



Bear Tracks AV Shuttle Presentation

NCITE – ITS MN Emerging Technologies Meeting
November 17th, 2022

Project Overview

- Purpose: Advance the use of emerging technology, provide better mobility options, including senior communities and persons with disabilities, and building the public's understanding of Connected and Automated Vehicles (CAV).
- Different AV shuttle projects by MnDOT
 - Rochester Med City Mover – Aug. 2021 – Aug. 2022
 - Grand Rapids, MN



Project Partners

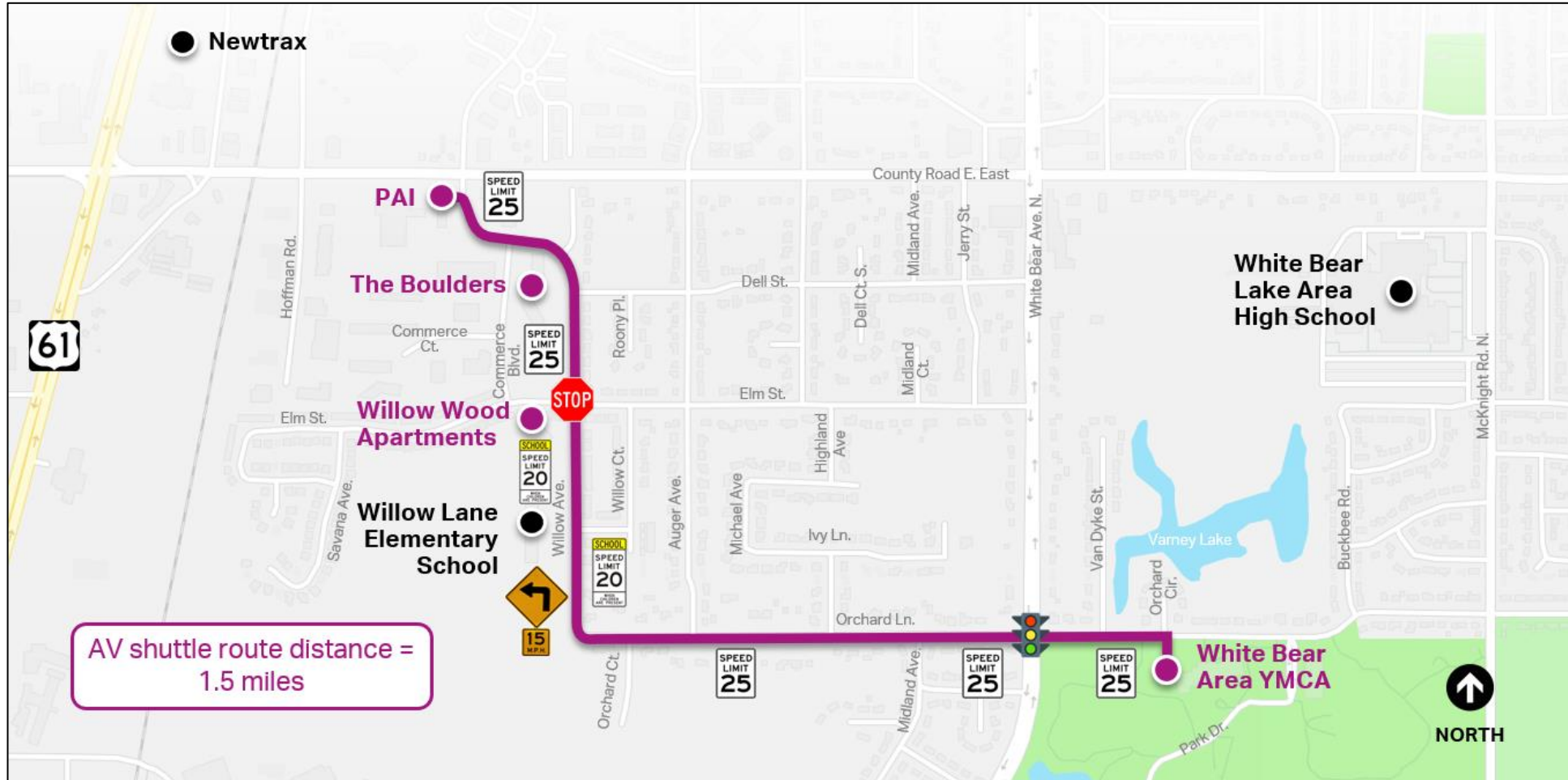


Initial Project Activities

- Shuttle Delivery to Newtrax (May 2022)
- Shuttle Wrap (June 2022)
- Warning Signage Installation (July 2022)
- Route Commissioning (July 2022)
- Media Day / Kickoff (Aug. 5th, 2022)
- Carrying public passengers August 2022 - July 2023



White Bear Lake AV Shuttle Route



Route Locations

- Phoenix Alternatives, Inc. (PAI)
 - Serving people with developmental and intellectual disabilities
- Boulders Senior Living Apartments
- Willow Wood Apartments
- White Bear Lake YMCA



Shuttle Wrap Time Lapse (Click on image for video)

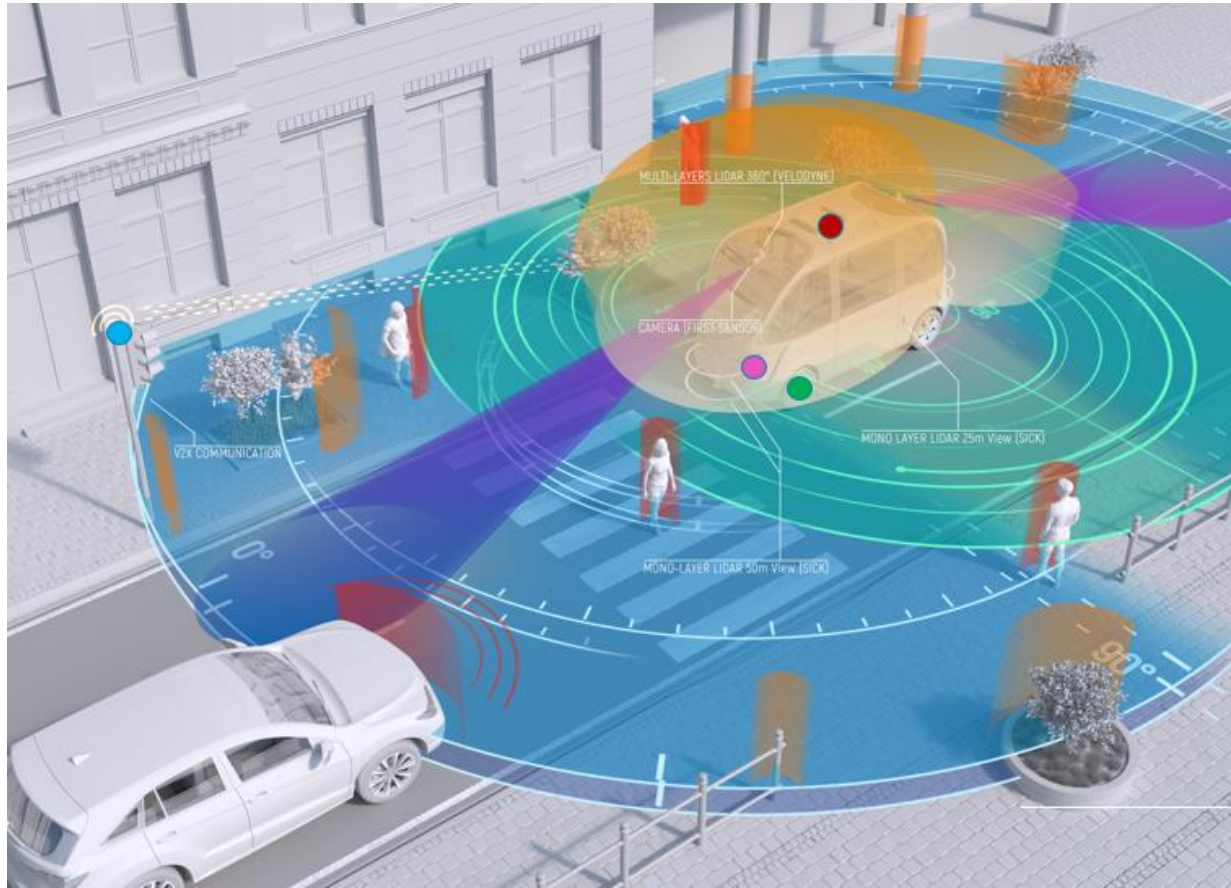


Vehicle Technology

- Exterior Vehicle Sensors
 - LiDAR Sensors on Top (1 on both ends)
 - LiDAR Sensors on bottom (2 on both ends)
- GNSS for Vehicle Localization
 - Communication with Newtrax location
- Electric Vehicle Battery
 - Charged overnight at Newtrax facility



Vehicle Technology



IN-HOUSE ARTIFICIAL
INTELLIGENCE SOFTWARE

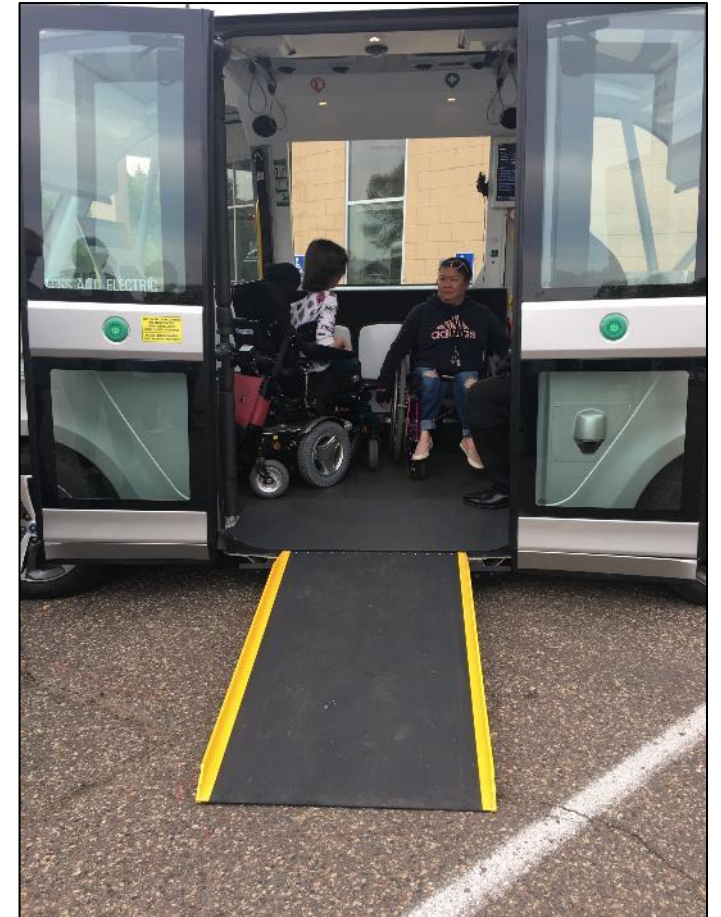


COMBINED WITH OUR SPECIFIC
SENSOR ARCHITECTURE

- 3-D MULTI-LAYER LiDAR SENSOR x 2
- 2-D MONO-LAYER LiDAR SENSOR x 6
- CAMERAS x 2
- GNSS ANTENNAE x 2
- ODOMETRY SENSORS x 4
- INERTIAL MEASURING UNIT
- V2X OBU x 1

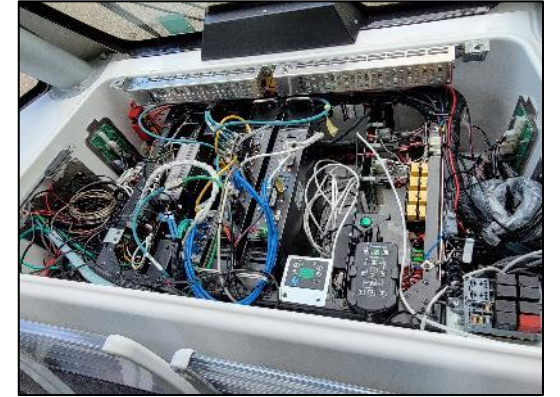
Vehicle Technology

- Wheelchair Ramp for Accessibility
- Senior living facilities
 - The Boulders
 - Willow Wood Apartments
- Interior On-Board Unit (OBU)
 - Communication with traffic signal at White Bear Avenue and Orchard Lane



Vehicle Technology

- Technology components internal to vehicle
- Signage for displaying route
- Air conditioning units / window defrosters



Automated vs. Manual Mode

- Automated Mode
 - Environment Mapped by Navya Prior to Operations
- Manual Mode
 - Operator can perform a Manual Take Over (MTO) if objects or vehicles are on route



Intersection Technology

- White Bear Avenue and Orchard Lane Traffic Signal
- Econolite Advanced Traffic Controller (ATC) and Siemens Roadside Unit (RSU)
- Integral Blue bench / field testing of DSRC communications



Intersection Technology – Lessons Learned

- Bench testing and field testing of initial Roadside Unit (RSU) from Iteris was valuable prior to installation
- On-Board Unit validator testing found transmission issues from RSU to the OBU and validator
- Alternate vendor (Siemens) model of RSU selected for installation
- Recommendation: Consider Omni-Air Consortium list of certified OBU and RSU devices for future AV shuttle projects

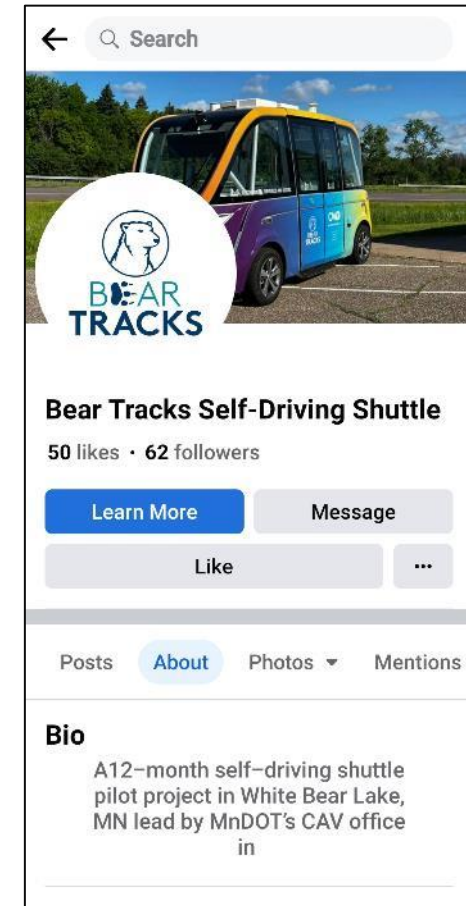
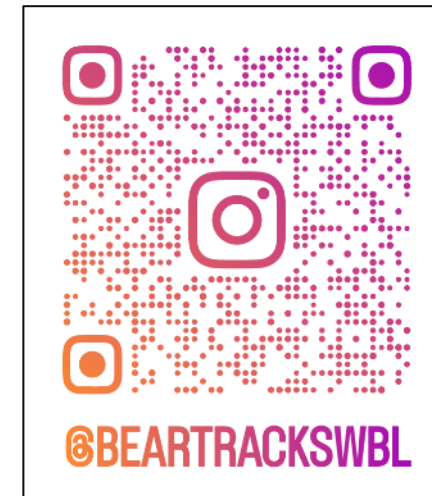
Bear Tracks Project Video (Click on image for video)



Project Communications

Web and Social Media Accounts --

- Website - <https://beartrackswbl.org/>
- Twitter - [@BearTracksWBL](https://twitter.com/BearTracksWBL)
- [Instagram](https://www.instagram.com/beartrackswbl)
- [Facebook](https://www.facebook.com/beartrackswbl)
- [YouTube](https://www.youtube.com/beartrackswbl)



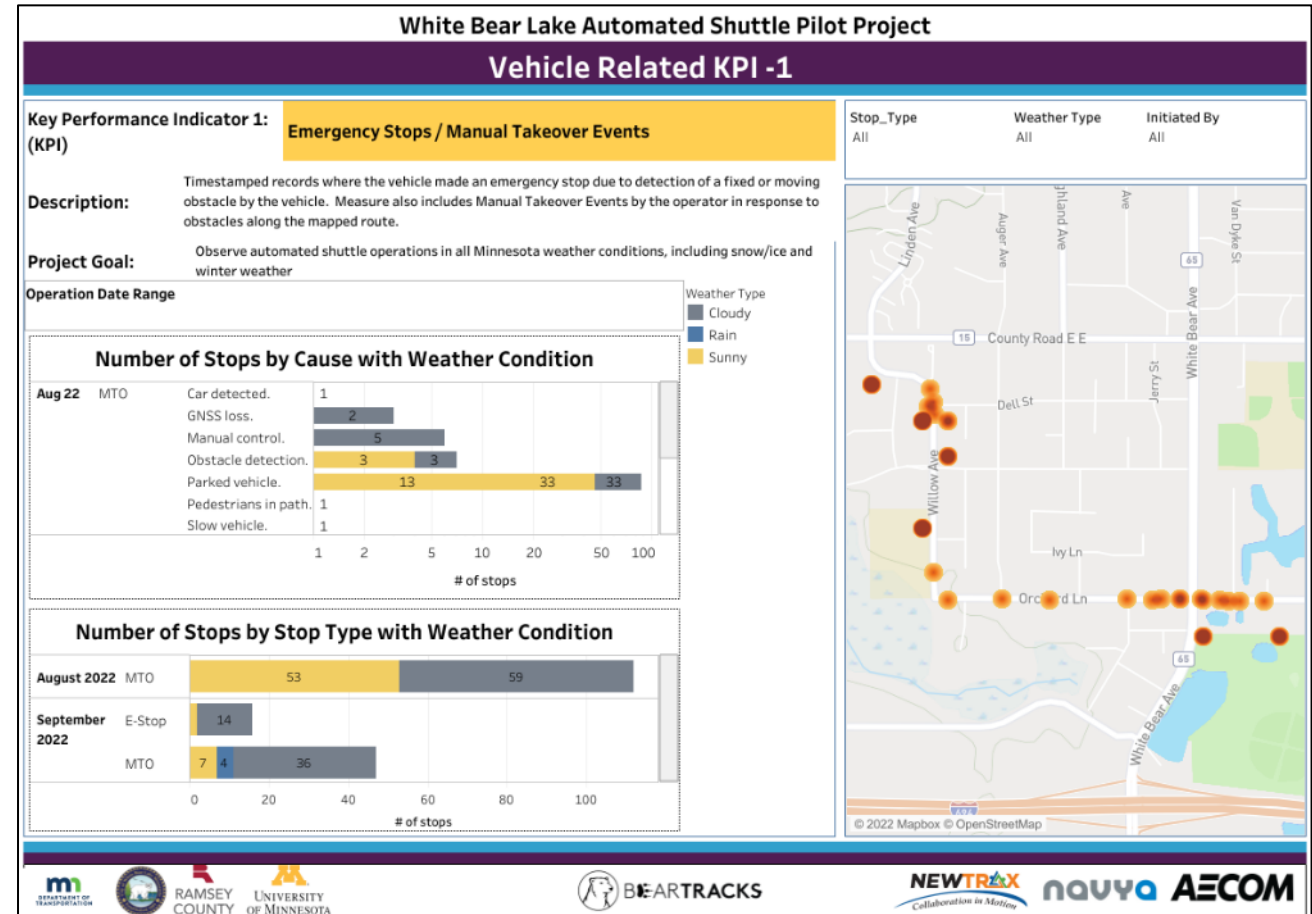
Project Events

- Public Events
 - Manitou Days Parade (June 2022)
 - Hockey Day Minnesota (Jan. 2023)
- White Bear Lake Area High School Demonstrations
 - Automated Route / Presentations (November 2022 / April 2023)



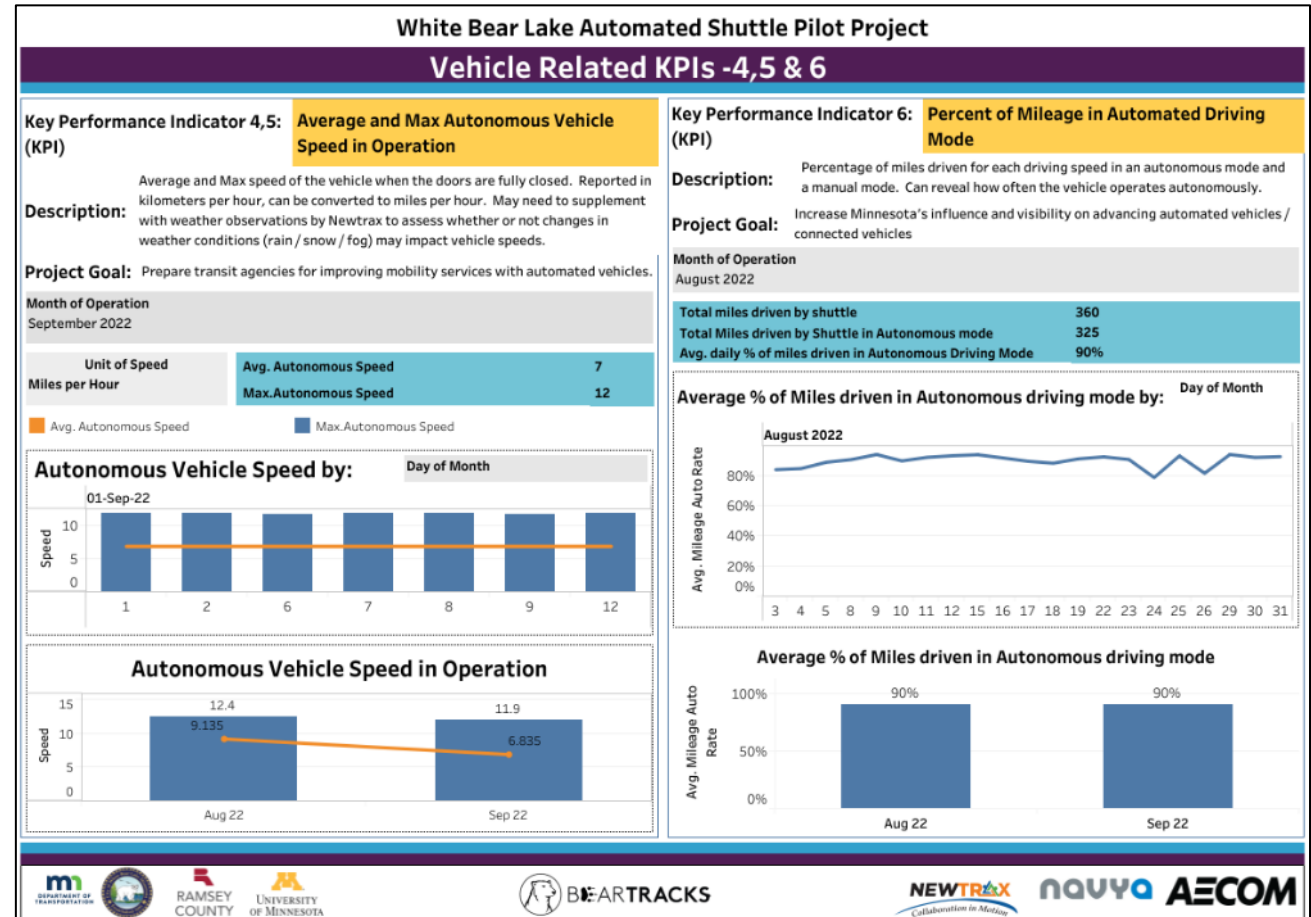
Project Evaluation

- Project Data Dashboard
 - Tableau Database
- Key Performance Indicators
 - Emergency Stops / MTOs
 - Ramp Activations
 - In-Service Time



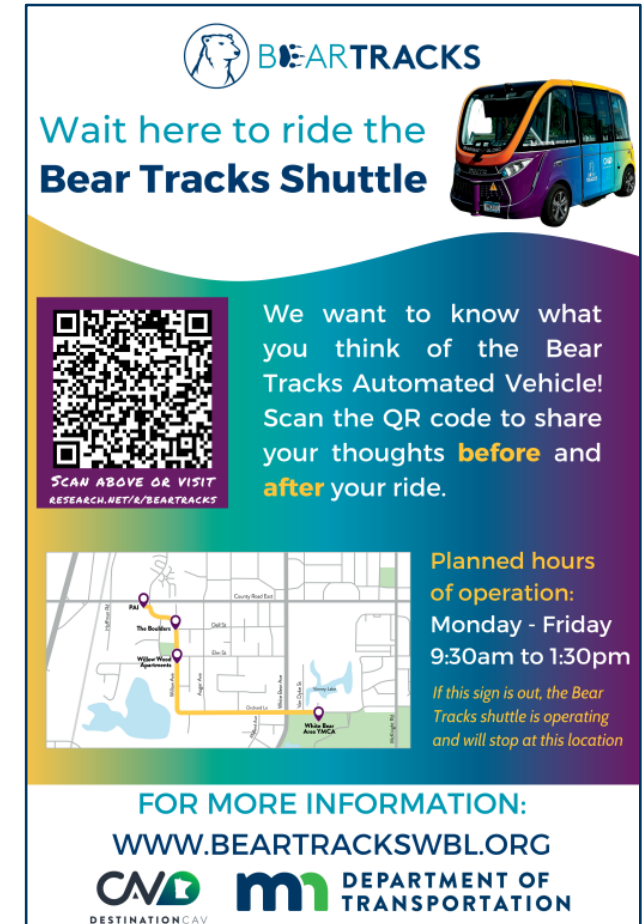
Project Evaluation

- Key Performance Indicators
 - Average / Max. Autonomous Speeds on Route
 - Percent of Mileage in Automated Driving Mode
 - Battery Consumption
 - Sensor Detection of Route
 - Ridership / Loops per Day



Project Evaluation – Rider Surveys

- Survey for passengers to take before and after their ride on Bear Tracks shuttle
 - QR Code for mobile survey
 - Paper copy as alternate
- Questions on familiarity with CAV and comfort with CAV on the roadway
- Additional surveys developed for neighbors along route and for citizens



The poster features the Bear Tracks logo at the top left, which includes a stylized bear head icon. To the right of the logo is the text "BEARTRACKS". Below this, the text "Wait here to ride the Bear Tracks Shuttle" is displayed in a blue font. To the right of this text is a small image of a purple and yellow automated shuttle vehicle. A large QR code is positioned in the center-left, with the text "SCAN ABOVE OR VISIT RESEARCH.NET/8/BEARTRACKS" below it. To the right of the QR code, the text reads: "We want to know what you think of the Bear Tracks Automated Vehicle! Scan the QR code to share your thoughts **before** and **after** your ride." Below the QR code is a map showing the shuttle route, with a yellow line indicating the path and several stop locations marked with purple dots. To the right of the map, the text states: "Planned hours of operation: Monday - Friday 9:30am to 1:30pm. If this sign is out, the Bear Tracks shuttle is operating and will stop at this location." At the bottom of the poster, the text "FOR MORE INFORMATION:" is followed by the website "WWW.BEARTRACKSWBL.ORG". Below the website are the logos for "CAV DESTINATION CAV" and "m1 DEPARTMENT OF TRANSPORTATION".

BEARTRACKS

Wait here to ride the
Bear Tracks Shuttle

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CAV DESTINATION CAV m1 DEPARTMENT OF TRANSPORTATION

Rider preferences on the White Bear Lake Bear Tracks Shuttle

Alexander Lee, under the supervision of Researcher Frank
Douma



UNIVERSITY OF MINNESOTA
Driven to DiscoverSM

Overview

The data reviewed comes from 3 surveys taken over this past year:

- Neighbors survey (Open August 5th 2022 - end of September 2022)
 - Residents who live along the route of the shuttle. (41 respondents)
 - Survey which measures respondents' awareness of, comfort with, and attitudes toward the pilot service.
- Citizens survey (Open August 5th 2022 - end of September 2022)
 - General Public - Residents in the City of White Bear Lake (28 respondents)
 - Survey which measures awareness of, comfort with, and attitudes towards CAV's generally and the pilot service.
 - Will re-open in Jan - Feb, and summer 2023
- MNDOT survey (August - still ongoing)
 - Given to anyone who rides the shuttle. (101 respondents and counting)
 - Understanding/perception of CAV's, demographics. Both before and after the ride.

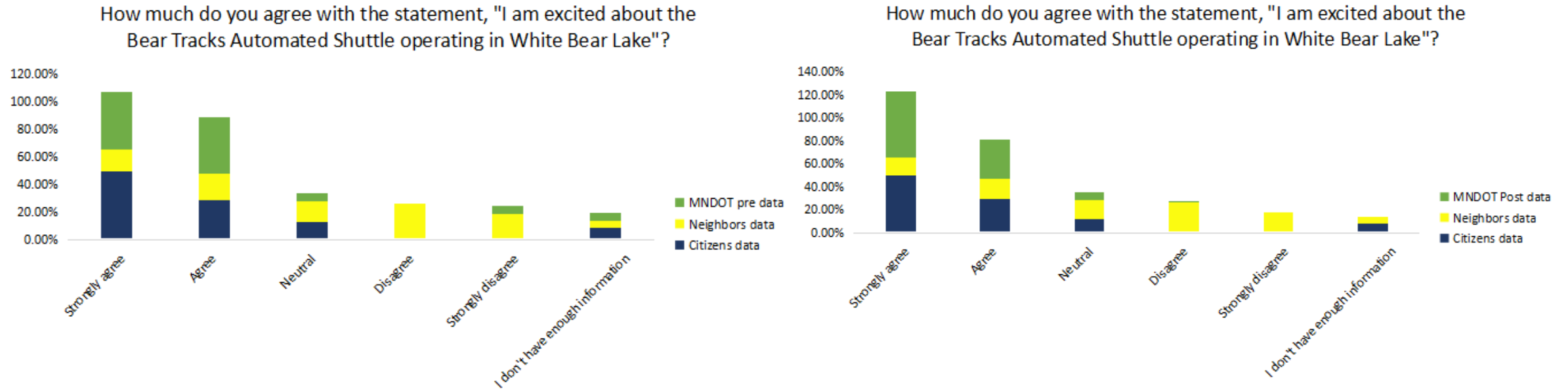
Main findings

- Overall the most notable difference between the 3 surveys was respondents' proximity to the shuttle.
 - Responses from the neighbors survey display generally more negative feelings towards the shuttle versus the other two surveys.
 - The MNDOT rider survey displayed the most positive feelings towards the shuttle, particularly in the post ride section of the survey.
- Despite previous literature on the subject indicating that age, race, gender, and familiarity, being important factors in attitude, none of those categories made a huge difference on attitudes towards the shuttle.

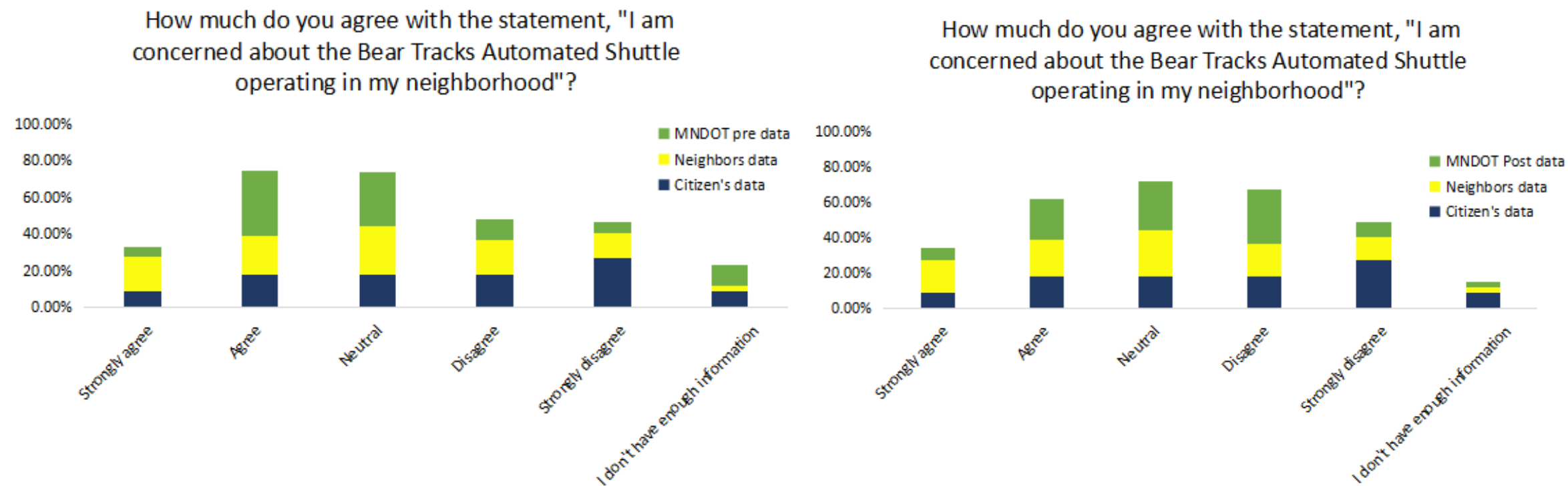
Other notes

- While age did not display strong enough evidence to conclude it affected feelings on the shuttle, it is important to note that the age range of respondents for each survey were generally older.
 - The route may play a role in this, as the shuttle runs past the YMCA, as well as a senior home meaning that senior citizens have more access to it.
- There is a likely chance there is a selection bias in the Citizens and MNDOT surveys, (i.e. people in favor of the shuttle are more likely to fill out the survey).
- The surveys do not capture any meaningful data in regards to race as all three have a large majority of White respondents.
 - The same can be said about people with disabilities, as a majority of of the respondents did not note that they had one.

How much do you agree with the statement, "I am excited about the Bear Tracks Automated Shuttle operating in White Bear Lake"?

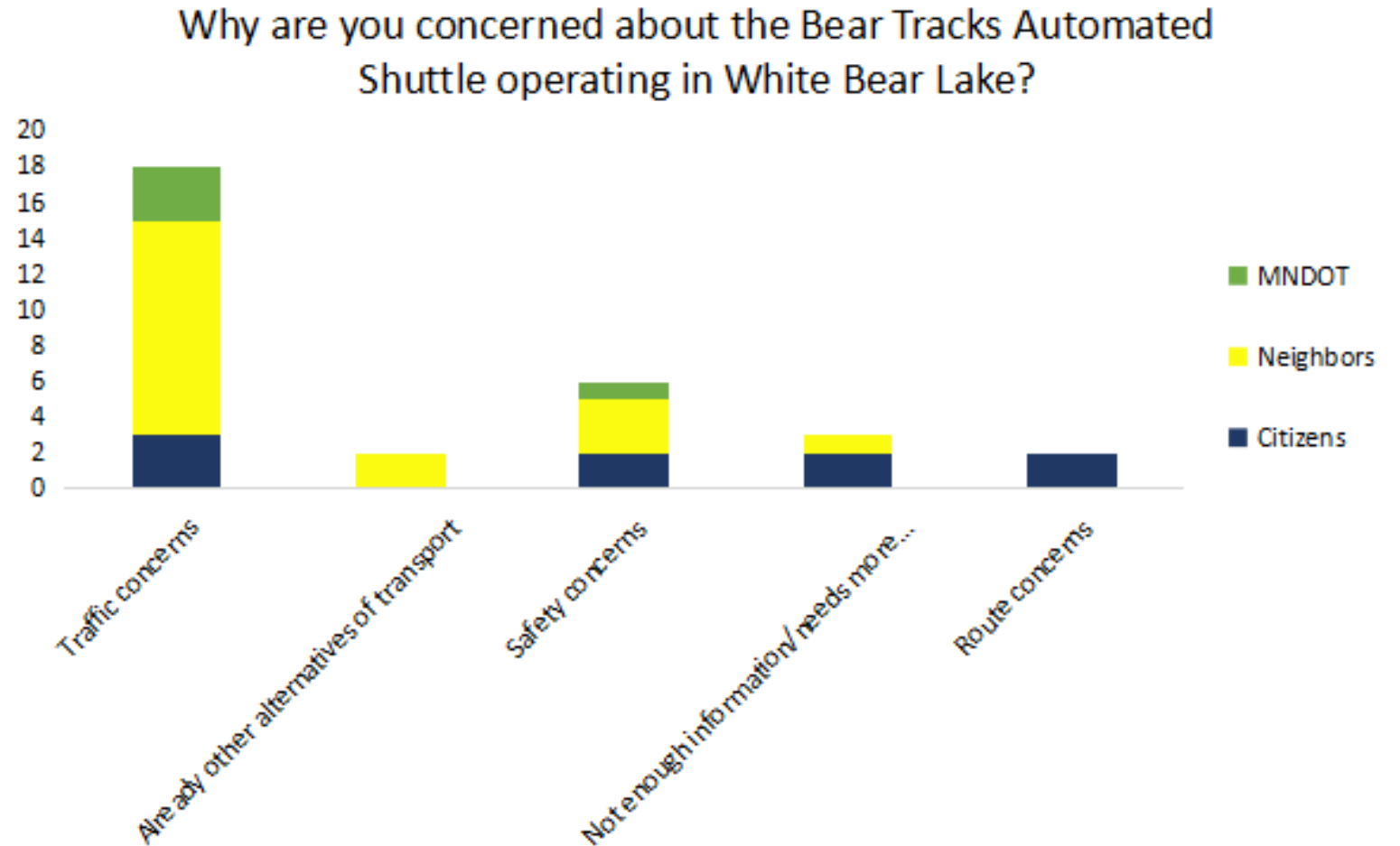


How much do you agree with the statement, "I am concerned about the Bear Tracks Automated Shuttle operating in White Bear Lake"?



Why do we see this trend?

- The largest concern over the shuttle is its effect on traffic, particularly in the neighbors survey.



Thank You!

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