Project Summary:

Automated Truck Mounted Attenuator (ATMA)

DESTINATIONCAV

Project Description

Connected and automated vehicle (CAV) technology has the potential to significantly increase work zone safety. Each day, MnDOT maintenance employees and contractors are at risk of being involved in crashes when performing road work. To mitigate this risk, MnDOT uses truck mounted attenuators – or crash cushions – to help protect roadside workers)

Project Goals

The following goals align with the state's broader CAV program goals. Reference page 18 of the Strategic Plan for full descriptions of the seven CAV program goals.

Program goal	Project goal
Safety	Improve worker safety by removing the driver from attenuator host vehicles exposed to traffic
Readiness	Understand and advance the capabilities of current technology to support driverless operation

The ATMA project sought to evaluate and deploy automation technology in support of MnDOT maintenance work zones. The main project goal was to find a solution to improve worker safety by removing the human from the host truck, a position with high exposure to being hit by the traveling public. The ATMA project may not have accomplished the goals as originally defined but did expand MnDOT's knowledge of automation technology, as well as develop understanding and support structure for how automation technology could be integrated into MnDOT's fleet.

Figure 1. ATMA Follow Truck

Project Accomplishments

- Performed 4 summers of testing in MnDOT work zones
- Improved our procedures for testing of automation equipment in the future
- Developed understanding of how equipment could be installed in MnDOT equipment in the future
- Identified key requirements for adoption of ATMA

Project Key Findings

Feasibility of Driverless Operation

The project found there is potential for future driverless operation of ATMA host vehicles. However the first generation equipment included in this project to date has not proven reliable enough at this time to attempt operation without a safety driver. Continued improvements will be needed to explore driverless operation.

Procedural Changes

One of the least expected findings was how ATMA operation affects current procedures. The ATMA's operations are quite simplistic, and providing TMA operation is within the simplistic operations provided, however the start, relocation and conclusion of a

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operation posed challenges. To address these challenges a combination of changes to crew procedures and extension of the ATMA operational abilities will be needed to feasibly deploy ATMA in Minnesota.

Equipment Ruggedness

MnDOT Snow plow trucks are exposed to some very harsh conditions. In addition to the salt spray typical of snow and ice operations the trucks experience significant vibration. The ATMA system experienced numerous failures caused by vibration and other environmental conditions. In the future a more thought out and detailed plan is needed for installation of equipment on MnDOT equipment. The project included a design and integration workshop to discuss what next steps for installation of future equipment may look like and we believe future collaborative planning can reduce the problems encountered.

Figure 2. ATMA Lead Truck

Equipment Breakdowns

One of the unexpected but significant challenges faced by the project was breakdown of the host equipment. Trucks breakdown, and to be successful a system need to be able to accommodate issues such as failing batteries and not be as depended on specific units working. Future systems should include more robust systems to ensure safe operation even with issues like low voltage situation, and the ability to swap equipment when a unit needs to be repaired.

Testing and development methods

The ATMA project started by providing the ATMA equipment to maintenance shop to test in addition to their existing work. The crew was not empowered to resolve issues and often problems were not reported to people who could resolve them quickly.

In the later seasons temporary positions were used to dedicated staff full time to ATMA operation. These staff were empowered and tasked to work directly with the vendor, work on the equipment and make efforts to resolve issues if the system was not working and documenting issues. In addition a truck was leased for Metro District to ensure the ATMA units were available all summer for testing. Using this method the ATMA saw far greater deployment time, and better understanding of the problems.

Lessons learned

- Dedicated crew structure works for development
- There is potential but more work is needed
- Collaboration is important when integrating with existing MnDOT equipment

Potential next steps for MnDOT

- Build the next generation of ATMA:
    - MnDOT Plow Truck to be more representative of large scale deployment
    - Built into truck during initial buildout
    - Universal system (either unit leader or follower) leading to future operational flexibility
    - Software improvements to accommodate operational needs

For more information on this project, please contact **MnDOTCAV.DOT@state.mn.us**

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