DEPARTMENT OF TRANSPORTATION

The Grand Iron Range CAV Initiative: History, Partnerships, and Community Engagement

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JULY 2024

Research Project
Final Report 2024-20

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Technical Report Documentation Page

1. Report No.	2.	3. Recipients Accession No.
MN 2024-20		

4. Title and Subtitle	5. Report Date
The Grand Iron Range CAV Initiative: History, Partnerships, and Community Engagement	July 2024
	6.

7. Author(s)	8. Performing Organization Report No.
Frank Douma and Evelyn Weiner	

9. Performing Organization Name and Address	10. Project/Task/Work Unit No.
Humphrey School of Public Affairs University of Minnesota 301 19th Ave S, Minneapolis, MN 55455	# 2022053
	11. Contract (C) or Grant (G) No. (c) 1036342 (wo) 59

12. Sponsoring Organization Name and Address	13. Type of Report and Period Covered
Minnesota Department of Transportation Office of Research & Innovation 395 John Ireland Boulevard, MS 330 St. Paul, Minnesota 55155-1899	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

http://mdl.mndot.gov/

16. Abstract (Limit: 250 words)

In fall 2022, a first-of-its-kind connected and automated vehicle (CAV) pilot program called goMARTI (Minnesota's Autonomous Rural Transit Initiative) was launched as a collaborative effort between numerous partners. The 18-month pilot offers free, on-demand rides to area residents and visitors using five autonomous shuttle vans (including three wheelchair-accessible vans) at 70 drop-off and pick-up points within a 17-square-mile area. In this project, researchers documented lessons learned from the pilot, which included exploring the recent history of institutional and community engagement efforts regarding transportation in Itasca County and Grand Rapids, as well as the innovations and collaborations that took place to make the pilot's implementation possible.

17. Document Analysis/Descriptors	18. Availability Statement
Autonomous vehicles, Demand responsive transportation, Shuttle service, Pilot studies, Outreach, Communities	No restrictions. Document available from: National Technical Information Services, Alexandria, Virginia 22312

19. Security Class (this report)	20. Security Class (this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	43	

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July 2024

Published by:

Minnesota Department of Transportation
Office of Research & Innovation
395 John Ireland Boulevard, MS 330
St. Paul, Minnesota 55155-1899

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Executive Summary

Citizens, leaders, and other transportation stakeholders in Itasca County, Minnesota (which includes the city of Grand Rapids), have long recognized the need for more accessible, affordable transportation. The United Way identified significant transportation and mobility challenges to accessing health and human services for county residents who are older, experiencing poverty, or both. Yet like many rural areas, the county's large geographic size and relatively small population have made it difficult to provide conventional alternative transportation.

Past studies conducted in the area have revealed common themes: a need for safe locations to access shared modes of transportation such as carpools; more transportation options for students and those with disabilities; and expanded multi-modal transportation choices. To address these, local leaders have focused on identifying ways to improve the multi-modal transportation network—including with connected and automated vehicles (CAVs).

In the fall of 2022, a first-of-its-kind CAV pilot program called goMARTI (Minnesota's Autonomous Rural Transit Initiative) was launched as a collaborative effort between numerous partners. The 18-month pilot offers free, on-demand rides to area residents and visitors using five autonomous shuttle vans (including three wheelchair-accessible vans) at 70 drop-off and pickup points within a 17-square-mile area. The pilot's goals are to advance CAV technology in rural, winter conditions; engage and educate the local community with real-world CAV experiences; provide safe, accessible mobility for all residents; and understand how the pilot could impact economic development while attracting future talent and technology to the area.

In this project, we documented lessons learned from the pilot, which included exploring the recent history of institutional and community engagement efforts regarding transportation in Itasca County and Grand Rapids, as well as the innovations and collaborations that took place to make the pilot's implementation possible.

To begin, we reviewed previously identified transportation and community goals related to the goMARTI project and the transportation needs of underserved populations. After creating a list of stakeholders involved in local transportation planning, we interviewed stakeholders to learn what progress had been made towards these goals—and assessed goMARTI's ability to address them.

Next, our team examined the innovations at work in the goMARTI project. We created a summary of evaluation criteria for CAV projects by reviewing other Minnesota-based pilot projects—White Bear Lake's Bear Tracks and Rochester's Med City Mover—along with the national Waymo and Cruise demonstrations. In addition, the team considered how the innovations of the goMARTI demonstration affected the Grand Rapids community. Finally, we evaluated the extent to which goals were met through stakeholder interviews, focus groups, and post-ride survey analysis.

Our analysis determined that the goMARTI project is successfully meeting the transportation needs that had been identified in previous studies. Many individuals who are unable to drive or who lack consistent

access to a vehicle reported a positive experience with goMARTI and want to see the service expanded and continued. Overall, these people enjoyed their goMARTI experience; any negative feedback received was related to a desire for expanded service. Riders requested increased hours, increased range, and shuttle stops at specific locations rather than the street.

The goMARTI demonstration is meeting many of the community needs identified in studies over the last 15 years. The services are available to those who cannot or are unable to drive, which includes young people and those with mobility challenges. It also provides an additional consistent form of transportation for the entire community and helps educate residents (especially young people) about CAV capabilities.

A better understanding of how CAVs function in winter weather was another benefit of the goMARTI demonstration. As the first CAV deployment in a rural community with winter weather conditions, this project provided a unique learning opportunity for CAV operations compared to other environments that lack snowfall and have only clear urban streets to navigate. The project team recommends this research be continued to ensure safe service in locations that experience winter weather.

Chapter 1: Introduction

This report provides an overview and evaluation of the goMARTI transportation service offered in Grand Rapids, MN. It includes five chapters, which address the following:

- Chapter two reviews previous studies in Grand Rapids and lists the transportation and community goals articulated in them. It also lists the stakeholders involved in the previous studies, noting whether they remain involved in the transportation planning processes in Grand Rapids, and notes new stakeholders that have become involved since the previous studies were completed.

- Chapter three discusses efforts to meet the previously identified goals and assess progress toward meeting them. It is based on interviews with stakeholders in the project conducted by the research team as well as a document review.

- Chapter four summarizes objectives and evaluation criteria of other CAV demonstrations. It also discusses how the technology, project design, and implementation efforts of this project might address the goals articulated for previous efforts to improve transportation in Grand Rapids.

- Chapter five assesses the extent to which the goals from the earlier projects were achieved in this project and notes the roles of significant stakeholders as well as new technologies and other innovations introduced in this project. It also discusses the extent to which additional goals were reached, substantiated by stakeholder interviews and available operational statistics.

- Chapter six summarizes findings and recommendations based on information in previous chapters.

Chapter 2: Stakeholder Review and Identification

2.1 Introduction

Below are the transportation and community goals identified in previous studies that frame the work that the goMARTI project is doing. Additionally, this chapter contains a list of 53 stakeholders involved in the previous studies, their job titles, the organizations they belong to, and whether they are currently involved or were in the past.

2.2 Transportation and Community Goals

In 2008, the United Way of 1000 Lakes identified transportation as a key barrier to accessing Health and Human Service Needs in Itasca County, Minnesota.[1] Significant portions of Itasca County's population are elderly and/or poor and thus face mobility obstacles. In addition, children and students who are unable to drive face similar mobility challenges. This problem is compounded by Itasca County's large geographic size and relatively small population, making it difficult to provide conventional alternative transportation options.[2]

Past studies were undertaken with the purpose of identifying options for coordination and collaboration that will yield efficiencies and opportunities to enhance transportation options for students in Itasca County.[1] Considering the diversity of its economy and the wide variety of cultural, social, and recreational activities around town, city leaders have been focusing on identifying improvements to the city's multi-modal transportation network that will increase mobility, increase modal choice, and enhance safety and community livability for all the residents and visitors of Grand Rapids.[3] Rural communities in Minnesota experience distinct barriers to safe and affordable transit and have the potential to benefit greatly from the advancements of CAV technology. Automated vehicles present new ways of improving transportation safety, increasing accessibility for transportation disadvantaged populations and spurring economic growth.[4] The goals of increasing mobility in Grand Rapids include ensuring economic vitality, improving health, ensuring connectivity for non-auto modes, decreasing biking and pedestrian crashes, increasing biking and walking opportunities, providing connections to

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[1] F. Douma, M. Schmit, and L. Eash (2011). *Opportunities for School Bus Coordination and Collaboration* (pp. 1–23). Blandin Foundation. Report available from author by request.

[2] F. Douma, Y. Fan, F. Robinson, G. Baas, C. Cureton, M. Schmit (2009). *Itasca County Area Transportation Study* (pp. 1-48). Blandin Foundation, CTS 09-28.

[3] M. Shands, F. Douma, and C. Zimmer (2013). *A New Route to Complete Streets? Using the TCAPP Model in Grand Rapids, Minnesota.* (pp. 1-30). Strategic Highway Research Program, SHRP2 Capacity Project C18C.

[4] F. Douma, A. Lari, and D. McNeil (2019). *Identifying the Opportunities and Obstacles of Connected and Automated Vehicles in Rural Minnesota: Community Engagement in Greater Minnesota* (pp. 1-36). Transportation Policy and Economic Competitiveness Program, TPEC 2019-02.

trails and recreation, providing multi-modal access to destinations, balancing needs of all users, and meeting ADA requirements.[5]

2.3 Stakeholders

Stakeholders were identified through a document review of previous studies and are listed under the organization they are affiliated with. At least one individual, if not more, were contacted during this research to gain their perspective.

2.3.1 The PLUM Catalyst

Tammy Meehan Russell, President and Chief Catalyst from The PLUM Catalyst. She is also the project manager for goMARTI and has been working on the project since its original conception.

Justin Johnson, Director of Technology for The PLUM Catalyst. He is deputy project manager for goMARTI and is responsible for weekly core team meetings as well as monthly meetings of goMARTI stakeholders to discuss the project and coordinates with each stakeholder party to gather information.

Patty Day was the Director of Strategic Communications for The PLUM Catalyst and has now transitioned to the role of Director of Engagement and Equity. She was responsible for much of the communications with the community when goMARTI was originally launched.

Claire Peterlin was the Strategic Partnerships and Ecosystems Manager for The PLUM Catalyst. She is based in Grand Rapids and had taken on much of the communication work within the community.

2.3.2 MnDOT

Thomas Johnson-Kaiser, CAV-X Engagement and Project Manager for MnDOT, served as Technical Liaison for the project.

Marcus Bekele, Project Coordinator, MnDOT Office of Research and Innovation, served as lead administrator for the project.

Duane Hill, District Engineer, MnDOT District 1, which includes Itasca County and the City of Grand Rapids.

Elliott McFadden, Greater Minnesota Shared Mobility Program Coordinator, MnDOT Office of Transportation and Active Transit. His office provided funding to the goMARTI project, and he represented his team in the stakeholder review with goMARTI.

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[5] F. Douma & C. Zimmer. (2012). *Complete Streets Through Community Partnerships: The Grand Rapids Experience.* (Project Summary Presentation). Strategic Highway Research Program, SHRP2 Capacity Project C18C.

Cory Johnson, Statewide ITS/CAV Technical Program Lead Engineer, MnDOT Connected and Autonomous Vehicles Office.

Tara Olds, MnDOT Connected and Automated Vehicles Office. Her office has provided funding to the goMARTI project.

Scott Shaffer, Senior Transportation Planner, MnDOT.

2.3.3 Blandin Foundation

Becky LaPlant worked for the Blandin Foundation as the Public Policy Program Associate. She was one of the project managers for the 2008 Itasca County transportation study and is now retired.

Linda Gibeau worked for the Blandin Foundation as the Grants Program Officer and was one of the project managers for the 2008 Itasca County transportation study.

Mary Magnuson works for the Blandin Foundation as the Grants Program Officer and has been responsible for administering grant funding to the goMARTI project. She took over the work of Linda Gibeau.

2.3.4 Citizens

Myrna Peterson is co-founder of Mobility Mania and is a citizen advocate. She is partly responsible for the project coming to Grand Rapids through her advocacy. Now she does outreach in the community, attends events sponsored by goMARTI, and rides the shuttle regularly to supply feedback from a wheelchair user perspective.

Lisa Arnold is a social worker with Itasca County, co-founder of Mobility Mania and is a citizen advocate. She is partly responsible for the project coming to Grand Rapids through her advocacy. Now she does outreach in the community and attends events sponsored by goMARTI.

2.3.5 May Mobility

Nick Leone, previous Customer Success Manager, May Mobility.

Mychael Mulhern, Director of Customer Success, May Mobility. He is responsible for coordinating different stakeholder groups, so information was available to all members of the goMARTI team.

Anirudh Batra, original Field Autonomy Engineer on the project, May Mobility.

Gerald Antony, Field Autonomy Engineer, May Mobility.

Daisy Wall, Director of Government Business, May Mobility.

Praveena Ramaswami, previous Global Community Engagement and Program Launches Marketer, May Mobility.

William Kawsky, Senior Operations Launch Program Manager, May Mobility.

Sheryl Seitz, Vice President of Marketing and Communications, May Mobility.

2.3.6 Via

Meghan Grela, Strategist, Via. She is the autonomous mobility lead. Via provides microtransit software for autonomous vehicles including the rider app, algorithms, and fleet management system.

Yumna Bham, previous Associate Principal of Partner Success, Via.

Alex Neumann, Expansion Associate Principal, Via.

2.3.7 City of Grand Rapids

Tom Pagel, City Administrator, City of Grand Rapids. He is the city government facilitator and has been responsible for facilitating collaboration between his team and goMARTI.

Rob Mattei, Community Development Director, City of Grand Rapids, and has been working on the project since its inception.

Steve Schaar, Policy Chief, City of Grand Rapids. He is responsible for enforcement of any traffic issues that could arise, attends safety meetings with goMARTI, and responds to road rage incidents as the goMARTI shuttles go under the speed limit.

Matt Wegwerth, Public Works Director and City Engineer, City of Grand Rapids.

2.3.8 Arrowhead Transit

Sandra Wheelecor, Transit Manager, Arrowhead Transit. She has been engaged with the project to collaborate on best operational hours and how to best complement the existing bus service.

2.3.9 Itasca County

Tamara Lowney, President, Itasca County Economic Development Corporation. The goMARTI project is housed in the incubator building they own, and she was an integral part of the planning process for goMARTI's deployment.

Brett Skyles, County Administrator, Itasca County, and has provided funding and support to the goMARTI project.

2.3.10 Grand Rapids Schools

Scott Patrow teaches elementary education classes at Minnesota North College in Grand Rapids and was the principal for the Grand Rapids school district. He is also the Director of Itasca County Schools Collaborative Career Pathways Program. His work has included creating an opportunity for students to

create landmarks along sections of the route for the lidar system to enable more accurate vehicle localization.

Matt Grose, Superintendent, Grand Rapids School District, and has been a program advocate since its inception.

2.3.11 Minnesota North College

Bart Johnson, Vice President of Academic Affairs, Minnesota North College, and has been working on the project since its inception.

Jessalyn Sabin, Academic Dean, Career and Technical Programs, Minnesota North College.

Lisa Marcis, Director of Operations for the Itasca campus, Minnesota North College.

2.3.12 Miscellaneous

Whitney Ridlon, Community Development Representative, Department of Iron Range Resources and Rehabilitation.

Megan Christianson, previously Executive Director, Visit Grand Rapids, and now an independent consultant working with Visit Grand Rapids.

2.3.13 University of Minnesota

Frank Douma, Director of State and Local Policy & Outreach, Institute for Urban and Regional Infrastructure Finance, University of Minnesota, and has been working on the project since its inception.

Tom Fisher, Director, Minnesota Design Center, University of Minnesota. He works with a research team developing designs for spaces the community can utilize alongside the goMARTI shuttles.

Gina Baas, Deputy Director, Center for Transportation Studies, University of Minnesota. She is the Principal Investigator for the UMN research teams.

Chapter 3: Institutional History

3.1 Introduction

Through interviews with the stakeholders identified in chapter 1, as well as review of relevant previous studies, this chapter outlines the efforts to meet the previously identified goals for the Grand Rapids Area and assesses progress toward meeting them. Many goals have been addressed by the goMARTI pilot project and though there are many other ways to address transportation challenges in the Grand Rapids community, and rural communities more generally, the integration of a connected and automated vehicle service that is free of charge introduces another accessible transportation choice.[6] Other options identified in both interviews and the literature review include an on-demand rideboard, better infrastructure for pedestrians and bicyclists, and additional support for existing volunteer driver services.

3.2 Itasca County Area Transportation Study

The "Itasca County Area Transportation Study" had the aim of learning and understanding the specific transportation needs and challenges of the noted populations, as well as the county as a whole, identifying comparable rural areas in the United States, and learning lessons from their successes and failures in meeting similar challenges, recommending practices and options that best fit Itasca County, and identifying key stakeholder and funding sources that need to be assembled to successfully implement the recommendation.[2]

This study identified a multitude of recommendations for transportation challenges in the Grand Rapids community and rural communities. Among these recommendations was to promote transit as safe, comfortable, economical, and "green." Although this was not a primary aim of the goMARTI pilot project, The PLUM Catalyst spent time working with Grand Rapids residents discussing transportation goals and discussing the safety of connected and automated vehicles. In our interviews with stakeholders, one individual mentioned that they had heard community members discussing whether they need to buy a second vehicle because the goMARTI demonstration is dependable, free, and a good service within the city.

[6] The goMARTI pilot project is currently free of charge as it is being used to collect information and refine connected and automated vehicle technology for future use.

Three other recommendations identified in the study were creating a Shared Rides program, creating a city- or county-wide ride-matching service online, and creating a small car sharing program. For each of these recommendations, the goMARTI pilot project is addressing the same need of a vehicle service that is not owned, but is on demand, low-cost (although, the goMARTI demonstration is free), and accessible online. The goMARTI pilot project eliminates the need for coordination with volunteer drivers and can provide safe and dependable access to transportation across the city of Grand Rapids.

This study also had a goal of creating a safe way for students to travel. One recommendation in the report was adding an after school "circulator" service that would bring the kids to after school events or other locations for kids to safely be until parents could pick them up. While the goMARTI pilot project is not exclusively for students, it is filling this need. The goMARTI demonstration was available for anyone age 12+ without parental supervision which makes this an ideal tool for middle school and high school students to utilize after school if they can't drive yet, or simply don't have access to a dependable vehicle. Although this has been changed to 18+, the goMARTI team is working on changing this to 13+ as they recognize the importance of the service for young people.

Finally, the study sought to develop safe, visible, and accessible carpool park and ride locations. The PLUM Catalyst did work with the community through listening sessions and meetings with stakeholders to develop the original route for the goMARTI demonstration. Now, as the six-month point approaches, they are reaching out to stakeholders again to get feedback about how the route is meeting their needs and how it could be changed to better meet the needs of the community.

3.3 Opportunities for School Bus Coordination and Collaboration

The "Opportunities for School Bus Coordination and Collaboration" study sought to identify options for coordination and collaboration that would yield efficiencies and opportunities to enhance transportation options for students in Itasca County. The tactics identified to do such were creating and reviewing a map of existing school bus routes, as well as other transit routes, seeking opportunities for coordination, identifying, through discussions with stakeholders, needs and supports for after school transportation services, identifying and discussing regulations governing school transportation, including differences in how these regulations affect district-supplied and contractor-supplied services, presenting options for improved collaboration and coordination, based upon: (1) likely cost impact (saving or new expense), (2) likely service impact, and (3) ease of implementation, and recommending options for new services that could be enabled.[1]

Four recommendations were created from this study including addressing hot spots where school buses from multiple districts service that area, adding Broadband Access to buses, increasing routes with smaller vehicles, and eliminating or changing district lines to accommodate a more appropriate bus schedule. Although the goMARTI pilot project does not address all these issues, people over the age of 13 were able to use the service without an adult accompanying them when the pilot was launched, and goMARTI operators provided anecdotal evidence that it has provided an alternative transportation

option for students from school to home or other after school activities. The minimum age changed to 18 on February 10th, and as shown in Figure 1, the number of individuals using the shuttle to and from the middle and high schools dropped. Since the Reif Center, the main performing arts venue in Grand Rapids, is located next to the high school, some of this travel can be attributed to individuals above the age of 18, but loss of ridership when the age requirement changed indicates that young people were utilizing the service up to that time. The goMARTI project intends to reinstate the language allowing individuals over the age of 13 to ride without adult accompaniment which would provide an additional public transit option to students in the Grand Rapids community.

Figure 1

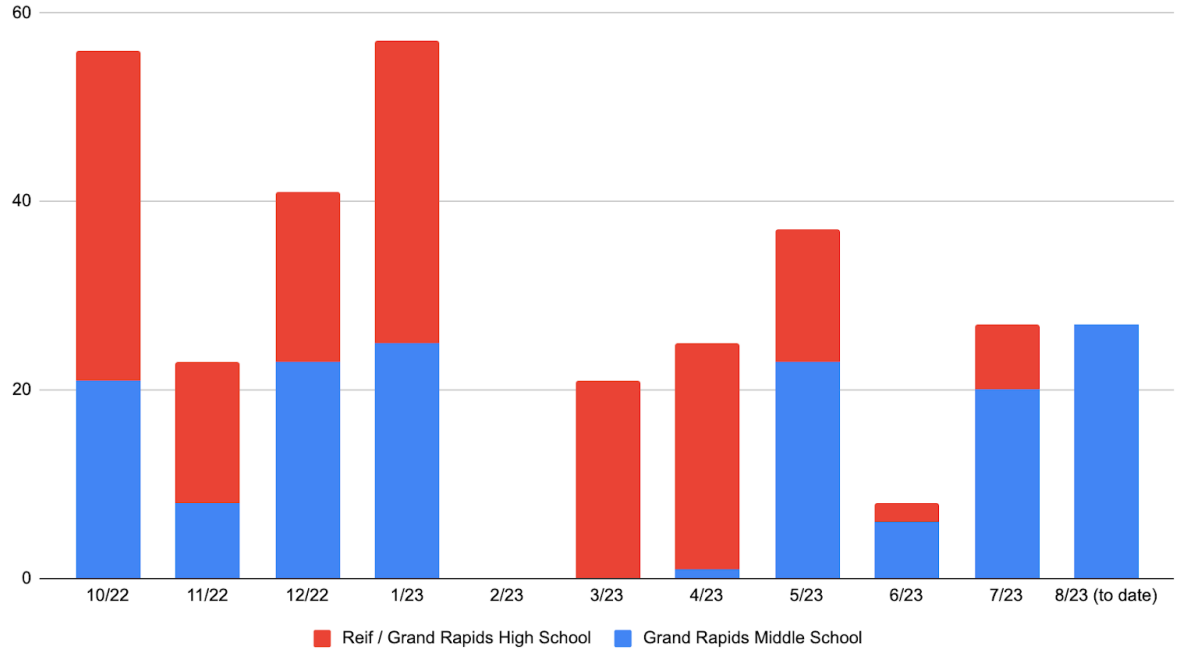

Figure 1 Number of Student Riders on goMARTI Shuttles

3.4 Complete Streets Through Community Partnerships

The "Complete Streets Through Community Partnerships: The Grand Rapids Experience" study identified goals of increasing mobility in Grand Rapids by ensuring connectivity for non-auto modes, decreasing biking and pedestrian crashes, increasing biking and walking opportunities, providing connections to trails and recreation, providing multi-modal access to destinations, balancing needs of all users, and meeting ADA requirements.[5]

Many recommendations were created based on this goal and one is being addressed by the goMARTI pilot program. The goMARTI pilot program offers a free service for individuals to use to get to various locations around the city of Grand Rapids. One user claimed that before the pilot program was in use, she would use her wheelchair to get anywhere she needed to go if there was no one available to drive

her accessible van which posed a substantial safety issue. One of the recommendations of this study was to create safe routes to parks and for seniors to move about Grand Rapids, and the goMARTI demonstration presents a viable solution.

3.5 Past CAV and SDV Community Engagement

The "Self Driving Vehicle Task Force Write-Up: Issues, Opportunities, and Next Steps" document summarizes the findings of various conversations on self-driving vehicle technology and policy implications that took place between 2014 and 2017. It identified major opportunities for transportation development to improve mobility and access to aid aging populations, people with disabilities, and other people unable to drive themselves. It considered options including deploying CAV's and identifying which models fit best in a variety of settings including urban, suburban, small cities, and rural. The goMARTI pilot project is addressing these concerns by providing more accessible transit options for individuals unable to drive themselves and thus increasing equity for older adults and individuals with disabilities.[7]

Similarly, the "Identifying the Opportunities and Obstacles of Connected and Automated Vehicles in Rural Minnesota: Community Engagement in Greater Minnesota" paper, written in 2019, discusses how automated vehicles present new ways of improving transportation safety, increasing accessibility for transportation disadvantaged populations, and spurring economic growth. Community engagement in Greater Minnesota (Grand Rapids, St. Cloud, Mankato, and Fergus Falls) revealed excitement about the opportunities CAV technology may offer for improving quality of life, accessibility, affordable and consistent transportation options, and aging in place opportunities for rural residents.[1] Each of these past listening sessions and community engagement demonstrate the need for alternative transportation options, like the goMARTI pilot program, in rural communities.

3.6 Conclusion

Through interviews with the identified stakeholders as well as review of relevant documentation, this chapter outlined the efforts to meet the previously identified goals for the Grand Rapids Area and demonstrates how the city has acted to meet goals. Many goals have been addressed by the goMARTI pilot project including providing transportation services for students from school to home or other after school activities, promoting transit as safe, comfortable, economical, and "green," creating a Shared Rides program, creating a city- or county-wide ride-matching service online, and a small car sharing program, creating a safe way for students to travel, develop safe, visible, and accessible carpool park and ride locations, create safe routes to parks and for seniors. Though there are many other ways to address transportation challenges in the Grand Rapids community, and rural communities more

[7] F. Douma, A. Lari, and S. Vargas. (2017). *Self Driving Vehicle Task Force Write-Up: Issues, Opportunities, and Next Steps.* Transportation Policy and Economic Competitiveness Program. Retrieved from: https://tpec.umn.edu/research/technology/cav

generally, the integration of a connected and automated vehicle service that is free of charge introduces another accessible transportation choice.

Chapter 4: Innovations of this Project

This chapter will provide a summary of objectives and evaluation criteria of other CAV demonstrations including Bear Tracks, which is currently running and is taking place in White Bear Lake, MN, and Med City Mover, which ended its pilot in August 2022 in Rochester, MN. It will also provide a discussion of the innovations of the goMARTI demonstration and how it is affecting the Grand Rapids community.

4.1 Minnesota Based CAV Demonstrations

All the Minnesota based pilot projects, Bear Tracks, Med City Mover, and goMARTI, are sponsored by the Minnesota Department of Transportation. They are each pilot projects with widely available information on goals, objectives, and criteria for evaluation.

4.1.1 Bear Tracks

The objectives identified for the Bear Tracks Automated Shuttle Pilot, which is a low speed, "level 4" shuttle from Navya operating on a 1.5-mile route that serves the YMCA, a day program offering an array of services and opportunities for adults with developmental disabilities, and two senior apartment complexes, in White Bear Lake, Minnesota, were to:

- Advance the operation of automated vehicle technology in winter weather conditions;
- Identify infrastructure gaps and solutions to safely operate automated vehicles on public roadways;
- Engage and educate the public by providing a real-world automated vehicle experience;
- Advance educational opportunities and exposure to students to develop a connected and automated vehicle talent pipeline; and
- Enhance the transit experience for the citizens of White Bear Lake and improve mobility in a suburban environment for those who can't drive.[8] [9]

Figure 2: Route for the Bear Tracks Automated Shuttle Pilot in White Bear Lake

These goals are being evaluated using multiple surveys including one given to individuals who ride the shuttle, one directed to people who live or work near the shuttle route, and one given to

[8] MnDOT. (n.d.). *White Bear Lake Automated Shuttle Pilot.* Retrieved from https://www.dot.state.mn.us/automated/destinationcav/cavinmn.html

[9] Bear Tracks. (n.d.). *A New Way to Get Around Town.* Retrieved from https://beartrackswbl.org/

stakeholders. The findings from these surveys are generally positive with some concerns noted about public perception of automated vehicles, the low operating speed of the shuttle which operates on a public road, and the delayed launch due to COVID-19 and low ridership.

4.1.2 Med City Mover

The Med City Mover was designed to serve several objectives including:

- Engaging Minnesotans about the potential benefits and opportunities of this technology;
- Improving how automated vehicles drive and function in winter weather conditions;
- Identifying changes to infrastructure needed to safely operate automated vehicles on public roads;
- Enhancing the transportation experience for Rochester residents, businesses and visitors; and
- Improving how people get around in the high-demand downtown area.[10]

The Med City Mover had about 3,000 riders. The project demonstrated an option that could complement existing transit options in cities as a small, downtown route. As mentioned above, two of the goals of this project were identifying changes to infrastructure to accommodate CAVs and improving how CAVs operate in winter weather conditions. The Med City Mover shuttles' sensors incorrectly perceived rain, leaves, and construction barriers as obstacles. This information allows CAV technology developers the opportunity to make changes to create a more efficient and accurate service.[11]

Figure 3: Route for the Med City Mover Shuttle Pilot in Rochester

4.2 Non-Minnesota Based CAV Demonstrations

While the following demonstrations do not have particular goals or evaluation criteria listed, they are making great strides in creating and marketing a self-driving vehicle service to their communities. These services, coming from private entities, demonstrate that on-demand autonomous and self-driving vehicle services are feasible in the future of transportation. Each of these services is available in warmer climates where there are fewer concerns about extreme weather conditions interfering with the safety

[10] MnDOT. (n.d.). *Med City Mover.* Retrieved from http://www.dot.state.mn.us/medcitymover/
[11] Petersen, R. (2022). *Med City Mover is Leaving Rochester.* Retrieved from https://www.postbulletin.com/news/local/med-city-mover-leaving-rochester

of the service. Increased research and demonstrations are needed in colder climates to develop the technology needed to have a fully autonomous service available in all regions of the United States.

4.2.1 Waymo

Waymo, located in Phoenix and San Francisco, is a fully autonomous and all electric vehicle that is available at the click of a button. It has over 20 million miles of driving experience and utilizes a safety framework to ensure that the vehicle is meeting all laws and regulations.[12] The service area in Phoenix is pictured to the right.

Figure 4: Waymo Ride-hailing Service Areas in Phoenix, Arizona

4.2.2 Cruise

Cruise presents a driverless, all-electric, and emission-free service to get individuals where they need to go safely. The self-driving cars have trained for millions of miles on city streets and include a variety of safety features including 360-degree vision, collision avoidance, passenger protection, siren sound detection, and many more. This service is available in San Francisco, Austin, and Phoenix.[13]

[12] Waymo. (n.d.). *Phoenix - Waymo*. Retrieved from https://waymo.com/phx/

[13] Cruise. (n.d.). *Driverless is Here.* Retrieved from https://getcruise.com/

Table 1 Summary Table of AV Demonstrations in Minnesota and Nationally

	Med City Mover	**Bear Tracks**	**goMARTI**	**Waymo**	**Cruise**
Number of vehicles	Two	One	Five	Unclear	Unclear
Length of route	1.5 miles long, two stops	1.5 miles long, four stops	36.4 miles long, sixty-eight stops	Within designated service area	Within designated service area
Accessibility	Vehicle had braille, wheelchair ramp and tie downs, audio messages, and trolly bells.	Vehicle was ADA compliant.	Three out of five vehicles have ADA compliant wheelchair ramps.	No accessibility measures apparent	No accessibility measures apparent
Objectives	● Provide an autonomous, on-demand service; ● Learn about operating autonomous vehicles in winter weather; and ● Engage the community in learning opportunities around autonomous technology.	● Provide an accessible, autonomous, on-demand service; ● Learn more about operating autonomous vehicles in winter weather; and ● Engage the community and students in learning opportunities around autonomous technology.	● Provide an accessible, autonomous, on-demand service; ● Learn more about operating autonomous vehicles in winter weather; ● Engage the community in learning opportunities around autonomous technology; and ● Bring economic development to a rural community.	● Provide an autonomous, on-demand service.	● Provide an autonomous, on-demand service.
State	Minnesota	Minnesota	Minnesota	Arizona and California	Arizona, California, and Texas
Location	Urban	Suburban	Rural	Suburban/Urban	Urban

4.3 goMARTI Innovations

The goMARTI pilot project addresses a variety of new challenges to bring innovation to the field of connected and automated vehicles (CAVs). This is the third CAV demonstration in Minnesota, following Med City Mover and Bear Tracks which had two and one vehicle(s) in their fleet respectively. goMARTI has five vehicles in their fleet which increases their ability to serve many in the community at one time. Additionally, while there have been two other demonstrations in Minnesota, this additional demonstration is gathering more data and input on how to design CAVs that are able to operate in winter weather conditions. Although there have been two other demonstrations in Minnesota, goMARTI is the first in Minnesota to have an on-demand service which includes almost seventy stops, and just over 36 miles, while other Minnesota based demonstrations have had less than five stops each. Although the on-demand model is being used in warmer climates, this is one of the first in winter weather. The two other Minnesota based demonstrations were based in urban and suburban communities, but the goMARTI project is one of the first demonstrations in the US in a rural community. The goMARTI pilot project is also developing technology on accessibility, as three of the five vehicles are fully wheelchair accessible.

Without all these characteristics, the project would not be achieving nearly the results that it is now. With fewer vehicles in the fleet, it would have a longer wait time for users. Without the app to order on-demand rides, the service would be harder to access, and less people would use it. With less stops on the route, people would have restricted access to the places in the Grand Rapids they need to go. If this service were offered in an urban setting, individuals in Grand Rapids would have fewer transportation options, and be unable to take public transportation after 8:30pm. Finally, without the goMARTI vehicles being wheelchair accessible, individuals with disabilities would not be able to use the service, severely limiting their access to public transportation. Each of the innovations in the goMARTI pilot project are significant to providing a transportation option that works in Grand Rapids.

Finally, it is worth noting that autonomous driving technology is still in its infancy, and pilots like these are crucial in making changes and improvements to increase accessibility and safety. When speaking to a stakeholder on the May Mobility team about the technology they claimed that although the shuttle operates autonomously 85-90% of the time, the technology does exist for it to operate almost completely autonomously. However, May Mobility's first objective is providing a service that is as safe as possible, so attendants continue to perform unprotected left hand turns and round-abouts without the autonomous technology. However, with the technology continuing to grow and learn, there is hope for a fully autonomous service in the future.

4.4 Conclusion

This chapter provided a summary of objectives and evaluation criteria of other CAV demonstrations including Bear Tracks, Med City Mover, Waymo, and Cruise. It also provided a table comparing and contrasting features of each demonstration. The findings demonstrate the different priorities of each demonstration, including goMARTI's emphasis on accessibility and researching autonomous technology

in winter weather. This chapter also provided a discussion of the innovations of the goMARTI demonstration and how it is affecting the Grand Rapids community.

Chapter 5: Qualitative Evaluation

This document will explore the extent to which the goals from the earlier projects were achieved in this project. It will note the roles of significant stakeholders, new technologies, and other innovations introduced in this project, as well as discuss the extent to which any additional goals were reached.

5.1 How Goals from Previous Studies are Addressed by the goMARTI pilot project

The study "Identifying the Opportunities and Obstacles of Connected and Automated Vehicles in Rural Minnesota: Community Engagement in Greater Minnesota" was performed in 2017.[4] This study discusses the feelings of the Greater Minnesota on CAV technology as such:

"These community discussions have demonstrated broad excitement about the potential for CAV technology to improve safety, quality of life and economic well-being in communities throughout Minnesota. There were also significant concerns expressed about how to equitably implement CAV technology in Greater Minnesota concurrently with the state's metropolitan areas as well as reservations about how these vehicles will perform in Minnesota's harsh winter weather."

In our discussions with stakeholders, we chose to consult with some members of the Grand Rapids community to inquire as to whether these opinions are still relevant. One member of the Grand Rapids community replied that rural individuals are not used to transportation systems as they live in an area that is not densely populated and so many transportation options are not feasible. However, this community member explains that the community has received the goMARTI project warmly because it offers more options to improve their lives, especially for those without steady access to vehicles. Many individuals remain hesitant to try the shuttle service, but this community member claims that once they do they realize how their life can be made easier. In addition, providing a call center as away to book rides, as an alternative to using the phone-based app, was a key feature to reach the target ridership groups, making up about 10% of the bookings each month.

Figure 5: United States Senator Amy Klobuchar

Focus groups with older adults in the Grand Rapids community yielded similar feedback. Older adults mentioned how the introduction of this service has provided an opportunity to learn about automated vehicle technology and would be a great tool to allow residents to "age in place," which is the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level.

Total rides were only 1,536 on March 5th which was the six-month mark of the goMARTI demonstration, but ridership was

up to 2,964 on July 16th.[14] This is nearly double the rides in far less than half the time. Ridership has grown over summer months when individuals are more willing to wait outside to try the service. During focus groups, many individuals explained that they had not tried the service yet due to concerns of waiting outside in the cold if the shuttle was delayed.

Common themes have emerged from past reports done in the Grand Rapids area. Among those are requests for safe carpool locations, increasing transportation options for students, providing transportation options for individuals with disabilities, and providing expansion to multi-modal transportation options. Each of these themes is addressed below.

Table 2 Transportation Goals Addressed by goMARTI

Goal from Study	goMARTI	Study Referenced
Provide multi-modal access to destinations.[5]	The goMARTI pilot project was designed to complement these existing services rather than replace them. Its hours of operation are offset from the bus service to provide a public transportation option during times that it is not normally offered.	"Complete Streets Through Community Partnerships: The Grand Rapids Experience"
Improve mobility and access to aid aging populations, people with disabilities, and other people unable to drive themselves, while meeting ADA requirements.[5, 7]  **Figure 6: goMARTI Vehicle Equipped with Wheelchai** **Myrna Peterson boards a goMARTI shuttle. https://www.gomarti.com/**	The goMARTI pilot project was developed to serve all individuals in the community, with special attention paid towards creating a service that is accessible to older adults and folks with disabilities. Of the five vehicles that are being utilized for the goMARTI project, three of them are equipped to have a wheelchair user as a passenger. In addition, providing a call center as an alternative to the phone-based app, was a key feature to reach the target ridership groups, making up about 10% of the bookings each month.	"Complete Streets Through Community Partnerships: The Grand Rapids Experience" and "Self Driving Vehicle Task Force Write-Up: Issues, Opportunities, and Next Steps"

[14] Numbers provided by The PLUM Catalyst team.

Develop safe, visible, and accessible carpool park and ride locations.[2]  **Figure 7: Sign for goMARTI Shuttle Stops** . https://www.gomarti.com/	Signs have been developed, like the one to the left, to indicate stops for goMARTI. These stops are being maintained by the City of Grand Rapids and can serve as carpool locations. The development of the signs was done in collaboration with the community to ensure they were situated in places that are helpful to those using them.	"Itasca County Area Transportation Study"
Identify options for coordination and collaboration that would yield efficiencies and opportunities to enhance transportation options for students in Itasca County.[1, 2]	Providing an option for youth to get around Grand Rapids has appeared as a priority in multiple past studies. Riders on goMARTI needed to be at least 13 to ride the shuttle when it was launched. This was changed to 18+ in February, but after discussion with stakeholders, will likely revert to the younger age to provide a transit option for young people. The goMARTI demonstration is vital in providing a truly accessible service for the community.[15]	"Itasca County Area Transportation Study" and "Opportunities for School Bus Coordination and Collaboration"

5.2 Methodology

Task 4.1 facilitated the collection and organization of important stakeholders, their job titles, and contact information. The research team utilized this document to connect with stakeholders and complete interviews about transportation challenges the Grand Rapids community is facing, and how goMARTI is addressing those concerns. Appendix A contains the interview questions used, and Appendix B includes the organizations that individuals interviewed were pulled from; seventeen interviews were completed in total. Each interview was recorded, and a member of the research team took notes during each interview. After all the interviews were completed, the research team identified themes within the interviews which contributed to the findings within this document.

[15] In October of 2022 on the goMARTI shuttles 9.5% of rides were coming or going to the Grand Rapids High School stop. The Grand Rapids high school stop tied for second place of the most visited stop in October. Provided by May Mobility. (2022).

In a visit to Grand Rapids, the research team conducted three focus groups with older adults, mental health professionals and clients, and the Minnesota North College. This was done using a question guide in Appendix C and was facilitated by one member of the research team while another took notes. Similarly, to the interviews, the notes were analyzed for themes which contributed to the discussion in this document.

Finally, statistics collected by May Mobility were utilized to contextualize how often the service is being utilized and by whom. The research team was able to get data on each month, as well as overall, to evaluate the utilization of the service. Additionally, surveys are provided to those using the service and these comments were used to substantiate themes identified in interviews and focus groups.

5.3 Significant Stakeholders

There were many significant stakeholders in this project that were responsible for successfully ushering the goMARTI pilot project into the Grand Rapids community. Among the most important are two community members, and founding members of Mobility Mania, for expanding transportation options that are accessible in their community, one of whom is a wheelchair user. About four years ago they got involved with the Governor's Advisory Council on Connected and Automated Vehicles. May Mobility, a company whose focus is development of technology for autonomous vehicles, reached out to The PLUM Catalyst to pilot autonomous technology in a rural community in Minnesota. The PLUM Catalyst then began coordinating with these community advocates to see if this pilot would work in Grand Rapids. Since deployment, the community advocates have been among the top riders and responsible for immense feedback on the experience from a wheelchair user perspective.

Figure 8: Mobility Mania Volunteers at 2022 Grand Rapids Tall Timber Days Parade

Arrowhead Transit, the primary existing public transportation option in the Grand Rapids area, was consulted during the development process of the goMARTI pilot project. Arrowhead Transit was consulted specifically to ensure that the goMARTI pilot was running at times that would supplement the existing service, rather than be concurrent and take riders from the bus system to a new service.

The PLUM Catalyst, a consulting firm focused on increasing mobility and transportation options, have been the facilitators of the goMARTI pilot project. The PLUM Catalyst coordinated the implementation of the goMARTI pilot project by working with community members, city officials, funding agencies, technology companies, and the organization managing the autonomous vehicles. The PLUM Catalyst was engaged from the beginning by facilitating listening sessions with the community, bringing all the individuals needed on the project together, and ensuring that the project would see deployment in a timely manner. Now that the project is running, they continue to manage the project and engage with the community on changes when needed.

May Mobility and Via are responsible for maintaining the vehicles, making changes to the route, and having up to date technology in the vehicle, and for the public using the app. Throughout the development process they worked together to create a safe and user-friendly experience. Now, just past the six-month mark of deployment, The PLUM Catalyst is facilitating meetings where community feedback and user reports are used to discuss possible changes to the route. Both May Mobility and Via use this feedback to increase accessibility to users.

The City of Grand Rapids provided the space and capacity that the project needed to get off the ground. In partnership with the PLUM Catalyst, the City of Grand Rapids worked to host listening sessions, ensuring that there was space available for activities, and helped to develop the stops that the goMARTI project would use for the duration of the pilot. Now with the end of the pilot in sight, individuals from the city are doing what they can to obtain increased funding to ensure that the service remains in their community.

Finally, some of the most important stakeholders are the funders, including MnDOT and the Blandin Foundation. The Blandin Foundation is a Grand Rapids based organization interested in investing in the economic vitality of the community. MnDOT is both a funder and sponsor of the project and receives all research done on the project. Both organizations have been pivotal in getting the pilot project off the ground and into the Grand Rapids community. The Minnesota Department of Iron Range Resources and Rehabilitation recently received the ATTAIN grant, which provides $9.3 million, which they will use to expand the current goMARTI pilot in fleet size and range, to
make transportation options services more reliant, convenient and accessible in rural communities, including for wheelchair users.[16]

5.4 Perceptions of CAVs by Stakeholders

Residents of Grand Rapids stated that the goMARTI shuttle service was received warmly, but with some apprehension. Most Grand Rapids residents we spoke to had very limited experience with CAVs and possessed only general knowledge based on media but seemed to be curious and interested in learning more. One stakeholder referred to autonomous vehicles as, “the coolest thing ever” and discussed how bringing autonomous technology to the community contributes to knowledge in the community, and knowledge is power. Stakeholders also perceived CAVs as a viable solution to transportation challenges in the Grand Rapids community. Concerns cited about CAVs were generally about safety and whether the technology had been developed to a trustworthy point. Concerns from stakeholders also surrounded how the technology would fare in cold and snowy weather conditions where visibility and accessibility can be inhibited. However, stakeholders indicated that they have not heard of any

[16] U.S. Department of Transportation Federal Highway Administration. (2023). *Biden Administration Awards $9.3 Million Advanced Technology Grant to Minnesota to Improve Transit Reliability in Grand Rapids.* Retrieved from https://highways.dot.gov/newsroom/biden-administration-awards-93-million-advanced-technology-grant-minnesota-improve-transit

compromised safety conditions since the goMARTI launch and they feel much more confident about it now.

5.5 Improvements

In conversations with stakeholders, many mentioned improvements they would like to see to the service to expand service and accessibility in the area. The goMARTI demonstration has collected 105 post-ride surveys for those using the service which included a write-in question that allows users to give additional feedback. The following word cloud demonstrates the common themes of the feedback including shuttle, operator, operators, great, ride, and efficient. Additionally, some words like long and wait indicate that the goMARTI demonstration has continued room for growth.

Figure 9 Common Terms from Qualitative Feedback

Focus groups in Grand Rapids also communicated that advertising the goMARTI service as a broad and inclusive opportunity to serve everybody should be emphasized. While priorities should continue to focus on providing the best possible service to disadvantaged populations, marketing it in a way that clarifies that it is a service for everyone would decrease stigma and could encourage greater use among even those that need it most. Particularly, staff from the Minnesota North College explained that some students would be hesitant to use the service because of the stigma attached to using a free transportation service instead of owning a car. Additional improvements discussed in focus groups are included in the chart below.

Table 3 . Recommended Improvements and Beneficiaries

Improvements	Who Would Benefit
Expanding hours	Individuals with late night or early morning activities
Expanding route to Minnesota North College and other spots outside the city	Individuals working or living outside of the city, as well as students attending Minnesota North College
Moving the stops from the sidewalk to the doors of specific locations	Individuals with mobility challenges
Holding information sessions and demonstrations at senior living facilities and Minnesota North College	Individuals frequenting senior living facilities and the Minnesota North College

5.6 New Goals Reached by the goMARTI Pilot Project

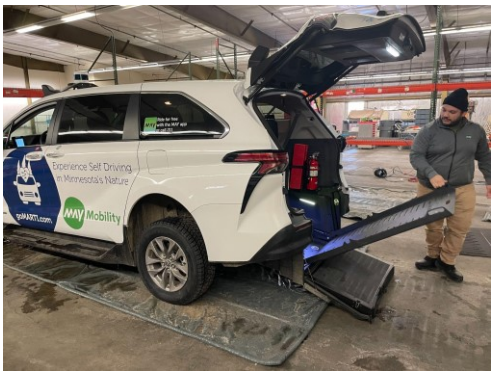

Figure 10: Wheelchair ramp on goMARTI shuttle

The goMARTI pilot project is one of the first CAV pilots to be deployed in a community that experiences harsh winter weather conditions that affect the CAV technology. This pilot is also one of the first CAV demonstrations to offer accessibility to those using a wheelchair with the inclusion of ADA compliant wheelchair ramps. In addition to this, a review of literature indicates that it is the first CAV demonstration offered in a rural community using an on-demand model with both a smartphone app and a call center. The data from this pilot will be used to inform future CAV demonstrations, as well as commercial services. It will provide information on best practices for CAV operation in cold, winter climates, in rural communities without pre-existing infrastructure that cities provide, and with individuals facing mobility challenges. The goMARTI pilot project is paving the way for equitable access to a new and evolving transportation option for all individuals.

Chapter 6: Summary Findings and Recommendations

6.1 Findings

In summary, conducting this review and evaluation led to a number of cross-cutting findings, which we present below.

- There is a need for accessible transit for those who cannot or are unable to drive. Many individuals who are unable to drive, or who do not have consistent access to a vehicle, report a positive experience with goMARTI and wish to see the service expanded and continued.
- There is a need for CAV research and development in rural communities experiencing winter weather conditions. This is the first CAV deployment in a rural community experiencing winter weather conditions. It has been a unique learning experience for CAVs, as other environments don't experience snow falling or buildup and have clear urban streets to navigate. This research should be continued to ensure a safe service in this environment.
- People enjoy using CAVs in the Grand Rapids community. The survey responses, interviews, and focus groups yielded positive feedback. Any negative feedback received was about expansion to the existing service.
- The demonstration would get more engagement if hours of operation were increased, range were increased, and/or the shuttles were able to go to specific locations rather than stop on the street. The feedback in interviews, surveys, and focus groups yielded consistent calls for expansion and refinement. This is particularly true among those experiencing mobility challenges who would use this service more with changes. In the experience of the research team, it is a sign of a successful project when the main suggestions for improvement are to increase the service. The ATTAIN grant, which was recently procured, will offer the pilot the opportunity to expand its fleet and range to continue toward its goal of service for all in the Grand Rapids community.[16]
- The Grand Rapids community has learned about CAVs by having them in their community. The goMARTI project has prioritized exposing the technology to young people and those who are interested. The goMARTI team has been present at many community events to answer questions about the technology.
- The goMARTI demonstration is meeting many needs in the community identified in various studies over the last 15 years. The services are available to those who cannot or are unable to drive, which provides service to young people and those with mobility challenges. It also provides an additional consistent form of public transit for the community.

6.2 Alternatives and Recommendations

Alternative options to address the transportation challenges in Grand Rapids were discussed with stakeholders in the interviews and focus groups. They suggested that Rural Rides was a strong program that needed better support to serve the needs of the community. In this model, individuals with vehicles could be compensated for taking other individuals to and from locations at no cost. Additionally, one stakeholder mentioned a voucher system that was in place for a time that provided low-income individuals opportunities to use taxis at a discounted rate. However, most stakeholders thought that the existing bus system and walking/biking trails throughout the city provided good options for transportation in the city.

Some recommendations from past studies are impossible to address with the goMARTI project because it is simply one additional mode to address mobility needs. Other transportation needs mentioned in past studies focused on expanding bike pedestrian routes, adding a commuter rail to Duluth and the Twin Cities, creating transportation options that would work outside city limits, and creating transportation options that function 24/7. Although these goals cannot be addressed by goMARTI because they are beyond the pilot's scope, with the ATTAIN grant procured, expanding transportation options beyond city limits is within reach. The Minnesota Department of Iron Range Resources and Rehabilitation received $9.3 million, which it will use to expand the current goMARTI pilot, to make transportation options services more reliant, convenient, and accessible in rural communities, including for wheelchair users.[16] The findings of the research team support continuing to source funding for expansions to the goMARTI demonstration to learn more about operating CAVs in rural, winter weather environments, as well as to provide a dependable and low-cost service to the community.

Appendix A
Interview Questions

Interview Questions

The following questions were used to conduct individual stakeholder interviews:

1. What organization are you from?
    a. What is your organization's role in the project?
2. Do you have any previous experience with connected and automated vehicles? In what way?
3. What are your general feelings about connected and automated vehicles?
4. What benefits, if any, do you believe the goMARTI shuttle will have for the citizens of Grand Rapids?
5. Do you have any concerns about the goMARTI shuttle? Do you have any concerns about automated vehicles in general?
6. How would you describe the transportation challenges in Grand Rapids?
7. Do you think that goMARTI shuttles are addressing the constraints in mobility in the Grand Rapids community?
8. Previous studies identified that limited transit hours and cost issues have been impediments to mobility access to individuals without vehicles in Grand Rapids, would you agree that's still the case?
9. Are there any other impacts you anticipate from the goMARTI shuttle?
10. Has the goMARTI pilot project come together like you had envisioned or hoped?
    a. If not, how has it been different? Has this caused your enthusiasm for CAV's to change?
11. Has anything surprised you or is there anything you didn't expect that you will take forward from the project?
12. Who do you think are, or should be, the key stakeholders in this project?
13. Do you feel other stakeholders and the public were adequately prepared for the project?
14. What improvements do you believe can be made about the project?
15. Based upon the project so far, have your feelings about connected and automated vehicles changed? If so, how?
16. 10+ years ago, The Blandin Foundation sponsored a study that identified a number of other options to improve mobility and access in Itasca County, an automated shuttle service wasn't one of them because the technology wasn't nearly as mature, are there other options beyond goMARTI that you view as worth pursuing?
17. Is there anyone else you recommend we interview as part of this process?
18. Do you have any other thoughts regarding the goMARTI shuttle you'd like to share with us?

Appendix B
Interviewees

Interviewees

Interviews included individuals from the following organizations:

- Iron Range Resources and Rehabilitation Board
- The City of Grand Rapids
- Minnesota Department of Transportation
- Itasca County Economic Development Corporation
- Itasca County Schools Collaborative Career Pathways Program
- Grand Rapids Police Department
- Arrowhead Transit
- The Plum Catalyst
- May Mobility
- Via
- Blandin Foundation
- Itasca County
- Grand Rapids community members

Appendix C
Focus Group Questions

Focus Group Questions

The following questions were used to conduct focus group interviews:

1. What are your general feelings about connected and automated vehicles?
2. What benefits, if any, do you believe the goMARTI shuttle will have for the citizens of Grand Rapids?
3. Do you have any concerns about the goMARTI shuttle? Do you have any concerns about automated vehicles in general?
4. Has the goMARTI pilot project had an impact on your ability to get around Grand Rapids?
5. What improvements do you believe can be made about the project?
6. Are there other transportation options beyond goMARTI that you view as worth pursuing for the Grand Rapids community?
7. Based upon the project so far, have your feelings about connected and automated vehicles changed? If so, how?

Appendix D
Focus Group Groups

Focus Group Groups

Focus groups included individuals within the following categories:

- Minnesota North College
- Mental Health Professionals
- Individuals Seeking Treatment for Mental Health Concerns
- Older Adults Living at Majestic Pines
- Older Adults Living at The Pillars