Future Research in C-ITS: A case for equity

(Submission on Principles for a National Approach to C-ITS)

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The first aspect of social equity is ensuring fair access to resources, services, and infrastructure, which encompasses fulfilling basic needs and creating opportunities for active social participation. Transport is a critical factor of social inclusion, contributing to citizens' ability to access economic opportunities. The introduction of new technology in transport has profound impacts on social equity. This notion of equity, addressed in this document, is framed to capture the fair distribution of transport safety and mobility benefits to all road users regardless of their geographic location and demographic. Vulnerable road users (VRUs), regions and rural and remote areas constitute a disproportionate share of people killed and injured in road crashes.

The impacts of Intelligent Transport Systems (ITS) on road capacity, fuel efficiency, emissions, and crashes are expected to be beneficial. The magnitude of these benefits will likely increase in line with increases with the level of automation and cooperation as well as market penetration. However, it has been suggested that new transport technology may exacerbate existing inequities and safety disparities in the transport area, such as the interaction of VRUs with motorised transport or deployment in the region or rural and remote. In this regard, transport research should focus on understanding the interactions of Cooperative Automated Vehicles (CAVs) and VRUs in various transport facilities, e.g., intersections, highway merging sections, bicycle lanes, arterial roads, and remote areas. Artificial Intelligence-based video analytics or LIDAR-based sensors can potentially understand the real-time safety dynamics of all road users holistically in many situations (Yasir et al. 2023).

Governments have a critical role in facilitating the equitable allocation of new transportation resources. Industries, governments, and researchers are responsible for evaluating the justice issues resulting from a public deployment of new transport technology such as Cooperative Intelligent Transportation Systems (C-ITS) (Martinez-Buelvas et al., 2022). Therefore, a national equitable approach to C-ITS investment in Australia is necessary. This submission highlights issues practitioners must address in designing and implementing sustainable and equitable C-ITS programs.

Most work in CAV focuses on the technology side of C-ITS sustainable deployment, such as standards, interoperability, security, congestion, sustainability etc. There is little consideration of whether C-ITS systems benefit VRU, or regional and rural or remote populations. CARRS-Q's research, as part of the iMOVE CRC Ipswich C-ITS Field Operational Test and CHAD, has shown that :

- Significant technical limitations are preventing the deployment of C-ITS and CAV in the regions, particularly rural and remote Australia. Lack of wireless coverage (4G/5G), maintenance facilities and slow market penetration will prevent groups and geographical locations from benefiting C-ITS advanced functions.
- C-ITS is an essential component for making CAV more reliable and safer. It also has the potential to reduce congestion and air pollution by providing real-time itineraries.
- The interaction pattern between C-ITS equipped vehicles and CAV with VRUs is not well understood and needs further research regarding hardware support and Human Machine Interaction.
- The deployment of Advanced Driver Assistance Systems (ADAS) in general, and C-ITS in particular, have led to the emergence of many onboard sensors , generating big data. Cars are becoming moving sensors, aka probe vehicles. Such vehicles have the potential to relay information to governments, industry and road users. The data generated would be available to feed new applications/business cases related to the environment, surveys, weather conditions, road degradation, road safety and mobility.
- The Quality of Service offered to different road users at different geographic locations in terms of safety, security, mobility and accessibility will never be uniform across Australia. Therefore, it is essential to specify the minimal quality of service requirement for given contexts.
- The different types of failures that C-ITS could be experienced need to be identified, together with the associated liability.
- Future infrastructure sensors, in-vehicles sensors or Internet of Things sensors (incl mobile phones), and connectivity will enable the collection and distribution of data from users, resulting in potential privacy risks and inequity with respect to who can afford to access such data.

The assessment of the fairness and appropriateness of the distribution of C-ITS infrastructure poses a significant challenge, as it requires the consideration of various types of equity, impact factors, metrics, and demographic groupings.

The latest trends in C-ITS research and development focus on the cooperation between vehicles and the infrastructure to enable highly accurate and frequent information to be exchanged. This development, as being day 2 and day 3 in the ETSI roadmaps, are not mentioned as being targeted by this national approach. Low density populations and long distance make this technological development out of the reach of such communities, and will widen the gap between the regions.

There are multiple frameworks to articulate equity and C-ITS deployment. ICLEI (2022), framed social equity along the three dimensions of access, participation, and opportunities, is also another approach to consider; it offers tools to map social risks and opportunities associated with programs, and identified key equity aspects to consider when designing sustainability programs and applying concrete policy instruments to integrate social equity in such programs. The framework also recommends the identification of suitable indicators to monitor social impacts over time in a holistic manner.

Martinez-Buelvas et al., (2022) investigated C-ITS and CAVs' capabilities and their potential perverse outcomes using transport justice as an evaluative framework. Alexander (2022) stated that a comprehensive equity analysis requires a detailed analysis of travel demands, accessibility, multimodal service quality, user and external costs, user acceptance, and obstacles, disaggregated to measure disparities between advantaged and disadvantaged groups and locations.

The transport landscape is undergoing profound changes, driven by new technology and business models. However, new technology alone will not magically make our society better without government and society modifying our current transport systems and policies. Flexible regulatory changes related to the vehicle approval framework, which will harmonise rules and principles for the type-approval of vehicles put into the Australian market, will be required to encourage future CAV deployment as the technology and its associated safety benefits are developing at a swift pace.

CARRS-Q is conducting multidisciplinary research on road safety, including CAV. Our research on CAV covers user acceptance, technology (AI), trust, safety, human-machine interface, equity, cost benefits and future mobility. Over the next 5 years, CARRS-Q will advocate the increasing use of CAV and will work with industries, governments, and communities to ensure Australians can benefit from its deployment as early as possible.

We encourage cooperation between governments, industries, and universities. CARRS-Q research will be focus on the need to lead and respond to innovation, while considering existing and future safety and equity problems. This requires optimising strategies for knowledge and technology transfer and research funding systems that are linked to these critical societal outcomes.

References

Litman, Todd. (2022) "Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transport Planning," ITE Journal, Vo. 92/4, April 2022

ICLEI (2022). Equitable transitions guidebook: Local tools for fair and inclusive sustainability programs. Bonn, June 2022.

Martínez-Buelvas, Laura & Rakotonirainy, Andry. & Grant-Smith, Deanna & Oviedo-Trespalacios, Oscar. (2022). A transport justice approach to integrating vulnerable road users with automated vehicles. Transportation Research Part D Transport and Environment. 113.

Ali, Y., Haque, M. M. and Mannering, F. (2023). "A Bayesian generalised extreme value model to estimate real-time pedestrian crash risks at signalised intersections using artificial intelligence-based video analytics". *Analytic Methods in Accident Research*, 38, 100264.