Final report

Evaluation of automated bunk management – Bunk Scanner monitoring

Project code: B.FLT.1010

Prepared by: Dr Stuart McCarthy[1], Daniel Mcleod[1], Dr Joseph McMeniman[2]

[1]Manabotix Pty Ltd, [2]Meat & Livestock Australia

Date published: 4 April 2022

PUBLISHED BY
Meat & Livestock Australia Limited
PO Box 1961
NORTH SYDNEY NSW 2059

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Executive summary

Bunk management is the process of determining feed allocation for pens of feedlot cattle for the following 24-hours. Feed remaining is a significant input to allocation decisions, and the Bunk Scanner has been demonstrated over several previous experimental campaigns to be more precise and accurate at determining these masses in cattle feed bunks than human callers. This world-first achievement enables semi-automation of bunk management utilising scanned data to assist the human decision-making process, or full automation of bunk management employing custom algorithms.

The purpose of this research activity is to demonstrate that feed bunk management is automatable, and to assist determinations of technology's value proposition for Australian lot feeders. The bases of the research are the Bunk Scanner, and a pilot software suite containing algorithms and interfaces enabling cattle feeding systems to be implemented programmatically; the software suite has been called Feedmetrix.

Two Bunk Scanners were built, delivered, and commissioned at the experiment host sites; ultimately only one site proceeded to the full experimental campaign. Feedmetrix was developed and refined by leading Australian beef nutritionists in preparation for the automated bunk management experiments. The site-based experiment protocols were developed and implemented between MLA and a third party, and these methods and results are project outputs from a parallel and separate research activity.

This final report summarises our system delivery and commissioning at the host sites. Through our equipment and software provisions and support, a highly-successful research pursuit was completed at one site, demonstrating to the cattle feeding industry that bunk management is automatable. The achieved outcomes ought to represent very significant safe productivity opportunity for Australian lot feeders.

Table of contents

1. Background

The fundamental objectives of bunk management are consistently maximising feed intake, whilst minimising feed wastage and digestive disorders (bloat and acidosis). Calling is a critical input for bunk management, and traditionally it is the human callers' actions directly determine feed intake and carcase weight gain of pens of feedlot cattle.

As an outcome of previous research campaigns, MLA and Manabotix have commercialised a Bunk Scanner (Australian Patent number: 2018203945) which is more precise and accurate at determining feed remaining in cattle feed bunks than human callers. This world-first achievement enables semi-automation of bunk management utilising scanner data to assist the human decision-making process, or full automation of bunk management utilising custom algorithms.

The value proposition of more precise and accurate feed remaining data was unclear. Scientifically robust research was required to determine the animal performance response (carcase weight, feed intake, morbidity, and mortality) when bunks are managed by different levels of automation.

With a view to developing these value propositions, MLA executed projects for a serialised experimental campaign to assess automation levels in commercial feedlots. MLA project B.FLT.1012 represented the implementation of experimental methodologies at two commercial feedlots. The current report's project (B.FLT.1010) provided technical support for installation, commissioning, operation, and monitoring of two Bunk Scanners at the two host sites.

This final report summarises our system delivery and commissioning at the host sites, and system support at the one site which proceeded to full experiment.

2. Objectives

The overall project objectives that were agreed in the contract are provided in the following list.

1. Construct and deliver two (2) Manabotix Bunk Scanner systems.
2. Install and commission the Bunk Scanner systems at the two experiment sites, including integration with current feedlot software systems for bunk management, and training of staff.
3. Provide technical support, monitoring, preventative maintenance, and timely repairs and maintenance of the Bunk Scanner systems for the duration of the two experiments.

All objectives have been met in support of the successful completion of the research activity.

3. Methodology

The current project's scope required us to build, deliver, and commission two Bunk Scanners at the experiment host sites. Custom feeding programme algorithms were developed (within a software framework output from MLA project B.FLT.1007) and refined by the MLA project manager and leading Australian beef nutritionists in preparation for the automated bunk management experiments. The algorithms were delivered to site as a pilot software suite (Feedmetrix) and included user interfaces and Bunk Scanner integrations.

The following subsections briefly describe the methodology for the Bunk Scanner monitoring activities. In all cases these were found to be successful, and efficiency opportunities were identified and implemented as appropriate.

3.1 Construct and deliver

Two Bunk Scanners of the original 'manual slew' mechanical arrangement (equivalent to prototype system) were constructed and delivered to the host sites. These were factory tested and packed and transported to the two experiment host sites.

3.2 Install and commission

At each host site the Bunk Scanner was installed on the tray of a bunk calling vehicle, and in both cases a small HMI was also provided in the cabin for the human caller; for specific experiment treatments the Bunk Scanner's feed remaining predictions were hidden from the human. A RTK GNSS base station was installed at each feedlot, in addition to sitewide radio communications network for robust transmissions of correction data. All experiment pens were georeferenced and baselined in preparation for the experiment.

Feedmetrix was prepared for the host sites, and appropriate user access credentials and training were provided; this included Bunk Scanner data integrations, limited manual inputs (heat event, mould, delivery deviations, etc.), and then automatically prescribed as-fed masses for use by the mill and delivery team. While at the time of the experiment the integrations with third-party feedlot software systems were not feasible, the implemented methods provided a very acceptable protocol while not introducing any human errors or biases.

3.3 Support

Technical support, monitoring, preventative maintenance, and timely repairs and maintenance of the Bunk Scanner system was provided during establishment and no load validations at both sites, although ultimately only Grassdale Feedlot proceeded to the full experiment.

Most technical support requirements during the experiment were operational. These included regular communications with site-based support, updating bulk density values for rations, and occasional physical layer assistance. Examples on the latter point were improving radio communications across site and transferring the Bunk Scanner between host vehicles on breakdown events.

4 Results

The following subsection provide information on key findings and results from the project.

4.1 Summary

The key metrics required by this project's agreement for the experiment hosted at Grassdale Feedlot are provided below in tabulated format. These data represent the consolidation of three treatments across the experiment's scope: control, as well as semi and full automation.

Table 1: Bunk Scanner operating metrics from Grassdale Feedlot experiment

ID	Metric	Value and units
1	Number of pens	21
2	Number of scanning events	4,710
3	Total quantity of feed scanned	703.4 m^3
4	Bunk scanning speed	9.3 kmh^{-1}

5 Conclusion

The following subsections summarise key insights and implications from the project.

5.1 Key findings

Through our equipment and software provisions and support, a highly-successful research pursuit was completed, demonstrating to the cattle feeding industry that bunk management is automatable. The pilot Feedmetrix provides a very scalable and flexible digital environment suitable for any implementation with any feedlot's feeding programme.

5.2 Benefits to industry

The outcomes of the activities ought to be a very significant safe productivity opportunity for Australian lot feeders, and more details supporting this position are available in parallel reports.

6 Future research and recommendations

Additional investment and effort will enable the exploration of automated bunk management benefits in more detail, especially if more use cases and a diverse group of feedlots are considered.