



Final report

Drover WOLF to Beef Australia 2021 – Final Report

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Abstract

Meat & Livestock Australia (MLA), HDT Global, and EPE participated in Beef Australia 2021 (BA21) and subsequently organised a day-long – Drover WOLF – open day and demo session at EPE’s facilities and invited industry representatives to:

- Showcase EPE and their facility.
- Demonstrate some useful opportunities for the meat industry for some of their products- autonomous ground and aerial vehicles.
- Showcase the WOLF vehicle and its capabilities.

At BA21 contact with potential sponsors and collaborators was established to increase the success of future phases. The show had great visibility and publicity. It was attended by the Prime Minister, state and local ministers and covered by local and national media.

The objective of this project was to introduce the Drover WOLF to the beef producing industry and get buy-in from it and input on future areas of development and research direction was accomplished. This follows past MLA partnership with HDT in the Drover WOLF – MLA project P.PSH.1197 (an unmanned vehicle with obstacle avoidance, GPS waypoint, navigation controller intended to operate quietly near livestock and with also a drone landing platform).

Executive summary

Background

Over the past decade, HDT and the US armed forces have invested over ten million US dollars in developing unmanned vehicles to carry heavy loads across rugged terrain to supply infantry soldiers. The current system is a 6X6 hybrid diesel/electric system with a built-in 20 kW generator. It can carry 500 kg more than 200 kilometers off-road on 70 liters of diesel fuel. The vehicle's generator provides power for an on-board storage battery and electric drive motors, as well as for payloads. For the Australian livestock market, we have developed the Drover WOLF variant of this vehicle with upgraded capabilities, including longer range, greater mission duration, autonomous control, and a limited silent-run capability for operating near livestock.

In January 2020, HDT completed the development (co-funded by MLA) of an Experimental Prototype, the Drover WOLF. The Drover WOLF is integrated with auxiliary fuel tanks (doubling its range), and a prototype obstacle avoiding autonomous way-point navigation system.

In May 2021, HDT delivered the Drover WOLF to the Beef Australia exhibition. The machine garnered enthusiasm and set the stage for continued efforts to deliver value to MLA's stakeholder community.

Objectives

Explore how the Drover WOLF can be used to: 1) Increase the productivity of cattle stations, primarily in Queensland, Northern Territories, and Western Australia through reduced labor costs and increased weight gain. 2) Increase the productivity of feed lots through lower labor costs, higher weight gain (by facilitating the delivery of supplements), and lower morbidity and mortality. 3) Reduce the loss of pasture lands to invasive species by eradicating these plants at a lower cost and a faster rate than current manual methods.

Methodology

Two demonstrations were performed 1) at Beef Australia 2021, and 2) a Ranchers Day demonstration and discussion event at EPE.

Results/key findings

HDT-MLA should leverage the work done to-date around autonomy, feed delivery, and other real-world applications, in the next 6-12 months.

Future research and recommendations

The next phase should focus on delivering demonstrations of specific applications to local landowners and producers.



Figure 1: (from top to bottom) Picture of Protector (the precursor device); Hunter WOLF v1, Drover WOLF (v2) (vehicle which integrates the autonomous navigation kit); Drover WOLF integrated with the dry-supplements distribution system; Drover WOLF being demonstrated to the Hon Scott Morrison

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1. Background

Over the past decade, HDT and the US armed forces have invested over ten million US dollars in developing unmanned vehicles to carry heavy loads across rugged terrain to supply infantry soldiers. The current system is a 6X6 hybrid diesel/electric system with a built-in 20 kW generator. It can carry 500 kg more than 200 kilometers off-road on 70 liters of diesel fuel. The vehicle's generator provides power for an on-board storage battery and electric drive motors, as well as for payloads. For the Australian livestock market, we have developed the Drover WOLF variant of this vehicle with upgraded capabilities, including longer range, greater mission duration, autonomous control, and a limited silent-run capability for operating near livestock.

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1.1 Development History

1.1.1 Protector

HDT has been developing Unmanned Ground Vehicles (UGV) since 2011. HDT recognized the need within the military for a new class of robot. While small, man portable robots were available they had severe limitations in payload capacity, mission duration and terrain crossing capability. The Protector was developed to solve those deficits and allow greater effectiveness of US fighting forces.



Figure 2: HDT's Protector

1.1.2 Wheels vs. tracks

Evolving requirements from the US Army have led to HDT investigating alternative system architectures than the Protector to better meet the need. Specifically, a faster, larger payload, longer range, and quieter platform was desired. Numerous tests were conducted and data was collected and analysed to determine the best drivetrain to meet the new requirements. Conclusions from these studies showed that a wheeled platform increased system efficiency, extending range,

while also resulting in a quieter audio signature. Payload capacity and terrain mobility remained adequate when all wheel drive systems were used.



Figure 3: Picture of MadDog, a battery only wheeled initial prototype

1.1.3 Phase 1: Hunter WOLF – Prototype

The Phase 1 Hunter WOLF™ prototype built in 2017 incorporated a hybrid-diesel electric drivetrain with a 400km range, the ability to carry 500kg (tow 2,000kg), and a 20kw generator.



Figure 4: HDT's Hunter WOLF (v1)

1.1.4 Phase 2: Drover WOLF – Experimental Autonomous Prototype

The Phase 2 Drover WOLF™ expanded the capabilities of the Hunter WOLF by integrating additional fuel tanks, a drone landing platform, and an autonomous navigation system.



Figure 5: HDT Drover WOLF (i.e. Hunter WOLF with AUV deck, waypoint navigation (NAV) kit, and additional fuel tanks.)

1.1.1 Phase 3: Drover WOLF – Functional Prototype

The Phase 3 Drover WOLF included the development and integration of a fiducial marking (i.e. land-marking) system, as well as the development of *proof-of-concept* attachments specifically a dry-supplement distribution system and an autonomous trailer drop-off/pickup kit.



Figure 6 :Picture of the HDT Drover WOLF during dry-supplement delivery demonstration.

1.1.2 Drover WOLF at Beef Australia 2021

In May 2021, HDT delivered the Drover WOLF to the Beef Australia exhibition. The machine garnered enthusiasm and set the stage for continued efforts to deliver value to MLA’s stakeholder community.



Figure 7 : Demonstrating, together with MLA, the Hunter WOLF to the Hon Scott Morrison, Prime Minister of Australia.

2. Objectives

Attending Beef Australia is an important step in gaining interest in the WOLF as a range management platform. The use of autonomous ground vehicles in livestock operations will have a positive economic impact in three major areas:

1. Increase the productivity of cattle stations, primarily in Queensland, Northern Territories, and Western Australia through reduced labor costs and increased weight gain.
2. Increase the productivity of feed lots through lower labor costs, higher weight gain, and lower morbidity and mortality
3. Reduce the loss of pasture lands to invasive species by eradicating these plants at a lower cost and a faster rate than current manual methods.

4. Methodology

The project is outlined by four (4) main activities/tasks, those being:

1. Manage the logistics of moving the Drover WOLF between its normal storage location and Beef Australia 2021 (BA21)
2. Provide man-power support for the show, notionally to include one HDT business development manager and one field service representative (FSR), for the duration of BA21.
3. Prepare video demonstration of the WOLF utilizing a compilation of video clips of the WOLF performing different tasks and navigating different terrain.
4. Demonstrate the Drover WOLF UGV.

5. Results

5.1 Logistics

HDT was successful in returning the vehicle to the United States to complete a battery replacement as well as a full maintenance service. A new import license was obtained in time for delivery into Australia and the vehicles satisfied AQIS requirements. The vehicle and all payloads were delivered to BA21 in time for bump-in at the MLA-HDT stand. At the show's conclusion, the vehicle and all accessories were collected and returned to the Brisbane warehouse.

5.2 Manpower Support

The original proposal included one business development person and one technical support person for the duration of the event (1 week). However, HDT was able to reduce this requirement and therefore bring costs down. First, HDT took additional steps to ensure that the machine was in peak technical condition to reduce the chances of a problem during the event. Second, a kit of tools was prepared and additional spare parts were kept on hand to mitigate any technical problems encountered. Second, business development staff was trained in basic operator level maintenance so that they could handle minor technical issues, should they occur. The result was that only one BD person was required for the full event, with one more attending for only 2 days to attend meetings and perform market research.

5.3 Video

HDT staff pulled together hours of video to create an attractive and information compilation of the Drover WOLF performing various tasks relevant to the market at BA21. The team produced a 5-minute video to be played on loop at the HDT-MLA stand, as well as a consolidated 2-minute version to be shown at the MLA-corporate booth, as well as in any other marketing events made available over the week.

5.4 Demonstration

5.4.1 At Beef Australia 2021

MLA and HDT secured twice-daily demonstrations to the public attending BA21. These demonstrations were listed in the show program as well as on the BA21 mobile app. The demonstration were approximately 30 minutes each and included opportunities to demonstrate the control, manoeuvrability, and features of the Drover WOLF. MLA provided an introduction to each demonstration describing its interest in the platform within the larger context of its efforts in autonomy and technology in the agricultural market. Price Rural provided insight from the user perspective about how such technology could bring value to producers and landowner. HDT staff demonstrated the physical performance and discussed technical details of the platform. The demonstrations were well attended and involved Q&A from audience members of all backgrounds.

A part of the WOLF's demonstration at BA21 will be to engage an Australian producer to trial the vehicle on farm following the event. Several producers have already shown considerable interest in this.

Following BeefAustralia2021 the vehicle will be transported to the selected producer site to conduct further trials with the vehicle or bring producers to a Ranchers Day event at EPE.

5.4.2 Ranchers Day

MLA, HDT, and EPE carried out a Drover WOLF UGV demo day at EPE's facilities in Brisbane, AU on June 13, 2022, between 0800 to 1530 hrs. The purpose was to demonstrate the capability of the WOLF vehicle to industry and receive input from industry that will drive the future direction of the R&D of this vehicle. The agenda for the day was the following:

Time	Activity	Facilitator
0900 - 0910hrs	Welcome & Housekeeping	EPE
0910 - 092hrs	History of MLA's interest in the vehicle	Darryl Heidke
0925 - 1000 hrs	Introduction to the vehicle, specifications and capability	Julio Santos
1000 - 1020hrs	Morning Tea	
1020 - 1120hrs	Vehicle walkthrough & demonstration	Jeremy Martin
1120 - 1250hrs	Interactive session on direction of research.	John McGuren
1250 - 1330hrs	Lunch	
1330 – 1430 hrs	Walkthrough of other EPE & Data 61 technologies	Jeremy Martin/Navinder
1430 – 1539 hrs	Interactive session on other technologies	John McGuren

A short presentation WOLF Open summarizing the history of MLA's interest, and R&D efforts with the Drover WOLF was given by Darryl Heidke. Followed by a presentation given by Julio Santos-Munné introducing HDT Global, the WOLF, including its specifications and capabilities, and some examples of how it might be of use in a ranch.

6. Key findings

6.1.1 From BA21

- BA21 is an excellent event to showcase our product and should be considered in the future.
- The public is impressed by the capabilities of the Drover WOLF platform, and want to see what it can do to solve their specific problems
- The next phase should focus on delivering demonstrations of specific applications to local landowners and producers.

6.1.2 From Ranchers Day

Key insights and feedback from our discussions with Producers during Ranchers Day are summarized below:

- Business case (BC) will need to be formulated to secure future work.
 - **Value proposition of WOLF requires its use across several applications, and not any one-use case.**
 - Producers do not want a different machine for every application, a single machine with a variety of attachments would be of interest to producers.
 - Business Case needs to be structured around savings in CAPEX (capital expenditure), OPEX (operational expenditure), and Labour improvements.
 - Leasing or Service models attractive to Producers.
- Autonomous capability fundamental to utility and Business Case.
- Applications of primary interest are:
 - Prickly pear eradication (and similar woody weeds)
 - Would need to be funded or at least partially funded by local, and/or state government.
 - Existing libraries of invasive weed data already exist and could be utilized.

- Tethered drone launch (or recoverable) for surveillance or supplement/fodder/chemical delivery
- Feed Systems, particularly if they can transmit operation feedback and status i.e. amount of feed remaining,
- Pasture Cutting
- Pasture/plant irrigation
- Soil Sampling
 - Other potential applications mentioned:
 - Sheep feeder
 - Fire Cart
 - Follow-Me load carrier
 - Body Scanning + Walk over weighing
- Producer support is fundamental to future funding approvals.
 - Specific pain points for producers are wages, chemicals, fertilizers, fuel.
- Surveillance and data monitoring/recording can be done actively or passively, and additional to primary Business Case.

7. Conclusion and recommendations

The overwhelming majority of the feedback about the Drover WOLF was one of excitement and potential for future growth. Having seen what the base platform can do stakeholders are now keen to see it put to work solving real and tangible problems on their land. It is recommended, therefore, that a proposal be put together as soon as possible to capitalize on the interest shown by performing demonstrations at stakeholder properties.

HDT-MLA should leverage the work done to-date around autonomy, feed delivery, and other real-world applications, in the next 6-12 months.