Design of an Accessible Autonomous Vehicle for All

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1. AIM

Identify design principles that would lead to a universal **Autonomous Vehicle** (AV) to be accessible to as many users as possible, including People with Disabilities (PwDs) and understand **needs, challenges, opportunities, requirements, and expectations** to provide AV design recommendations for an Australian context.

2. METHOLODOGY

Study One: Online survey with PwDs (n=344) to gain insight on demographics, preferences, challenges, needs and perspectives on current transport use and future AVs in Australia.

- PwDs willing to use AVs as public / shared system than owning the vehicle (Figure 1&2)
- There is a desire to have an attendant present on a public or shared AV (Figure 3)
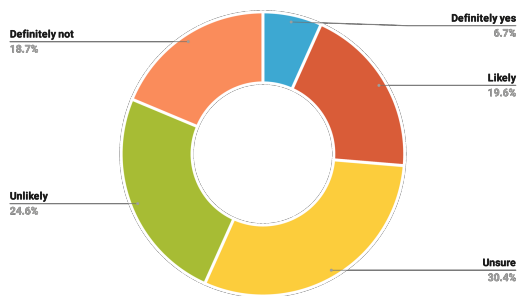- Majority of PwDs positive about AV technologies as mode of transportation (Figure 4).

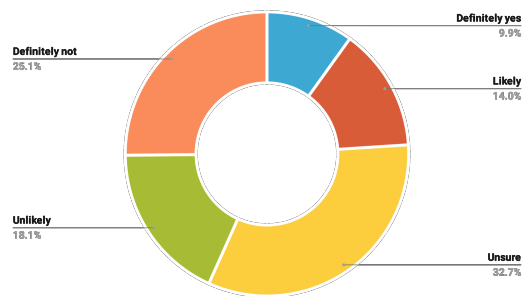**Figure 1.** Willingness to use public/shared AV
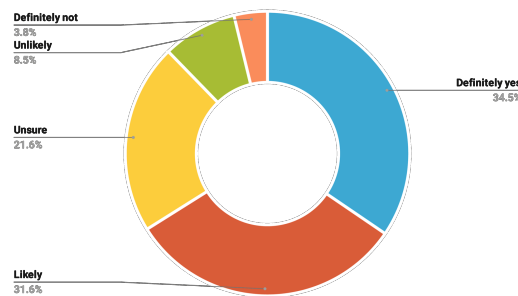

Figure 2. Desire to own an AV

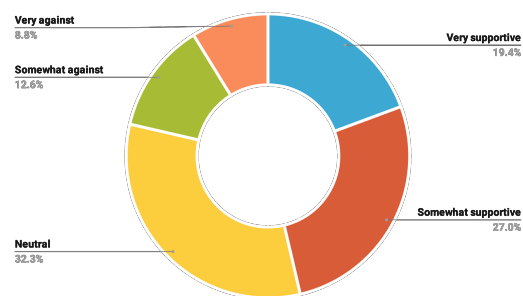**Figure 3.** Desire for trained attendant on AV

Figure 4. Feelings towards AV technology

Study Two: Semi-structured interview and workshop with transdisciplinary group of 5 experts on the challenges, opportunities and limiting factors in the design / implementation of Accessible AV technology in Australia. Findings formed a complex system of relationships within three domains:

- **High frequency:** high conversational occurrence (e.g. Seating)
- **High relational:** low conversational occurrence but high topic relevance (e.g. Risk).
- **Limiting factor:** high conversational or relational seen as limiting factors (e.g. Cost).

Ideal design factors cannot be discussed without addressing its relationship with, and impact on, other aspects. Several limiting factors were identified that would dictate the success of implementation, such as regulations, the associated costs or the gaps in anthropometric data. Figure 5 summarises findings from Study Two.
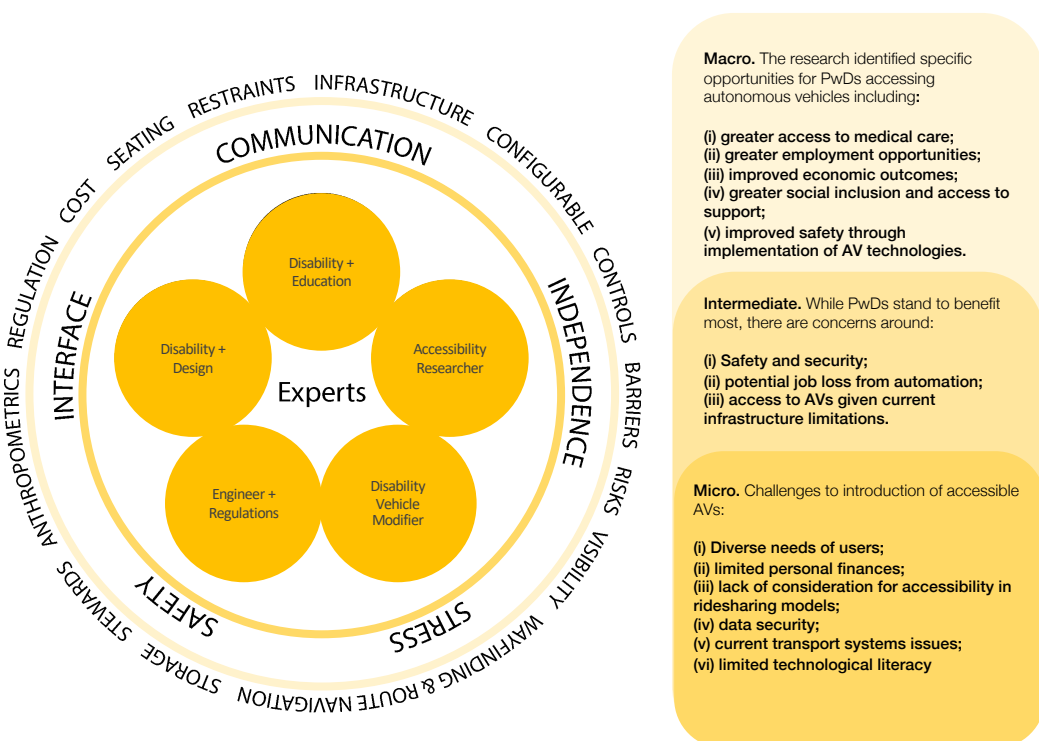

Macro. The research identified specific opportunities for PwDs accessing autonomous vehicles including:

(i) greater access to medical care;
(ii) greater employment opportunities;
(iii) improved economic outcomes;
(iv) greater social inclusion and access to support;
(v) improved safety through implementation of AV technologies.

Intermediate. While PwDs stand to benefit most, there are concerns around:

(i) Safety and security;
(ii) potential job loss from automation;
(iii) access to AVs given current infrastructure limitations.

Micro. Challenges to introduction of accessible AVs:

(i) Diverse needs of users;
(ii) limited personal finances;
(iii) lack of consideration for accessibility in ridesharing models;
(iv) data security;
(v) current transport systems issues;
(vi) limited technological literacy

Figure 5. (Left) Study Two summary including experts interviewed (inner circles), parent themes (middle circle) and child themes (outer circle) and (Right) Findings identified at the micro (person/vehicle), Intermediate (community/infrastructure), and Macro (social/urban) scales.

3. PRACTICAL OUTCOMES

The potential outcomes from this research include implications, suggestions, and recommendations at three levels (Figure 6).

- **Vehicle:** (i) Interior dimensions, layouts, and configurability; (ii) Door dimensions and access; (iii) Seat restraints, dimensions and layout; (iv) Storage options; and (v) Interface and controls.
- **Vehicle / Context:** (i) Stewards and attendant recommendations; (ii) Road infrastructure requirements; (iii) Service, access and cost; (iv) Data security; (v) Personal safety; (vi) Route navigation; and (vii) Visibility.
- **Context:** (i) Regulation requirements; (ii) AV implementation; (iii) Urban / city infrastructure gap; (iv) Technology gap; and (v) Social acceptance.
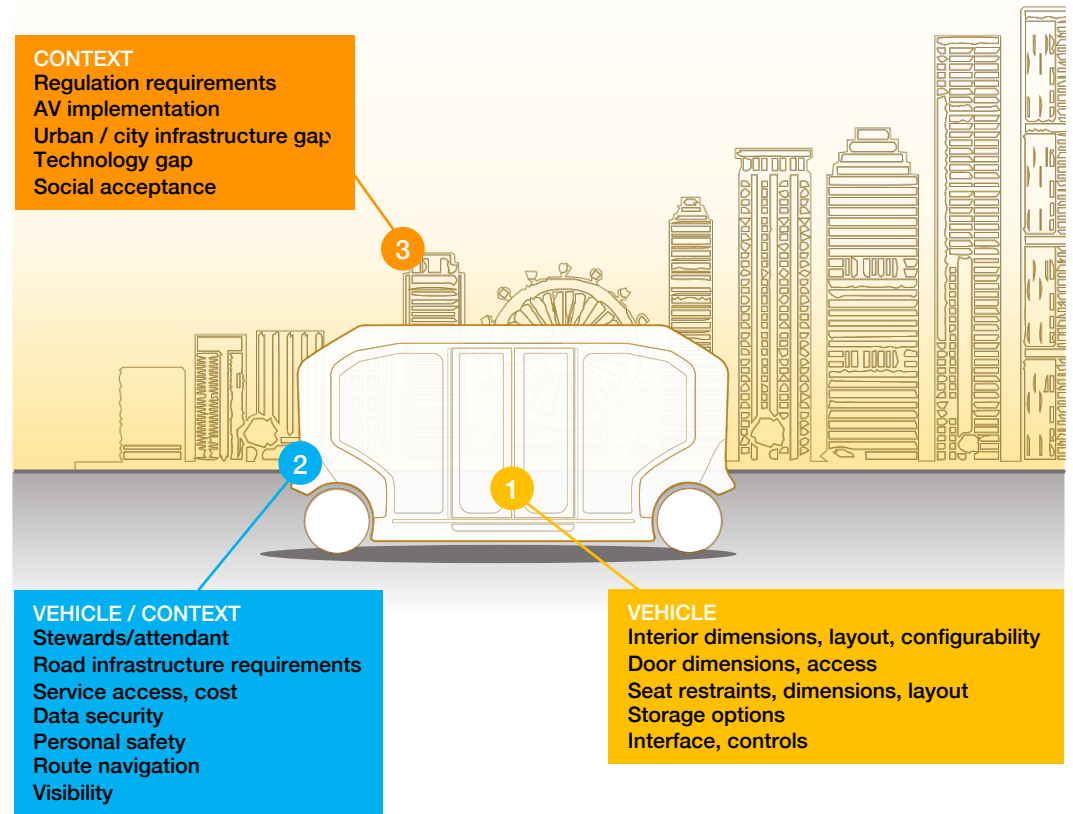

CONTEXT
Regulation requirements
AV implementation
Urban / city infrastructure gap
Technology gap
Social acceptance

VEHICLE / CONTEXT
Stewards/attendant
Road infrastructure requirements
Service access, cost
Data security
Personal safety
Route navigation
Visibility

VEHICLE
Interior dimensions, layout, configurability
Door dimensions, access
Seat restraints, dimensions, layout
Storage options
Interface, controls

Figure 6. Practical outcomes from the overall research across vehicle design; vehicle / context interface and context levels.

4. FUTURE WORK

The research completed to date is Phase 1 of 3. The goal is to develop, test and establish design principles for future AV designs specifically targeting the needs of PwDs in the Australian context.

Phase 2:
- Conduct benchmarking on existing AV prototypes and concepts.
- Develop and validate an initial AV concept that incorporates findings from Phase 1.

Phase 3:
- Build a 1:1 prototype of the AV concept developed in Phase 2.
- Test and validate the prototype with PwDs and other users.
- Deliver tested and validated design principles for the design of future AVs for PwDs in Australian context.

It is envisioned this project will positively impact mobility for PwDs and all other users by:

- Improving the design of AVs (e.g. communication, interface, seating, layout);
- Establishing design principles for AVs in Australian context;
- Increasing access to healthcare, job opportunities and economic outcomes;
- Improving safety for PwDs in transport experience;
- Ensuring the spectrum of PwD needs are considered; and
- Provide independence and increase overall access of AVs

Figure 7. Two vehicles used as benchmark for Phase 2. (Left) Rinspeed Metrosnap and (Right) Auvetech Autonomous Vehicle concept.