A counterbalanced between-groups methodological design with random allocation, such as that employed in the ICVP ensures that robust statistics can be calculated, and analyses performed. This gives greater confidence that findings are less likely to be a result of random chance and are therefore generalisable to the larger driving population.

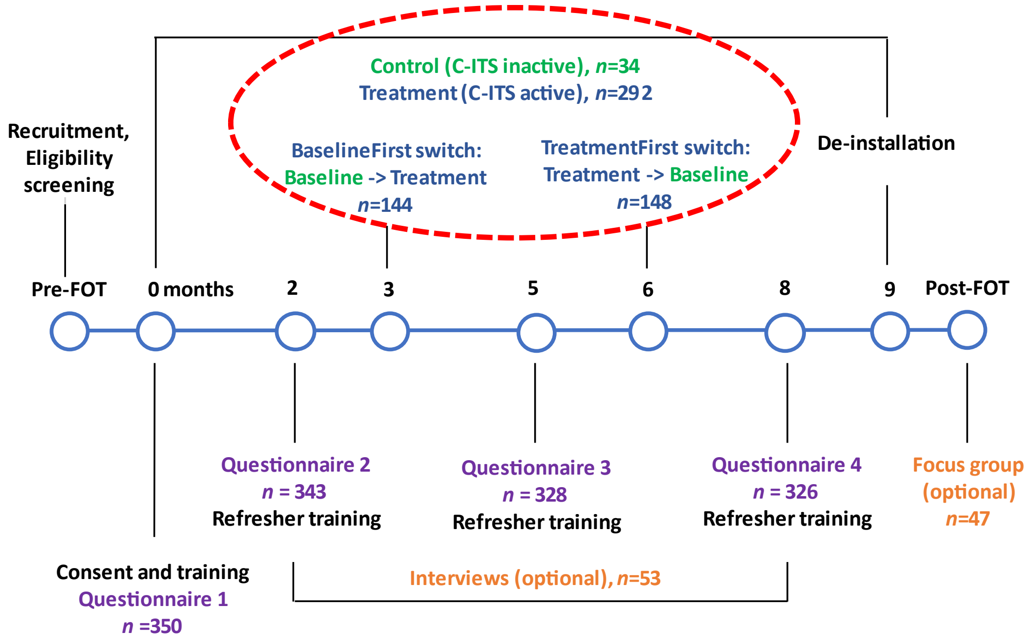

Figure 3: The design of and methods used within the Ipswich Connected Vehicle Pilot (ICVP).

For their participation, participants were offered up to $500 in shopping e-vouchers. Dissemination of vouchers was linked to project tasks such as initial consent, submissions of questionnaires, and finally for return of the C-ITS equipment. Participation in the optional interviews and focus groups was associated with an entry in a prize draw to win one $500 Personalised Plate Queensland (PPQ) voucher.

Participant sample representativeness

The ICVP participant sample was considered relative to TMR licensing statistics[3]. Although the ICVP sample was slightly younger with a mean age of 46.61 years (SD = 13.76 years) (see Figure 4), any potential impacts of self-selection bias were considered minimised to the extent that the sample was considered representative of the licensed driver population in Queensland.

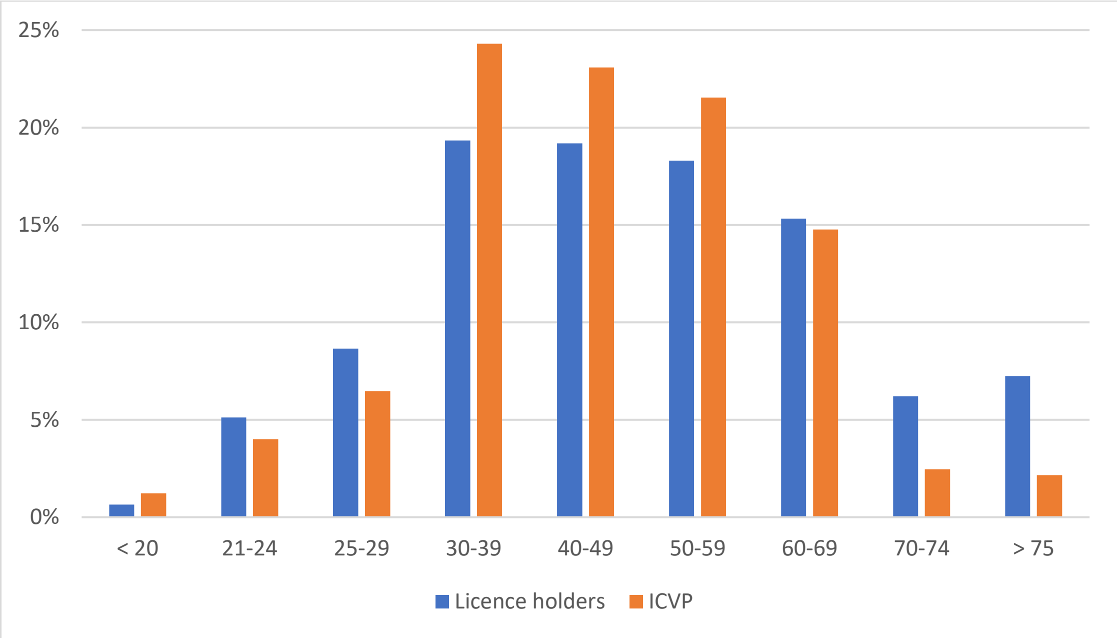

Figure 4: ICVP sample and QLD licence holders age distribution comparison.

The final sample of participants in the ICVP were equally divided between those identifying as male and female and had a diverse range of education, with the majority reporting having completed either university or TAFE (see Figure 5).

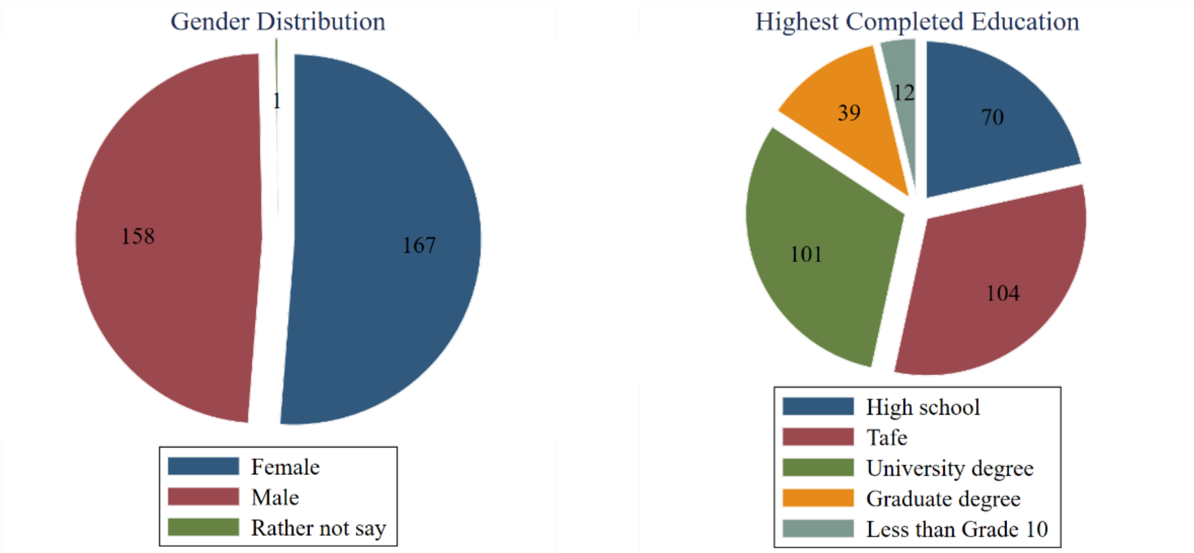

Figure 5: Snapshot of the demographics of the final sample of ICVP participants

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[3] https://www.tmr.qld.gov.au/safety/transport-and-road-statistics/licensing-statistics.aspx

SELF-REPORT METHOD 1: QUESTIONNAIRES

The questionnaires (four in total, comprising Questionnaire 1 [Q1], Questionnaire 2 [Q2], Questionnaire 3 [Q3], and Questionnaire 4 [Q4]; see Figure 3 for timing of administration and sample details) investigated participants' acceptability before in-vehicle equipment installation (Q1) and acceptance following experience with the C-ITS equipment (Q2-Q4 inclusive). Also assessed were participants' perceptions of safety, experiences relative to warnings, and the overall design of the system. Most items used Likert-type response scales ranging from 0 to 100 with higher scores indicating greater agreement. Linear mixed effects regressions were conducted to analyse the questionnaire data.

Key findings related to six overarching aspects, including:

- **Positive expectations of C-ITS.** Participants had positive expectations regarding the C-ITS prior to the equipment being installed in their vehicle and, overall, their expectations remained positive throughout their time in the FOT. Such findings suggest that C-ITS is likely to be well-received by Queenslanders more broadly when commercially deployed.
- **C-ITS perceived as beneficial to safety.** Overall, participants reported that the C-ITS had safety benefits for them and that the HMI had the ability to capture awareness without being distracting.
- **System design generally approved.** Participants generally approved of the ICVP's system design (e.g., HMI display, warning content, and timing) acknowledging it was a pilot of the technology. However, findings also suggested that it would be beneficial for warning timings to align more with drivers' expectations of when they should occur. Improvements to the timing of warnings may encourage more effective interactions with the system and support drivers' decision-making and safer driving behaviour.
- **Experiencing HMI warnings not directly associated with lower acceptance but a deterrent for continued use of the system.** There did not appear to be a direct relationship between participants' acceptance ratings and the actual number of warnings (simple count) they experienced (as obtained from data collected from vehicles). However, participants who experienced warnings more often were less likely to opt-in for continued use of the C-ITS.
- **Decreased attitudes toward C-ITS from expectations after experiencing active HMI.** The results suggested that experiencing the active HMI warnings slightly reduced participants' acceptance towards the C-ITS technology compared to their expectations reported in the previous questionnaire when the C-ITS was inactive. This finding was detected via small decreases in ratings over the four questionnaires in acceptance, intent-to-use, intent-to-buy, and usefulness of the use cases. The ratings remained positive with the average rating sitting above 60%; however, as shown in Figure 6 after a group changed to an active HMI condition there was an approximately 3.5-4% drop from their original expectation. These data suggest that the implementation of the C-ITS deployed in the ICVP did not meet participants' expectations; however, their overall attitudes toward C-ITS were still positive. Assessing Figure 7, between Questionnaire 1 and Questionnaire 4 the Treatment groups reported lower predicted usefulness of the collective use cases although responses are still weighted towards the 'useful' end of the scale suggesting that participants' expectations remained positive overall.

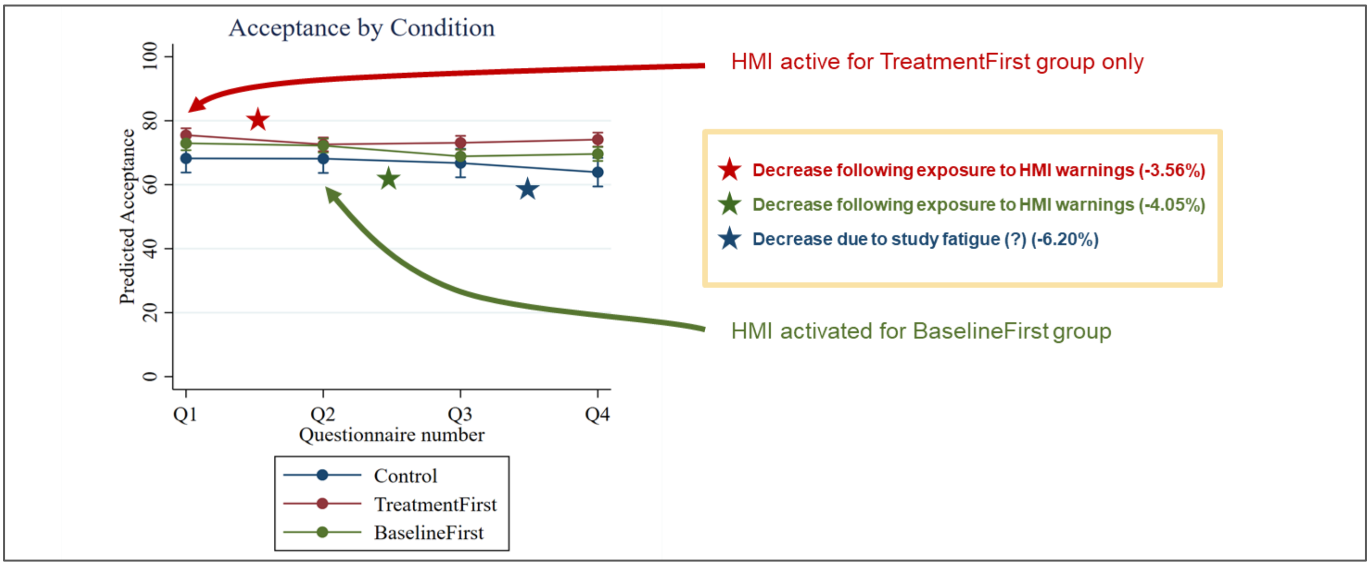

Figure 6: View of the Acceptance data which measured participants' expectations and attitudes towards C-ITS. The generally positive (high) ratings and slight negative trends following exposure to the HMI were detected for many measures.

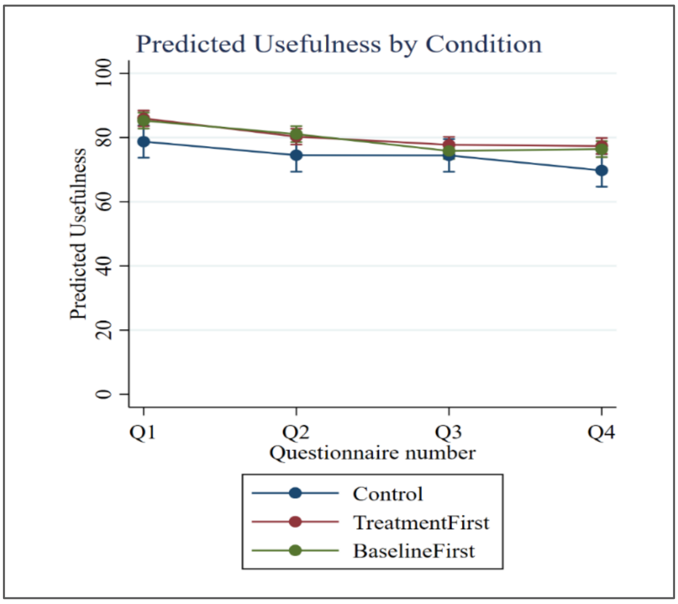

Figure 7: Marginal effects of the usefulness of each use case based on condition and questionnaire number.

- **Use cases perceived as useful.** Participants' ratings of the usefulness of each independent use case remained high throughout the FOT. Figure 7 and Table 3 depict the usefulness findings overall as well as for each individual use case, respectively. Uniformly, over the four questionnaires, treatment participants rated in-vehicle speed (IVS) as the most useful (Table 3, rightmost column, rows labelled "IVS") while advanced red-light warning (ARLW) and turning warning for vulnerable road-user (TWVR) tended to be the two use cases rated the lowest. Other than IVS, the use cases tended to have lower usefulness rating and greater variability in latter questionnaires, compared to earlier questionnaires (see Table 3 , "Q Grand mean" rows, columns Questionnaire 1, Questionnaire 2, or Questionnaire 3 versus column Questionnaire 4). As shown in Figure 8, most (>65%) participants reported that none of the individual use cases should be removed, suggesting they could see benefit in all of them. In Figure

8, there is clear indication across experimental conditions and consistently throughout the four questionnaires that participants indicated no use cases should be removed.

Table 3: Mean usefulness ratings (Standard Deviation) of use cases across the 4 questionnaires and study group and overall.

Group		Questionnaire 1	Questionnaire 2	Questionnaire 3	Questionnaire 4	Use case Grand mean (SD)
	Use case	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Control	ARLW	75 (21)	67 (26)	74 (20)	67 (21)	71 (22)
	BOQ	82 (15)	76 (20)	78 (20)	71 (24)	77 (20)
	TWVR	74 (19)	70 (26)	68 (23)	65 (23)	69 (23)
	RHW	83 (14)	78 (19)	77 (19)	72 (22)	78 (18)
	RWW	77 (19)	75 (22)	74 (23)	67 (25)	73 (22)
	RWW-Speed	79 (20)	73 (23)	75 (19)	70 (23)	74 (21)
	IVS	85 (13)	87 (15)	82 (20)	82 (18)	84 (16)
	Q Grand mean (SD)	79 (17)	75 (22)	75 (20)	71 (22)	
TreatmentFirst	ARLW	83 (17)	75 (24)	73 (25)	72 (24)	76 (23)
	BOQ	88 (14)	81 (19)	78 (23)	77 (21)	81 (19)
	TWVR	81 (20)	73 (25)	68 (27)	68 (26)	73 (25)
	RHW	88 (13)	82 (17)	81 (20)	77 (19)	82 (17)
	RWW	85 (17)	79 (20)	76 (25)	77 (19)	79 (20)
	RWW-Speed	87 (15)	83 (19)	81 (20)	80 (20)	83 (19)
	IVS	90 (14)	91 (14)	90 (17)	90 (18)	90 (16)
	Q Grand mean (SD)	86 (16)	80 (20)	78 (22)	77 (21)	
BaselineFirst	ARLW	83 (17)	79 (18)	68 (27)	72 (26)	75 (22)
	BOQ	89 (13)	82 (19)	75 (25)	75 (26)	80 (21)
	TWVR	78 (18)	77 (20)	67 (27)	67 (28)	72 (23)
	RHW	86 (14)	81 (17)	75 (26)	76 (23)	80 (20)
	RWW	85 (15)	79 (18)	75 (25)	77 (23)	79 (20)
	RWW-Speed	86 (14)	81 (20)	78 (22)	78 (21)	81 (19)
	IVS	88 (17)	88 (18)	90 (15)	88 (18)	89 (17)
	Q Grand mean (SD)	85 (16)	81 (19)	76 (24)	76 (24)	

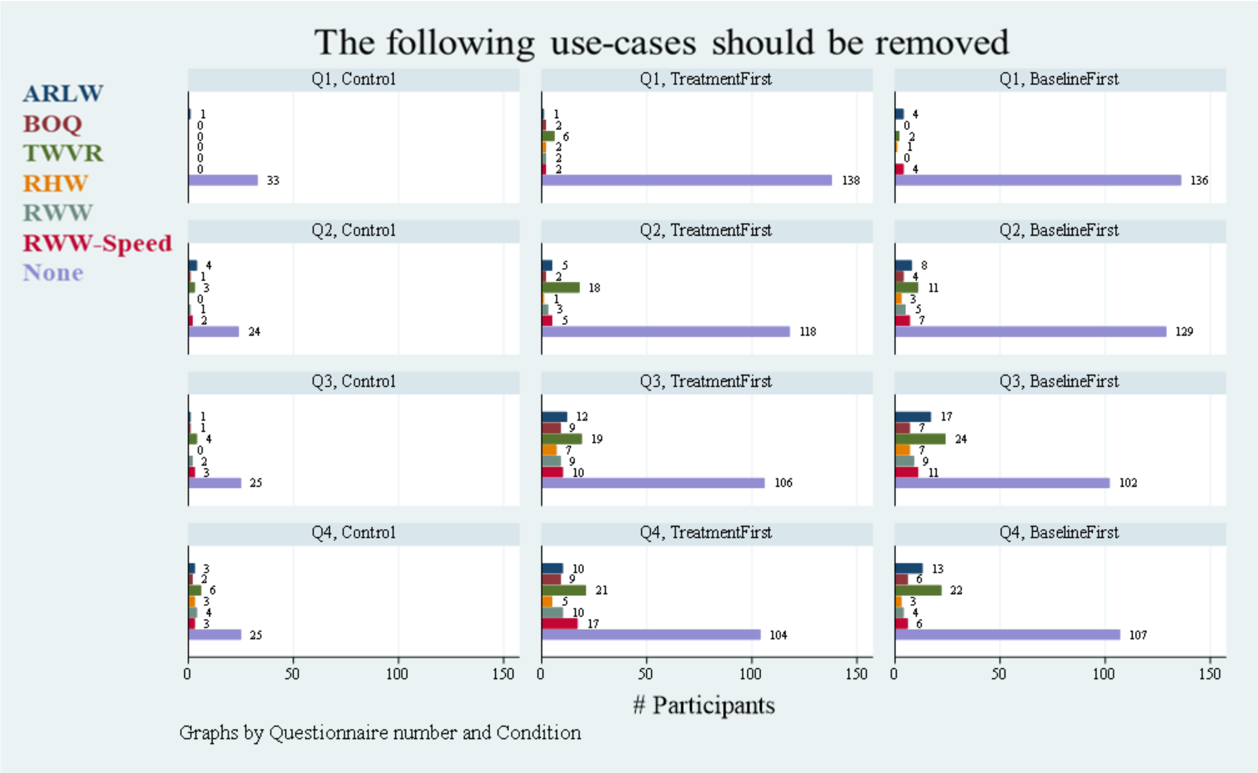

Figure 8: Use cases that participants perceived should be removed.

Note: The labels on the Y-axis are the same for each graph, but only displayed once, enlarged in the top left corner. The bottom bar for each graph (i.e., purple bar labelled as "none") indicates that most participants reported that all the use cases should remain as part of the system.

SELF-REPORT METHOD 2: INTERVIEWS

The aim of the interviews was to gather qualitative data about participants' views of the ICVP C-ITS technology. Specifically, their experience of the technology, willingness to use it, perceptions of the technology's impact on their behaviour, and ultimately its impact on safe driving. The telephone interviews were of about 10 minutes' duration and were conducted in three phases (refer to Figure 3 for timing and sample details) throughout the FOT. They were guided by a semi-structured interview schedule and were audio recorded. Owing to data saturation (i.e., no new or novel information emerging), and in line with qualitative methods, the schedule was modified for each phase to ensure thorough exploration of participants' experiences with the technology. Question-by-question deductive conceptual content analysis was conducted, whereby the analysis of data sought to capture in-depth insight relevant to each of the questions explored. Data analysis was based on notes documented by the research team. The findings of the interviews were generally consistent across all three phases of data collection, despite interview schedules being amended to explore new issues over time.

Overall, findings were generally positive and related to six main concepts, including:

- **In-vehicle Speed (IVS) was perceived most positively.** IVS was the most discussed and most well-liked use case across all three phases of interviews. Nearly all participants reported that IVS was a helpful addition to their driving with it representing a trusted information source to confirm the speed limit in unfamiliar or inadequately signed areas.
- **Advanced Red-Light Warning (ARLW) and Turning Warning Vulnerable Road-User (TWVR) warnings were not that useful because they came too early, too late, or when not needed.** ARLW and TWVR were discussed less often than IV**S**. Nevertheless, many participants mentioned experiencing them. When discussed, these use cases were typically associated with neutral or negative comments regarding their accuracy, timing, and participants' general experience when presented with them. Many participants suggested that timing needed to be adjusted for these use cases to be helpful, but also that the warnings were triggered inappropriately resulting in false or nuisance alarms.
- **Reactions to other warnings were mixed but the amount of experience with these warnings was lower.** In Phases 1 and 2, Road-Works Warnings (RWW) were deemed by many participants to be conceptually helpful, but the implementation was perceived to lack accuracy. Back of Queue (BoQ) and Road Hazard Warnings (RHWs) were not experienced often and therefore, discussions were limited. Some participants described BoQ warnings as relevant, mostly those interviewed in Phase 3, however, there were locations that individuals thought they should occur but did not. Discussions related to traffic congestion often included suggestions to incorporate navigation and route planning as a potential improvement to the C-ITS. Few, if any, participants recalled experiencing a RHW but many participants reported wanting that type of information (e.g., general roadway obstructions) on the HMI.
- **ARLW alert tone was shocking or annoying.** Many participants commented that they found the alert tone accompanying the ARLW as 'shocking' because it occurred when they perceived it was not needed. However, improvements to ARLW timing and accuracy may negate these perceptions.
- **Integration, such as in-dash display, with the vehicle was desirable, and more control of volume and screen brightness is needed**. Most participants generally wanted the system to be more

integrated into their vehicles thus removing the need for an external antenna or an extra screen. Many participants reported wanting increased control of the HMI volume, mostly in relation to turning the device volume down (which was often connected with discussion about the ARLW alert tone). Several participants reported wanting to control screen brightness which was often perceived as being too bright at night.

- **C-ITS is a beneficial idea but further development and increased accuracy is needed to improve road safety.** Many participants reported that the C-ITS was a beneficial addition to their vehicle and nearly all participants expressed positive expectations that future, improved systems could provide significant safety benefits. This aligned with criticisms across each phase of interviews about the accuracy and timing of warnings being current pain points but are expected to improve in future systems.

SELF-REPORT METHOD 3: FOCUS GROUPS

The focus groups sought to explore findings more deeply from the previous subjective studies and the preliminary analyses of the objective driving data. They also sought to explore participant perceptions about broader, future-oriented issues related to C-ITS but not necessarily specific to the ICVP.

The focus groups were conducted post-FOT, approximately one month after removal of the C-ITS equipment from all participants' vehicles (see Figure 3 for timeline and sample details). The discussions were conducted virtually via Zoom and were guided by a semi-structured interview schedule. The discussions were audio recorded and professionally transcribed. A thematic analysis was conducted on the transcriptions.

Seven overarching themes were identified, including:

- **Increased awareness and safer driving behaviours**. Several participants with active HMI warnings reported feeling both more aware and safer on the road. Conversely, several others indicated that although they were more aware, they did not feel safer. When the HMI was inactive, many participants said that they were also more aware of their own driving behaviours because of the mere presence of the C-ITS equipment or via the need to log-in to the system. These participants reported driving more safely and conservatively as they were aware or reminded of being monitored. Several participants said that they returned to their old driving style when the C-ITS was removed.

"Oh yeah, definitely, you know you're being monitored, so yeah. Just making sure that you're doing the right thing there." – Female, Group Seven, Discussing C-ITS messages disabled (i.e., a blank HMI)

- **The use of C-ITS as a support mechanism to complement and improve situation awareness**. Several strengths and limitations of the technology were discussed. IVS was almost universally reported as being the most helpful use case. Many participants criticised ARLW as being inaccurately timed, which resulted in an unnecessary alert tone sounding in their vehicle. Many participants described this alert tone as shocking or distracting, and some said it had changed the way they drove to avoid triggering the unpleasant alert tone. However, it is noted that comments about the unpleasantness of the alert tone may not have been made had it arrived, as intended, in driving situations where it was likely that the participant would perform a risky or dangerous behaviour.

"No, I just, it was, just aware that it was there… but still was aware of what was happening on the outside." – Female, Group Twelve, Discussing the use of C-ITS as a support mechanism to complement and improve situation awareness

"But when it turned off, towards the middle, the end of the trial, and I no longer got any warnings, it was like losing a friend." – Male, Group Nine, Discussing the use of C-ITS as a support mechanism to complement and improve situation awareness

- **More C-ITS information and involvement**. Most participants did not seek out additional information about C-ITS other than the information provided to them as an ICVP participant. However, most participants in the focus groups (60%) suggested they would be interested in participating in future C-ITS projects.
- **Some participants wanted to receive personalised feedback about their driving.** Participants expressed interest in a future system that would provide them with personalised feedback about their driving. Generally, while most participants identified themselves as safe drivers, they liked the prospect that feedback provided by the system could confirm this self-perception. Alternatively, the feedback could help to reveal potentially bad driving habits that participants could improve.

"Because you might be doing something absent-mindedly. So yeah, I think that feedback, I agree, would've been great to receive during that. To also know that you're just doing the right thing." – Female, Group Seven, Discussing Receiving personal driving statistics and feedback

"It's potentially a good thing for changing habits that develop over many years." – Male, Group Eight, Discussing Receiving personal driving statistics and feedback

- **Data privacy**. Most participants were open to having their data collected and shared. There was some discussion about the need for legislation to regulate its use and that collection should be for road safety or insurance purposes, and not for sales and marketing. Some participants expressed concerns about the potential for hacking and data misuse that could accompany widespread deployment of C-ITS.

"…It's all well explained. So, once it started, you know, once you knew that they weren't tracking your speed and going to send you out speeding tickets or something as a result, you felt a lot more comfortable." – Male, Group Three, Discussing Data collected in the ICVP

"I think governments are going to have to watch it, control these companies, but for the most part I'm willing to take a swing." – Male, Group Eleven, Discussing Confidentiality: ensuring anonymity and data aggregation

- **Customisation.** Key improvements that were suggested related to system customisation, such as, to control the volume and the brightness levels of the HMI.

- **Broadening types of road hazards or events presented.** Possibly due to the low incidence of Road Hazard Warning (RHW) use case during the ICVP, several suggestions were made to include types of information or warnings (e.g., road obstructions, stopped vehicles) that would already be captured in the RHW use case. Additional suggestions were made about other types of information that could be included in RHW such as information about approaching emergency vehicles.

OVERALL FINDINGS FROM THE SUBJECTIVE EVALUATION STUDY

Overall, some of the key findings emerging across the three self-report studies suggested that participants were generally positive towards the system, could see the potential for safety benefits afforded by C-ITS technology, and had interest in future use of the technology (presuming maturation of the technology).

Broadly, the findings across the three studies could be conceptualised in terms of two overarching categories: (i) the use cases (i.e., warnings); and (ii) future implementation of C-ITS (see Figure 9).

Use cases

- Overall, participants perceived the use cases positively.
- Participants perceived the technology as benefical to safety and reported interest in adopting it in the future when it is more mature.
- Participants rated the In-vehicle Speed (IVS) use case most positively.
- Participants could see, conceptually, the value of the various types of the warning-based use cases.
- Participants reported the need to improve the timing and accuracy of the warnings, including potential personalisation to individual's driving style.
- Participants’ direct experience of some of the use cases was relatively infrequent (e.g., RHW). The amount of experience with a use case should be considered when assessing perceptions regarding its effectiveness, value, or usefulness.
- Participants had increased awareness of their surroundings but did not always perceive the system contributed to behaviour change or increased safety.

Future implementatior

- The ICVP, as a pilot, required standardisation of system features. Thus, the aspects noted below are those features for consideration in future implementation of C-ITS.
- Most participants wanted greater control of the system’s features such as selection of its volume and the HMI-screen brightness.
- Participants generally wanted the system to be more integrated into their vehicles such as the removal of the external antenna or extra screen for the HMI.
- Some participants wanted to receive personalised feedback about their driving.
- Participants reported improvements in timing and accuracy would be important for future implementations.
- Participants were accepting of their driving data being shared in the context of system improvements, road safety and insurance purposes but not for sales and marketing purposes.

Figure 9: Overarching categories and findings emerging from the three self-report studies.

CONCLUDING REMARKS

At the time it was being conducted, the ICVP represented Australia's largest on-road trial of C-ITS. The subjective evaluation study comprising mixed-methods of quantitative and qualitative research provided valuable insight into ICVP participants' user experience regarding C-ITS in the pilot as well as more broadly. In this regard, it contributes to the growing body of literature in Australia and internationally as to the user experience of connected vehicle technology. The "human in the mix" and how they use and interact with such systems is a key consideration for implementations and ultimately the uptake of the technology in the future.