

Implementation Planning Document
for
DRIVER ASSIST SYSTEMS

SPECIALTY VEHICLE APPLICATIONS – SNOW PLOWS



Mn/DOT Research Project # 2000-007R

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INTRODUCTION

This implementation plan is a follow up activity to Minnesota Department of Transportation (Mn/DOT) research project # 2000-007R, which was conducted by the University of Minnesota (U of Mn) Intelligent Transportation Systems (ITS) Institute under the direction of Dr. Max Donath. Four technical reports containing specific details of the evaluation of Driver Assist Systems (DAS) for snowplows are available on line:

Evaluation Report Volume 1: System Performance and Human Factors –
<http://www.lrrb.gen.mn.us/PDF/200407.pdf>

Evaluation Report Volume 2: Benefit Analysis -
<http://www.lrrb.gen.mn.us/PDF/200408.pdf>

System Performance and Human Factors Evaluation of the Driving Assistive System - <http://www.lrrb.gen.mn.us/PDF/200409.pdf>

System Performance and Human Factors Evaluation of the Driving Assistive System (DAS) – Supplemental Track Test Evaluation -
<http://www.lrrb.gen.mn.us/PDF/200412.pdf>

The basic technologies used in the snowplow system are based on a prior research project; “Driver Assist Systems for Snowplows - <http://www.lrrb.gen.mn.us/PDF/200313.pdf>.” An

ongoing ITS Institute research project is evaluating the DAS effectiveness during ‘gang plowing’ situations. DAS snowplow prototypes for continuing situational evaluations are presently in Polk County, Minnesota and Valdez, Alaska.



The following three sections of this plan include an overview of the Intelligent Vehicle Initiative (IVI) specialty vehicle project, a plan to begin the DAS transition from prototype one-at-a-time builds to private sector production, and this plan’s implementation measures of effectiveness.

EVALUATION OF THE RESEARCH PROJECT

The Problem

The problem is to provide the driver of specialty vehicles with the means to maintain desired lane position and avoid collisions with obstacles during periods of low visibility. Low visibility often occurs during snow, blowing snow, fog, and night. Nationwide, snowplow drivers experience about 7,000 incidents per year because of low visibility blocking drivers' sight of the roadway, curves, and preceding vehicles.

The Project Approach

The Driving Assist System is comprised of an on-board computer, on-board high accuracy geospatial database, integration software, Differential Global Positioning System (DGPS), forward looking radar, and a driver interface system which provides lane position information and warnings utilizing a Heads Up Display (HUD), a haptic seat, audio feedback, tactile steering wheel, and a driver control panel display.

The ITS Institute research team built and integrated DAS into snowplows, an ambulance, a patrol car, and a city bus to evaluate driver responses. Geospatial databases and DGPS base stations were established for several areas in Minnesota. The HumanFIRST laboratory at the University of MN created training materials, trained bus and snowplow drivers in use of the system, then observed the snowplow drivers using the systems. An independent contractor, the Minneapolis office of URS, conducted the Benefit Analysis, Volume II report.

The Project Results

The Driver Assistive System created by the Intelligent Transportation Systems Institute researchers at the University of Minnesota was quite successful in that it demonstrated necessary cues for lane keeping and collision avoidance normally unavailable during poor visibility conditions. In the case of snowplows, the DAS facilitates all weather emergency services by opening roads and keeping them passable for other emergency vehicles and the general motoring public. The Benefit Analysis ascertained that if

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snowplow Driver Assistive Systems could be built and installed for an average cost of \$10,000 per vehicle, then many agencies would consider procurements.

Projected Benefits of DAS Implementation

The DAS lane following system displays the snowplow's position relative to the centerline and road's edge, which allows the driver to maintain a reasonable plowing speed during driven-snow and other low visibility situations. Maintaining reasonable plowing speeds means more miles cleared per hour, potentially saving labor costs.

The forward-looking sub-system will detect stopped or slow moving vehicles then alert the driver so that he/she will be less likely to hit them when plowing in limited visibility situations. Fewer crashes will save costs, time, and lives.

The expected public benefits of DAS in winter maintenance vehicles include the reduction in travel times, less disruption to routine travel behavior, and improved safety for the traveling public during and immediately following winter weather events.

The laboratory build costs of over \$20k per system installation can be reduced if production line quantities can be built. This is necessary to attain the above DAS safety and efficiency benefits.

IMPLEMENTATION PROJECT PLAN

This Driver Assist System implementation plan has two phases with the plan for Phase II to be developed near the end of Phase I. Phase I focuses on application of the DAS to snowplows. Phase II will focus on application to public bus systems. Ambulance and patrol vehicle DAS implementation is deferred to a future time.

Task 1 – Technical Support Documentation Consolidation

Some training documentation exists because 'snowplow test drivers' were instructed in the use and operation of the DAS system. Procure a WEB-CAST software package. This task will obtain the electronic copies of that training documentation plus presentation materials used at conferences and forums. The DAS electronic information will be

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sorted into subsystem data then converted into formats for “web-cast” presentations.

The sub-systems include:

- The embedded processor and integration software requirements,
- The forward looking radar system,
- The DGPS equipment and infrastructure mapping requirements for new application areas,
- The geo-spatial database creation and maintenance for new areas,
- The steering wheel tactile system hardware,
- The haptic seat subsystem hardware,
- The Heads-Up display subsystem hardware, and
- The system interface to the 3M magnetic tape following system.

Deliverables for this task are the above sub-system technical information in web-cast formats and a status report.

Task 2 – Informational Presentation Materials

Create a one sheet ‘glossy’ description for each of the subsystems detailed in task 1. These sheets are needed for Task 3 communications. These will also be available for distribution as handouts at conferences and workshops attended by county and state maintenance personnel. These flyer descriptions may also form the baseline for the subsequent manufacturer’s marketing materials. Electronic copies of these condensed information flyers will be provided so that web-cast techniques can be used for product advertising and for future use in operator/driver training sessions.

Deliverables for this task are 50 glossy copies of the flyers, an electronic copy of the flyers, and a status report.

Task 3 – Candidate Manufacturer Communications

Current DAS have been assembled and installed into vehicles at the U of MN’s Mechanical Engineering laboratory. The research team recognizes that in order to become a ‘production’ product, the DAS hardware will need some packaging and mounting design updates to mitigate truck vibration. In order to produce DAS for multiple jurisdictions, a willing industry manufacturer must be identified, negotiated with, and authorized to make design changes for production. This task includes preparation for, then scheduling meetings to communicate with two or three companies

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to ascertain their willingness to accept design update, build, and sales responsibility for the DAS. Licensing agreements will then be effected. Candidate organizations for this communications are ForceAmerica, ThomTech, and at least one other candidate to be identified during TASK 1 performance.

Deliverable for this task is a status report informing the sponsor of the success or snags in obtaining a licensing agreement.

Task 4 – Technology Transfer Support

This task assumes successful completion of Task 3, i.e. an organization agrees to become the producer of the Snowplow DAS. In order to successfully transfer the subsystem designs, the performer of this contract and the University researchers must be available to answer questions by the manufacturing process engineers for up to a year or until the first unit is built and installed, whichever comes first.

Deliverable for this task is a status report listing the technology transfer activities and 'lessons learned' during the interaction with the manufacturer's engineers. The WEB-CAST software package will be transferred to the Mn/DOT library when this contract is completed.

Task 5 – Next System Planning

Most of the snowplow DAS hardware and software subsystems are in use in the U of MN/Metro-transit Techno Bus. Once a licensee is identified by Task 3, the technology transfer team will generate a proposal to supplement the documentation from Task 1 and Task 2 for transit applications. The lane following and obstacle detection subsystems from this research project can aid transit drivers using freeway shoulder lanes and bus drivers on Bus Rapid Transit systems. The real purpose is to get higher DAS production quantities thus attaining lower unit manufacturing costs for all specialty vehicles.



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Deliverables for this task are an electronic copy of a new plan and a final status report.

Resource estimates for tasks

Task	Cons Hrs	U of MN support	Mn/DOT support	Misc. costs	Mileage & parking	Line Sum
1	96	32	16	\$600	\$50	144 hrs.
2	80	24	16	\$320	\$30	120 hrs.
3	40	32	16	\$0	\$80	88 hrs.
4	96	48	24	\$0	\$60	168 hrs.
5	20	4	2	\$40	\$15	28 hrs.
Sub-Total	332	140	74	\$ 960.00	\$ 235.00	
Rate	\$60	various	\$0			
Costs	\$19,920	\$11,000	\$0*	\$960.00	\$ 470.00	\$32,115

This plan assumes that Mn/DOT is not a direct project cost, rather a match - ~ \$4,500.

Task 1: Time estimates assume 10 hrs per subsystem for sorting and format conversions plus 2 hrs per subsystem for communications with University, Mn/DOT, and the project sponsor. The miscellaneous cost is for the acquisition of a software package; such as that available at www.Screenwatch.com for communications, online learning and live web-cast.

Task 2: Time estimates assume 10 hrs for each of the eight subsystems plus Mn/DOT and University support time for technical accuracy review. The miscellaneous cost is for printing the flyer set.

Task 3: Time estimates assume two meetings by the contractor and the University ITS Institute Director with each candidate manufacturer plus Mn/DOT participation at one meeting.

Task 4: Time estimates assume two half days per month for a year plus Mn/DOT and University time for local communications and issue resolution.

Task 5: The time estimates are approximately the same as expended writing this plan.

MEASURES OF IMPLEMENTATION BENEFITS

Description of Measures

The immediate measures for this plan will be four or five status report memos to the funding agency with copies to Mn/DOT Research Services Section and the Center for Transportation Studies. Note that if Task 3 does not result in a licensing agreement, Task 4 will be cancelled and Task 5 will be the resources for generating research project closure documentation. Future measurements of improved plowing efficiencies and reduction of low visibility incidents can't be effectively measured until systems are deployed and in widespread use. Note that the current DAS evaluation during gang plowing research project has had difficulty getting enough snow over the last two winters thus isn't providing immediate benefit measures.

Purposes of Measures

The purpose of the measure is to inform the funding agency of the completion of each task, and to provide Mn/DOT and the University with technical documentation for future training use and WEB posting.

Responsibility of Measures

The implementation plan consultant shall be responsible for the report deliveries.

Resources and Cost of Measures

The resources and costs are included in the resource table in the previous section.

Schedule of Measures

- ⇒ Task 1 – three months after contract begin date.
- ⇒ Task 2 – four months after contract begin date.
- ⇒ Task 3 - five months after contract begin date.
- ⇒ Task 5 – six months after contract begin date.
- ⇒ Task 4 – twelve months after Task 3 licensing agreement.