

# Robot Procurement

AGVs (with articulated legs) - Stage 2 & 3  
Hardware

Project Code  
2021-1270

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## 1.0 Executive Summary

To find ways to improve the health and safety of workers, AMPC has engaged DroneDeploy (formerly Rocos) to assist them in undertaking a Proof-of-Concept trial to identify potential use cases of ground robotics and how these robots may benefit the meat processing industry.

Through the workings of this Project 2021-1270, the team from AMPC and DroneDeploy selected and purchased a Boston Dynamics Spot Enterprise robot with a corresponding Docking Station and Robotic Arm Payload.

The Boston Dynamics Spot robot was selected due to its leading position in the robotic industry and advanced capabilities in navigation and mission planning, as well as mobility over a variety of terrain. The DroneDeploy team has been involved in the Boston Dynamics Spot Early Adopter program since its commencement in 2019 which offers the Project the best opportunity to prove meaningful use cases.

This robot was shipped first to the DroneDeploy office in New Zealand where it was configured, set up and tested prior to being deployed on the selected site, Casino Food Coop, in Casino, New South Wales.

## 2.0 Introduction

The purpose of this project was to cover the hardware requirements and setup requirements of a selected robotic solution to be used in Project 2021-1271.

DroneDeploy (formerly Rocos) is considered one of the industry leaders in robot operations software and was chosen as a partner in this project to facilitate the education and selection of an appropriate robot solution. DroneDeploy has many relationships among different robot providers but has mainly focused on Spot from Boston Dynamics in recent years due to Boston Dynamics' maturity in the industry.

Along with DroneDeploy's experience in robotics, they have also engaged with many other customers around the world on similar types of projects resulting in them having a sound understanding of robot capabilities and viable applications.

## 3.0 Project Objectives

The overall objectives of this Project 2021-1270 and Project 2021-1271 were to:

- Through on plant studies, develop an Industry AGV narrative specific to the Australian red meat processing sector including:
- 'Educate': AMPC, processors and providers of possible use-cases
- Ascertain industry readiness level (ability and mindset) to adopt and leverage AGVs beyond the current single deployment example at Kilcoy Pastoral Company
- Document possible use cases now and in the future (the latter require further developments or third-party value-adds)
- Demonstrate use cases identified on a single host site
- Develop Stage 3b and Stage 4 pilot programs (technology, software, and training)

The objective of this project in particular was to conduct a thorough investigation with current knowledge and expertise to select and validate the most viable robotic solution and its payloads to achieve the broadest range of capabilities while proving potential use cases.

The success of milestone one included the ordering and delivery of the robotic solution and its payloads to the DroneDeploy Auckland Office where preparation work could be completed.

## 4.0 Methodology

Initially, there was a review process in the form of a workshop and proposal where it was identified that Spot from Boston Dynamics would be the most appropriate robot for the project.

Along with Spot being the industry leader in production ready industrial inspection type robots, DroneDeploy (formerly Rocos) had been involved with Boston Dynamics from the beginning of Boston Dynamics' Spot Early Adopter program and had a few years' worth of experience integrating and making the robot more practical for a production-type application and testing.

There were two options for the purchase of Spot, the Explorer vs The Enterprise package.

The Explorer package included the standard package for Spot, including 2 batteries, a controller, a case and a transportation box.

The Enterprise package had the same basics as the explorer but also includes the mobile docking station and compatible batteries.

For this project, DroneDeploy recommended the Enterprise package as it was considered worthwhile to build the remote charging into any onsite use cases they are exploring. This allows Spot to be used in repeated operations without human intervention in between each mission to change batteries.

Once the robot package was selected there was then a review of the payloads to be attached. Spot compatible payloads from Boston Dynamics included:

- Spot Core compute Unit,
- EAP (VLP16 LiDAR navigation sensor),
- Spot CAM including a 360 camera and lighting rig,
- Spot CAM+IR which included the previously mentioned 360 Camera and lighting rig but has an additional high-quality camera and thermal imaging camera on a PTZ swivel.

In addition to the above-mentioned basic payloads, there is the option to utilize the robot arm attachment for Spot. This was entirely optional, the arm enables Spot to interact with the physical environment - press buttons, open doors etc. which could extend any use case viability that is being considered. It is important to note that the arm payload is in a beta phase and not yet fully integrated into the Boston Dynamics mission planning capabilities.

3<sup>rd</sup> Party sensors included an option to get a colourized Lidar scanning system. This solution would provide colourized point cloud mapping of entire facilities to aid with a visual representation of the environment.

This recommended solution is the Hovermap solution from the Australian company Emesent

<https://www.emesent.io/colourisation/>

The Hovermap unit can provide this functionality either with a handheld unit or an autonomous Drone system that can map new unknown environments autonomously.

## 5.0 Project Outcomes

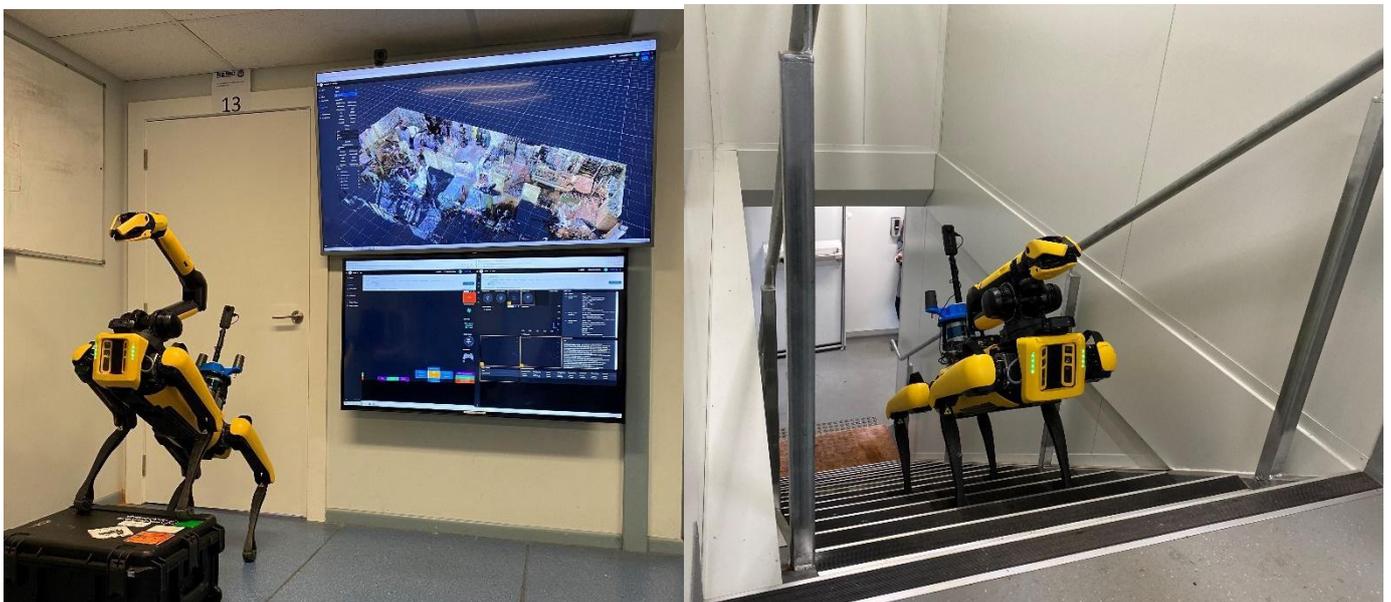
The following robotic solution was selected for the project

- Spot Enterprise
- Docking Station
- 2x Docking Station compatible batteries
- Boston Dynamics Controller
- Battery Charger (separate to the docking station)
- Spot Core compute unit
- Spot EAP (VLP16 LiDAR attachment)
- Spot Actuating Arm attachment

3<sup>rd</sup> party sensors included

- Insta360 One X2 360 Camera
- Logitech Webcam – for teleoperation
- Dual Antenna GNSS Mounts with RTK Base Station

### 5.1 Images



*Images courtesy of Jade Baker, from Casino Food Coop*

## 6.0 Discussion

Choosing the Spot Enterprise was a very good decision. Having the robot always powered on and on the dock, and charging proved invaluable for the project as remote engineering teams could update software and configure settings through the DroneDeploy platform without the need for supervision from teams on site. The dock allowed the DroneDeploy team to schedule missions on repeat in testing the robot's capability to be valuable as an autonomous

inspection robot. In previous experiences, the actual testing time and the ability of the teams to provide meaningful development was limited by the robot's battery capacity and the requirement to be tethered to a power outlet. Although the use of the dock meant the tethering requirement was avoided during this project and proved efficient for proving out use cases, the dock proved to be quite noisy while cooling fans were engaged and interfered with the onsite teams.

The robot was required to be stored in a safe location in offices on the Casino Food Coop site which happened to be in very close proximity to team members trying to perform their day-to-day functions.

The Arm as a payload was an exciting addition and proved to be very functional as an independent feature. Spot was able to open doors, grab and lift objects and even drag items. The only disadvantage at this stage of the robot's maturity was that the arm is still in a beta phase from Boston Dynamics and was not yet available to be included in autonomous mission recordings and playback. It was for this reason that actions such as opening doors during missions could not yet be included but with future work and developments, this could unlock more potential use cases. Using the robot arm in a manual mode as an extension of an operator proved challenging with 2 joy sticks on the controller and would require the operator some additional time to learn in order to become fluid and efficient with this function.

It was noted that to have truly tested the robot's capabilities as an inspection robot, the CAM+IR payload might have proved to be a better solution or result. This may have been used to inspect gauges and other thermal related areas in operational areas such as the engine room.

Throughout the testing and implementation of this robot in alignment with Project 2021-1271 the following objectives were covered

### **Through on plant studies, develop an Industry AGV narrative specific to the Australian red meat processing sector**

Found in the discussion and conclusions of the final report for Project 2021-1271, the report covers where the Spot robot best fits into the current setup of a typical meat processing facility and what might be possible in the industry if other robotic form factors were considered.

### **'Educate': AMPC, processors and providers of possible use-cases**

An initial Project kick-off workshop was held to brainstorm initial potential use cases. These use cases along with Spots robotic capability and subject matter experts' input during the project shaped the use cases defined and tested in the final report for Project 2021-1271

### **Ascertain industry readiness level (ability and mindset) to adopt and leverage AGVs beyond the current single deployment example at Kilcoy Pastoral Company**

During the Project, and as documented in the report for Project 2021-1271, there may still be some slight scepticism about the technology and may still be considered more of a toy. This is particularly relevant with Spot, the selected robot, which many have seen dancing and the like on social media channels such as YouTube. This may change over time with some ease when an applicable use case is selected and implemented where business value metrics could be documented and analysed.

### **Document possible use cases now and in the future (the later require further developments or third-party value-adds)**

From the findings and work covered in Project 2021-1271 the following table summarizes the findings of possible use cases

Use Cases	Availability	Constraint	Value Category
Confined areas and restricted areas	Now	Internet or Radio communications	Health & Safety
Emergency Response	Now	Internet or Radio communications	Health & Safety
Planned inspections of Veal floor or similar Processing area (non-active)	Future	Industry and Process change	Record and Maintenance
Ammonia Detection	Now	Sensor Integrations	Health and Safety
Engine Room Maintenance Inspection	Now	Sensor Integrations	Record and Maintenance
Thermal Imagery of Servers, Switches, and Computers.	Future	Sensor Integrations + Industry Change	Record and Maintenance
Lairage - Working with live animals	Now	Operator Training and Ease of Use	Health and Safety
Transporter Robot - Moving consumables around the site	Now	Defined Autonomous walkways on Site	Productivity
Last Check Pallet Scanning and Truck loading Inspection	Future	Process Change from Order Picking	Productivity - Quality - Health & Safety
Geospatial Data (Point Cloud) LiDAR gathering	Future	Development of Mobile Mapping	Record and Maintenance

### Demonstrate use cases identified on a single host site

Covered thoroughly in the final report for Project 2021-1271 Methodology (4.3.2) and Project Outcomes (5.0) chapters, the work in Project 2021-1271 saw the discovery and site testing of use cases at the Casino Food Coop which can be found in the list below:

- Planned inspections of Veal floor or similar Processing area (non-active)
- Engine Room Maintenance Inspection
- Lairage - Working with live animals
- Transporter Robot - Moving consumables around the site
- Geospatial Data (Point Cloud) LiDAR gathering

### Develop Stage 3b and Stage 4 pilot programs (technology, software, and training)

Covered in the Next Steps (7.1) chapter in the final report for Project 2021-1271 covers the recommendations for Stages 3b and 4.

## 7.0 Conclusions / Recommendations

The Spot Enterprise on a docking station is a functional and practical solution as an autonomous ground robotic platform.

Boston Dynamics have developed a wide range of payloads specific to some applications which allow the robot to be useful in industrial applications.

DroneDeploy was able to successfully integrate 3<sup>rd</sup> party sensors through their platform to enable extra functionality that Spot does not have as standard.

DroneDeploy is researching and testing ways to achieve the initially recommended capability to capture colourized point clouds using standard Spot payloads.

With further developments from Boston Dynamics Spot, the actuating arm will become an important feature that enables advanced capabilities that could unlock further autonomous robotic abilities.

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