Final Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Automated Container Loading System for Meat Export Cartons

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1.0 Abstract

Container loading of export cartons remains a labour-intensive process within meat processing facilities and involves repetitive lifting of heavy cartons in confined spaces. This project investigated the feasibility of developing an automated container loading system capable of replacing manual loading operations.

An initial proof-of-concept prototype developed at John Dee was further engineered by Fibre King into a Beta prototype capable of automated container loading. The system receives cartons from a conveyor, aligns and collates cartons into rows, and automatically places them into export containers.

Operational trials demonstrated that automated container loading is achievable, with the prototype capable of sustained loading rates of approximately seven cartons per minute and runtime of up to three hours without manual intervention. While the system currently operates slightly slower than manual loading by two workers, it significantly reduces manual handling risks and offers the potential for continuous automated operation.

Industry demonstration of the system confirmed strong interest in further development. The project has successfully demonstrated the feasibility of automated container loading within meat processing facilities and provides a foundation for development of a commercially viable system.

2.0 Executive summary

Container loading of export cartons is currently performed manually within meat processing facilities and requires workers to repeatedly lift heavy cartons above shoulder height in confined container environments. This creates ergonomic risk, limits productivity, and contributes to labour shortages in dispatch operations.

A secondary issue of global competitiveness is also key as automation and AI continues to be rolled out in manufacturing at increasing speed. Australia's red meat industry will need to broadly embrace any automation and efficiency advantages it can make to remain competitive. Product quality aside, where Australia is a leader, price still matters to international buyers.

This project aimed to develop an automated container loading system capable of reducing manual handling while maintaining practical loading performance. Efficiency over the long run may be able to be improved through constant use and performance without influence of downtime due to illness, holidays or staff turnover and loss of skills.

For the industry more broadly, investment in specific manual handling technology advancement, which can give the industry a range of gains, is a positive for all processors. Keeping Australia's beef industry globally competitive requires constant innovation and market leading productivity enhancement. The container auto-loader has the potential to make a significant contribution to manual handling innovation in the processing industry.

John Dee partnered with engineering company Fibre King to transform an early prototype container loader into a fully engineered Beta prototype. The system automatically receives cartons from a conveyor, rotates and aligns cartons, forms rows of cartons, and pushes them into the container to create structured stacks.

After the original proof of concept built and tested at John Dee, the project was discussed with AMPC to gage interest in supporting further development to commercial quality. AMPC recognised the potential of the innovation and the current project was developed to move forward toward commercialisation. A specification for a revised prototype of the container loader was scoped, designed, built and tested. It was then iterated through a variety of improvements and resolutions of issues as encountered. The prototype was installed at the John Dee dispatch facility and trialled loading export containers. Testing confirmed that automated loading of containers is achievable, with the loader sustaining approximately seven cartons per minute and operating for up to three hours without intervention.

While the loader currently operates slightly slower than manual loading, it offers major safety benefits by removing overhead lifting and providing the potential for 24-hour automated operation. Additionally, it has the potential for '24x7' operation with one trained operator ultimately across multiple containers which would add labour saving as a benefit.

Industry engagement was undertaken through an industry demonstration event held at John Dee on 27 February 2026. Innovation managers from JBS attended and expressed interest in further trials of the technology.

The project has demonstrated the technical feasibility of automated container loading and provides a strong foundation for further development toward a commercial system.

3.0 Introduction

Export container loading remains one of the most physically demanding operations within meat processing dispatch facilities. Workers are required to repeatedly lift cartons weighing up to 27 kg within confined refrigerated containers.

This work environment presents several challenges:

- high levels of manual handling
- repetitive overhead lifting
- limited workspace within containers
- labour availability constraints

Automation within processing plants has increased significantly in recent years; however, container loading remains largely manual due to the complexity of stacking cartons within confined spaces.

The objective of this project was to investigate whether an automated system could perform container loading reliably while maintaining acceptable loading rates and carton integrity.

4.0 Project objectives

The objectives of the project were:

- develop an automated container loading prototype
- demonstrate automated container loading capability

- validate performance through operational trials
- identify improvements required for commercial deployment
- demonstrate the system to industry stakeholders.

5.0 Methodology

The project was undertaken through multiple development stages.

Stage 1 – Prototype Concept

An initial alpha prototype container loader was developed internally at John Dee to demonstrate the basic concept of automated carton stacking.

Stage 2 – Engineering Development

Engineering company Fibre King was engaged to design and manufacture a fully engineered Beta prototype capable of reliable operation within export container environments.

The design phase addressed several engineering challenges including:

- carton alignment
- layer height detection
- machine manoeuvrability
- container clearance constraints
- operator safety.

There were multiple loops in the development stage as feedback, both theoretical and practical feedback from subsystem and overall system testing, was incorporated into the final prototype tested. Many were identified in the

Stage 3 – Prototype Installation on site for initial testing

The Beta prototype was installed at the John Dee dispatch facility and connected to the existing carton conveyor system supplying cartons for export loading. Further issues were identified in the site environment

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The Beta prototype was installed at the John Dee dispatch facility and connected to the existing carton conveyor system supplying cartons for export loading. Further issues were identified in the site

Figure 1 – Prototype Container Loader Installed in Container

The general physical appearance of the prototype is extremely professional and typical of high-grade industrial equipment. The HMI screens are operator friendly and comprehensive. Loadout leading hand level resources were able to operate the loader after training with no constant supervision from Fibre King resources.

Images of the HMI screens and additional loader images are available in the appendices.

Stage 4 – Operational Trials

Operational trials were conducted using export cartons to evaluate system performance, reliability and throughput. While performance was less than the goal of 12 cartons per minute, there is scope in the existing design to significantly improve, and long-term possibilities of meeting this metric with some planned changes in a revised version in the future.

6.0 Results

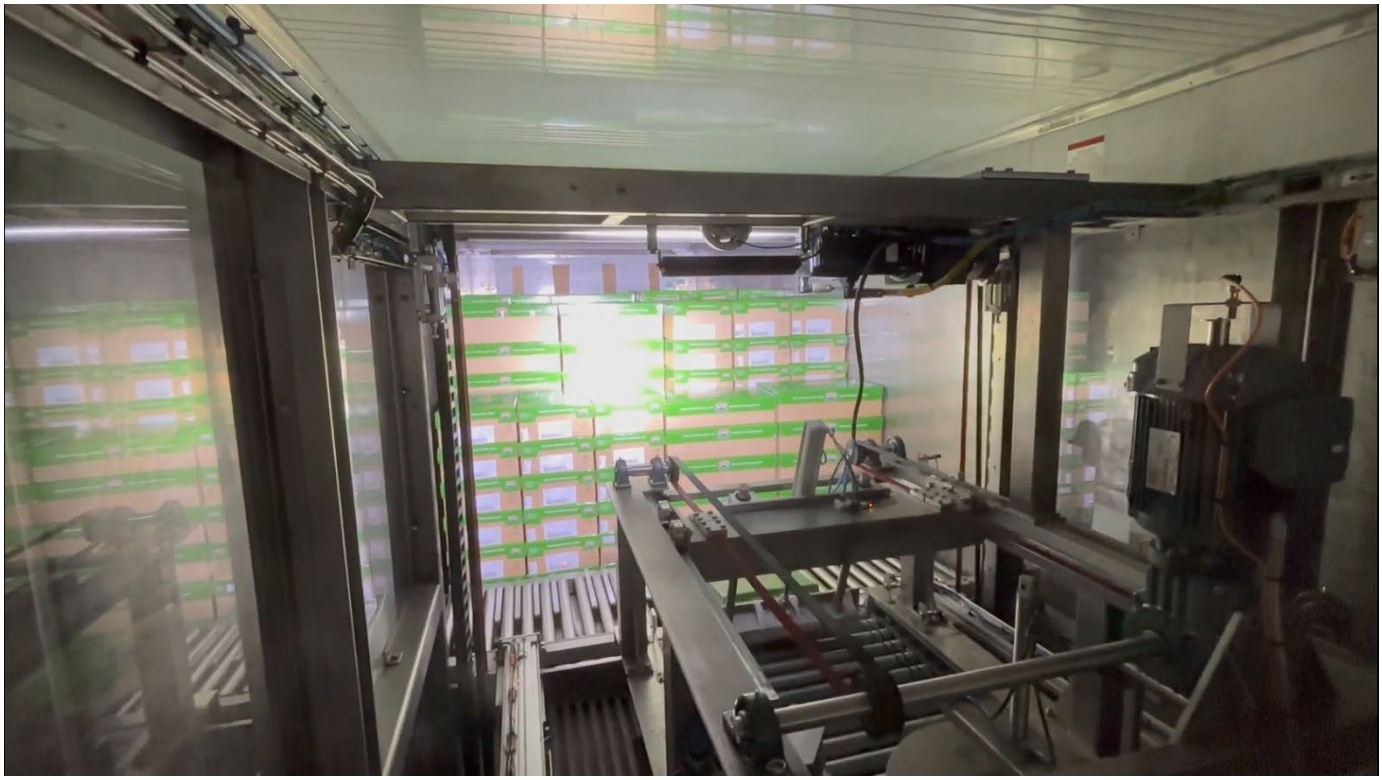
Operational trials demonstrated that automated container loading is feasible within a commercial meat processing environment.

Performance Metrics	Metric Result
Throughput	~7 cartons per minute
Manual loading equivalent	~12 cartons per minute
Runtime without intervention	Up to 3 hours
Automatic container completion	Majority of container

The loader was capable of automatically loading most of the container without intervention. Carton integrity was a key factor in error reduction.

The final three rows of cartons cannot currently be completed automatically due to loss of container side constraints used for carton positioning. This is one of the open issues where a solution is needed be able to automate the end of the container loading process.

Figure 2 – Internal Loader Mechanism and Carton Stacking



7.0 Discussion

The project demonstrated that automated container loading is technically achievable.

While the prototype currently operates slightly slower than manual loading by two workers, the system offers several advantages:

• elimination of repetitive heavy lifting

• improved workplace safety

• potential for continuous automated operation

• consistent stacking patterns.

The development process identified several key engineering challenges including:

• carton squaring within the container

• height detection for stacked cartons

• machine alignment within containers

• maintaining stable stacks during loading.

These challenges are typical for automated material handling systems operating with variable product dimensions.

8.0 Conclusions

The project successfully demonstrated the feasibility of automated container loading for meat export cartons.

Operational trials confirmed that the system can automatically load containers with minimal intervention and maintain stable stacking patterns.

The prototype represents a significant advancement toward automation of container loading operations within the meat processing industry.

9.0 Recommendations

Further development should focus on improving machine robustness and throughput. Recommended improvements include:

- additional laser sensors for height detection
- servo motor driven carton turner to increase speed
- improved container alignment mechanisms to improved manoeuvrability
- further refinement of carton squaring systems to reduce stoppages

Estimated investment required to complete improvements: Approximately $120,000

10.0 Project outputs

The project produced the following outputs:

- automated container loader Beta prototype
- operational trials at John Dee facility
- industry demonstration event (27 Feb 2026)
- engineering design improvements identified for future development.

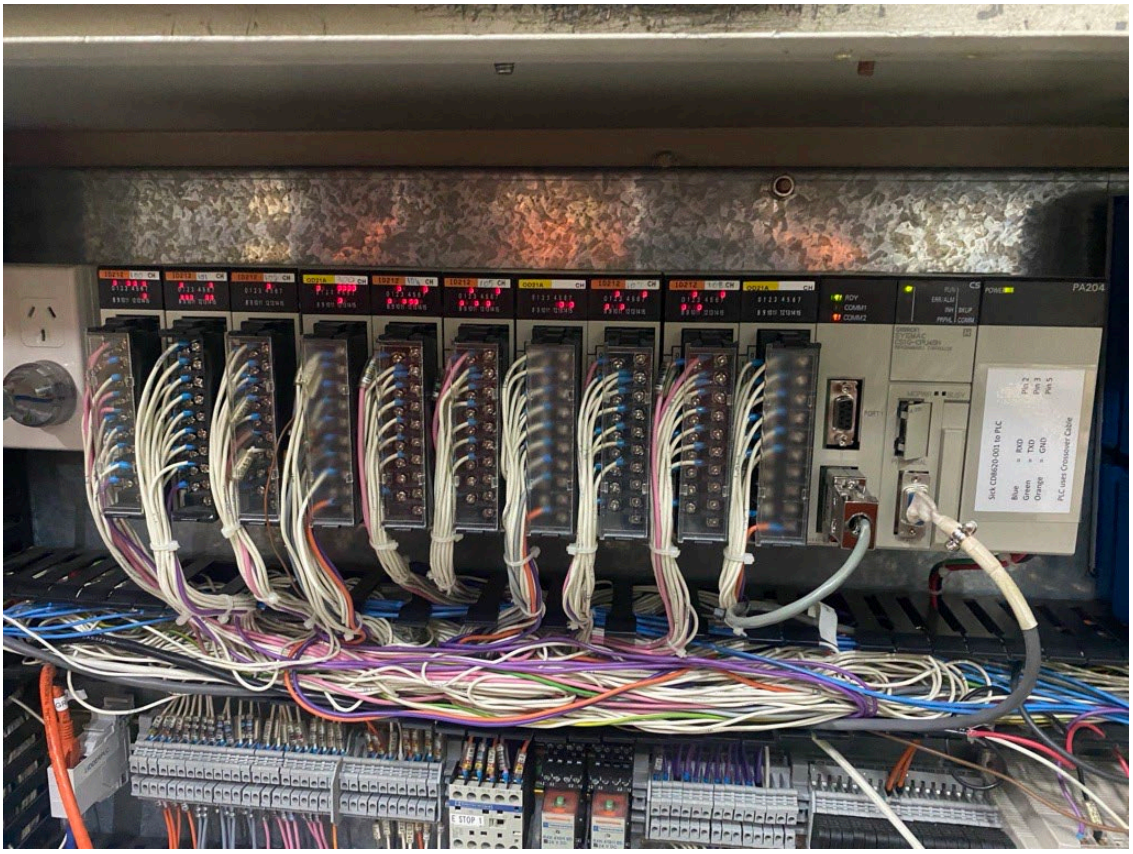
11.0 Appendices

11.1 Loader Photos

View of Loader from Carton Stack: tines retracted

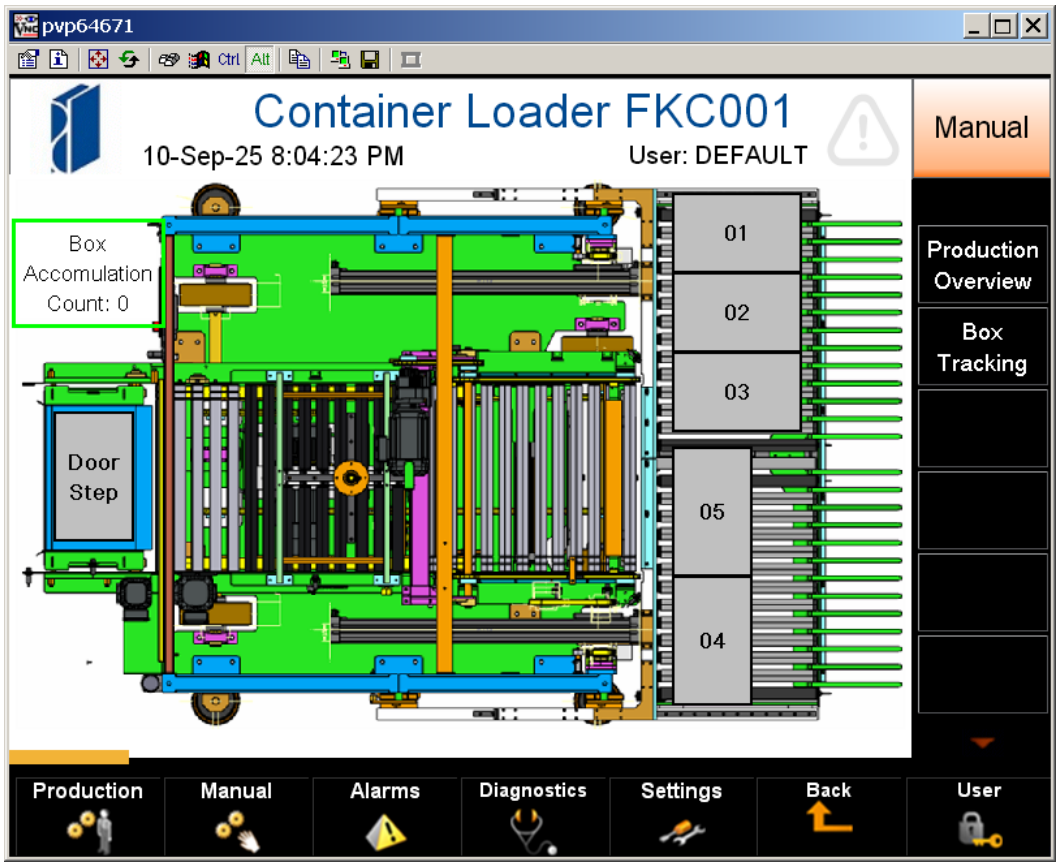
Loader in Operation

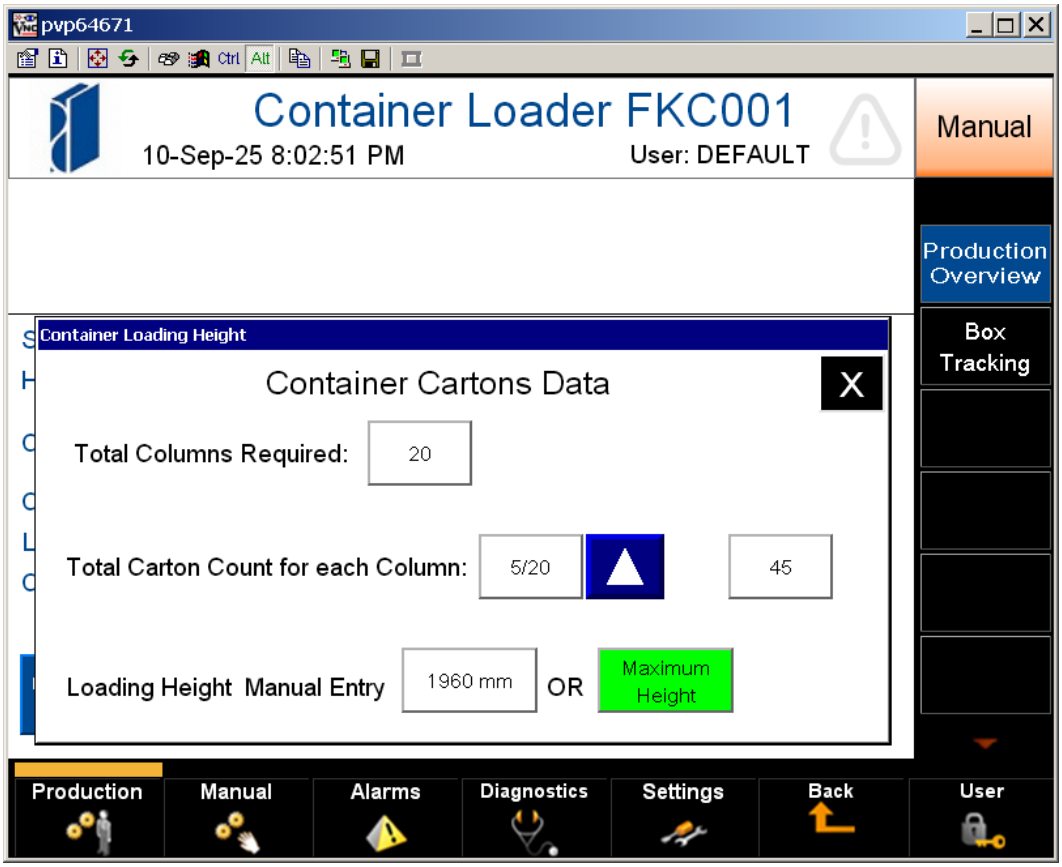
John Hart (John Dee), Greg Constantinidis (Fibre King project engineer), Raj

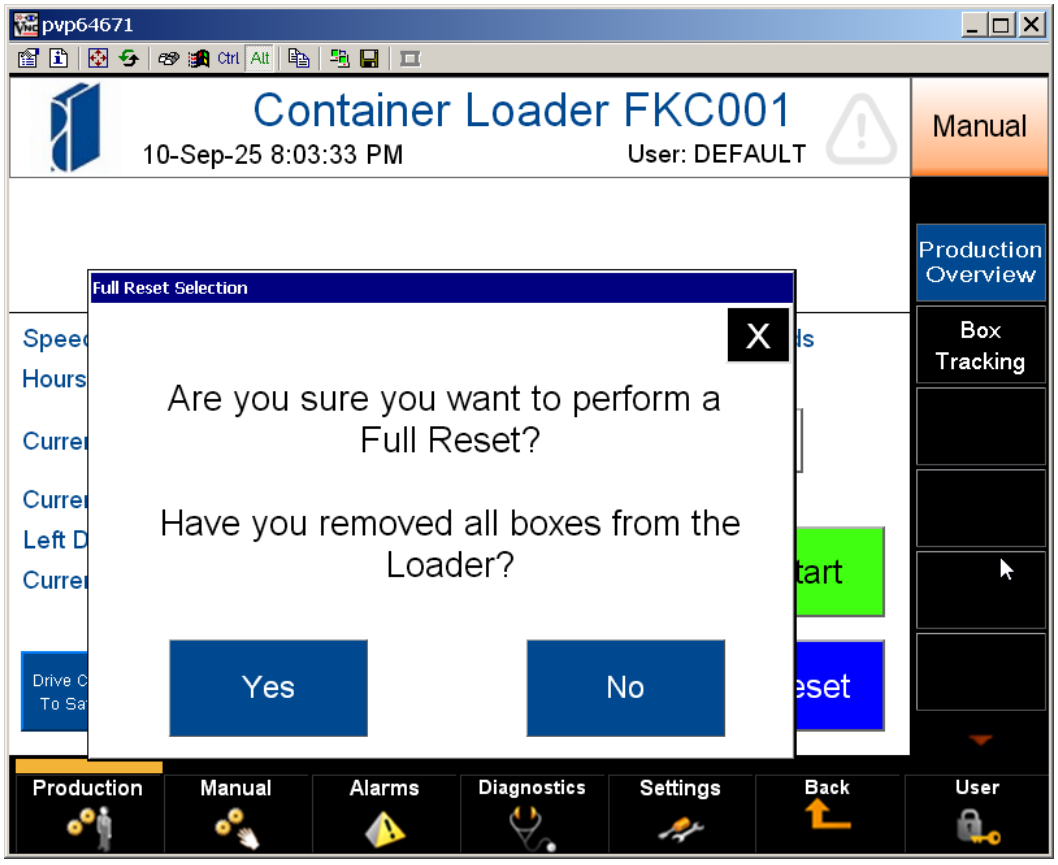


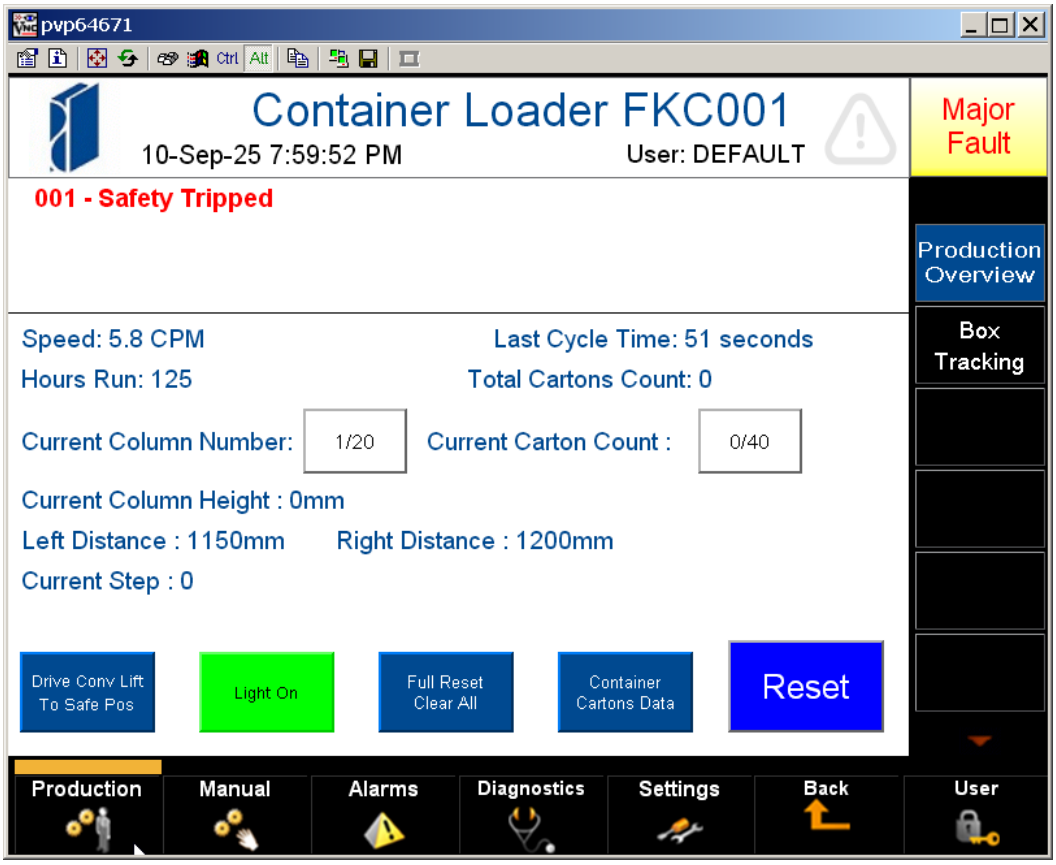
Electrical Harness

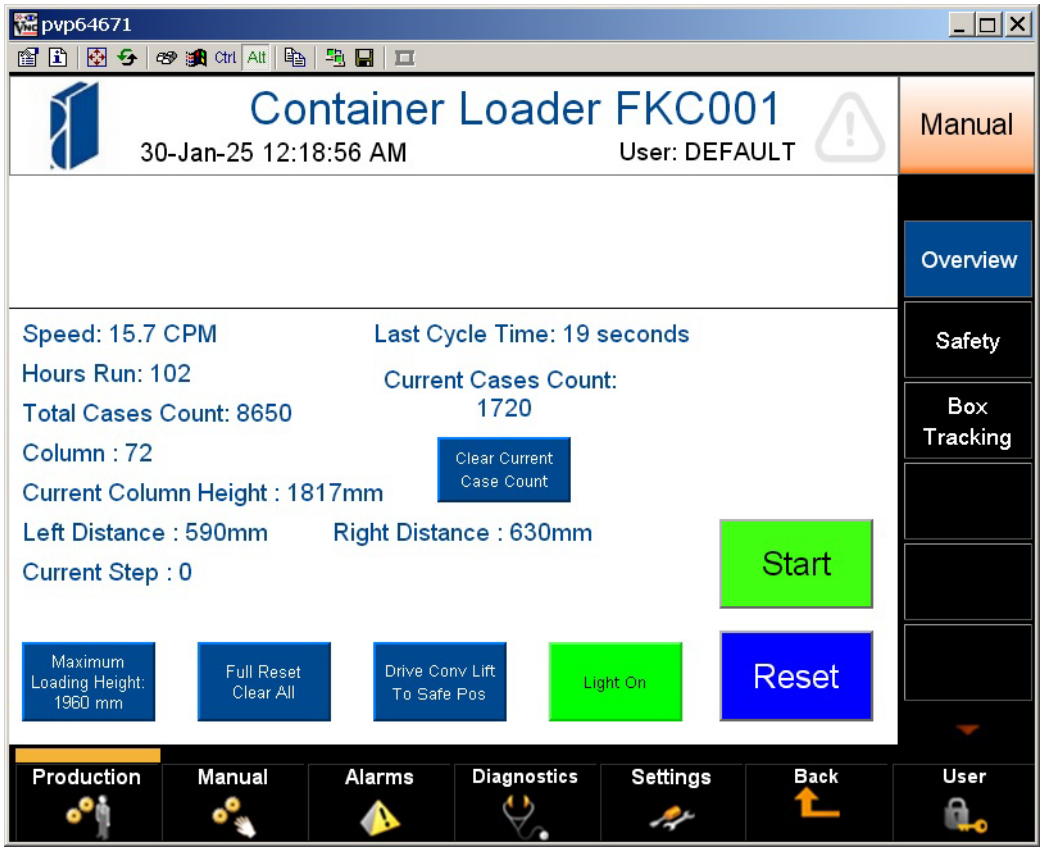
11.2 HMI Screens Samples




pvp64671
Container Loader FKC001
10-Sep-25 8:02:51 PM
User: DEFAULT
Manual
Production Overview
Box Tracking
Container Loading Height
Container Cartons Data
Total Columns Required:
20
Total Carton Count for each Column:
5/20
45
Loading Height Manual Entry
1960 mm
OR
Maximum Height
Production
Manual
Alarms
Diagnostics
Settings
Back
User


pvp64671
Container Loader FKC001
10-Sep-25 8:03:33 PM
User: DEFAULT
Manual
Production Overview
Box Tracking
Full Reset Selection
Are you sure you want to perform a Full Reset?
Have you removed all boxes from the Loader?
Yes
No
Production
Manual
Alarms
Diagnostics
Settings
Back
User


pvp64671
Container Loader FKC001
10-Sep-25 7:59:52 PM
User: DEFAULT
Major Fault
001 - Safety Tripped
Production Overview
Box Tracking
Speed: 5.8 CPM
Last Cycle Time: 51 seconds
Hours Run: 125
Total Cartons Count: 0
Current Column Number:
1/20
Current Carton Count :
0/40
Current Column Height : 0mm
Left Distance : 1150mm
Right Distance : 1200mm
Current Step : 0
Drive Conv Lift To Safe Pos
Light On
Full Reset Clear All
Container Cartons Data
Reset
Production
Manual
Alarms
Diagnostics
Settings
Back
User


pvp64671
Container Loader FKC001
30-Jan-25 12:18:56 AM
User: DEFAULT
Manual
Overview
Safety
Box Tracking
Speed: 15.7 CPM
Last Cycle Time: 19 seconds
Hours Run: 102
Current Cases Count:
1720
Total Cases Count: 8650
Column : 72
Clear Current Case Count
Current Column Height : 1817mm
Left Distance : 590mm
Right Distance : 630mm
Current Step : 0
Start
Maximum Loading Height: 1960 mm
Full Reset Clear All
Drive Conv Lift To Safe Pos
Light On
Reset
Production
Manual
Alarms
Diagnostics
Settings
Back
User

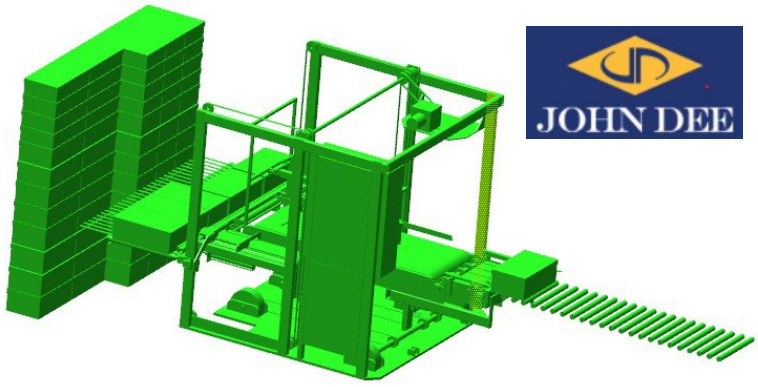
11.3 Fibre King Development Path Presentation

THE BEGINNING

- John Dee approached Fibre King with a view to take John Harts initial prototype to a commercially available machine.
- Initial Discussions focused on the challenges faced by John and his team
- John provided invaluable feedback on his learnings
- A project was set up for the design of a MK2 Container loader

We design, build, install and maintain End of Line Packaging Machinery within the food, beverage, meat, dairy, FMCG, personal care, pharmaceutical and fresh produce industries.

MK 1 CONTAINER LOADER



SAFETY CONSIDERATIONS

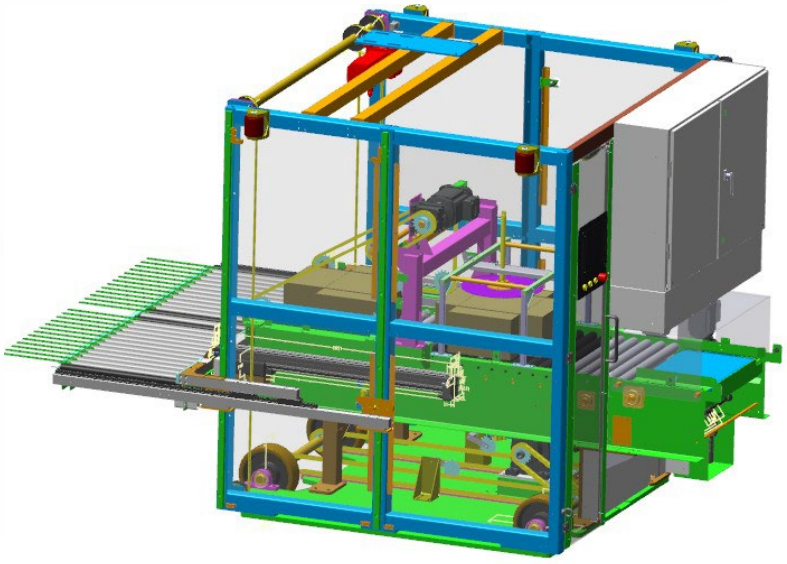
- Guarding all nip points
- Ensuring operators can safely move machine into the container
- Avoid awkward body position when rectifying issues
- Maintaining visibility within the container
- Ensuring nobody can get hurt when machine is partly in container and partly on the dock

We design, build, install and maintain End of Line Packaging Machinery within the food, beverage, meat, dairy, FMCG, personal care, pharmaceutical and fresh produce industries.

DESIGN PHASE

- Fibre King Engaged in a design project with access to initial machine and drawings
- Fibre King received container specifications and product specification
- Design phase was completed with reviews along the way
- Project to build MK 2 was awarded upon completion of Design Phase

INITIAL DESIGN



MECHANICAL DESIGN CHALLANGES

- Maintaining a positive 90° Tray rotation
- Finding a compromise position for infeed conveyor to form both Column A and Column B Pattern
- Delivering product low enough onto container floor
- Delivering product high enough for Max Height in container
- Machine manoeuvrability
- Balance between clearance withing the container and being able to collate to container edge
- Smooth loader movement
- Loader clearance at base for container entry and exit
- Operator Access

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FIBRE KING
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FIBRE KING

INITIAL BUILD

FIBRE KING

INITIAL BUILD

INITIAL BUILD

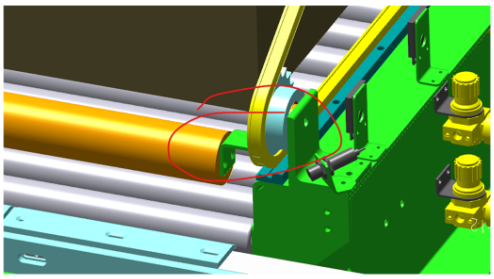
PROTOTYPE CHALLANGES

We design, build, install and maintain End of Line Packaging Machinery within the food, beverage, meat, dairy, FMCG, personal care, pharmaceutical and fresh produce industries.

Not all containers are created equal!!!

PROTOTYPE CHALLANGES

- Not having a robust enough Squaring/Aligning mechanism for cases already within the container.
- Flight Bar sweep mechanism difficult to control accurate delivery onto east west conveyor
- Connection of Flight Bar to chains unsuitable

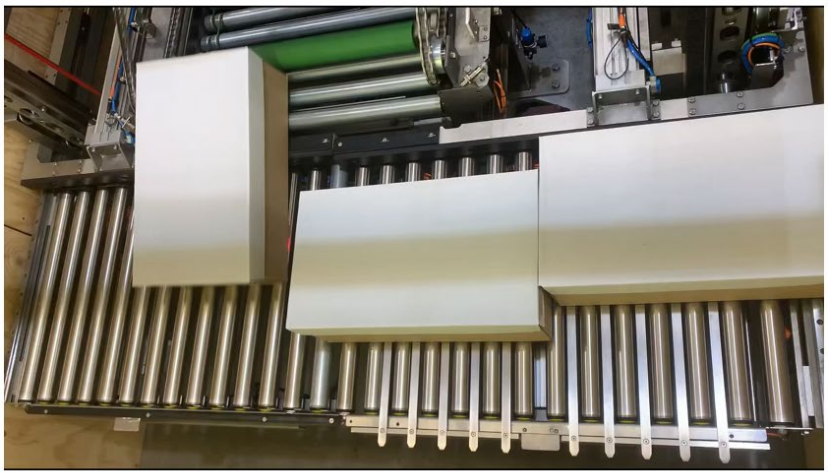


INITIAL TESTING

- Test trays and lids supplied filled with sand to simulate weight
- Mock container made within Fibre king facility for initial run-up

FIBRE KING

INITIAL TESTING

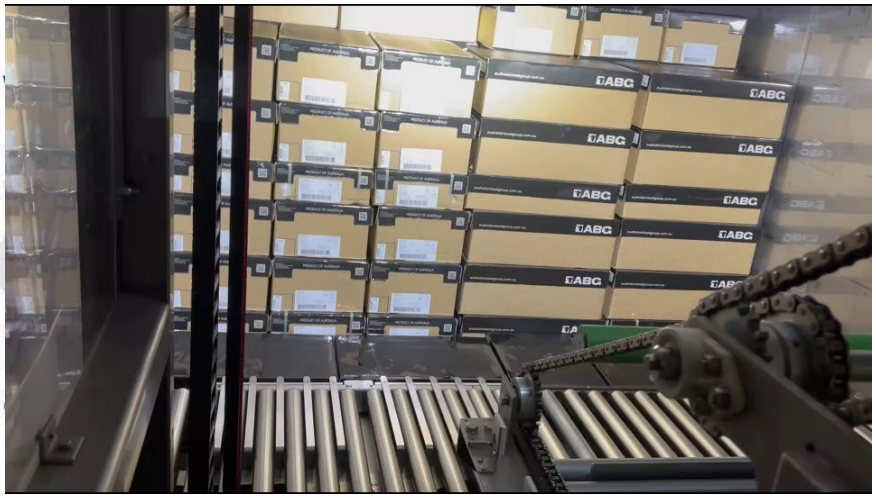


FIBRE KING

CONTROL CHALLANGES

- Accurately measuring height of each tray and tying that to the lift height to deliver following layer
- Measuring 5 trays in a row are same height and not false alarming bulge
- Measuring across the entire delivered layer to ensure we don’t crash when delivering next layer
- Maintaining square and neat stacks within the container
- Making recovery quick, easy and intuitive
- Dealing with bulged trays or popped flaps

FIRST CONTAINER



EARLY LEARNINGS

- Loader fitted with a pneumatic case turner. - Unsuitable
- 2 Laser distance sensors insufficient
- Recovery needed improvement
- Having single programmer follow machine start to finish
- Fixed boom for controls impractical
- Aligning loader with the container is difficult
- Flight Bar ineffective as means of case movement
- No allowance for angle of loader when ½ inside container
- Step from infeed conveyor to East West Conveyor for Unbalanced Trays
- Container can't be automatically loaded beyond a certain point

SUBSEQUENT VISITS

- Implemented changes to improve recovery
- Retrofitted wireless drive controls removing boom
- Streamlined container aligning process
- Replaced flight bar assembly with reciprocating pusher
- Reduced step height from infeed conveyor to east west conveyor
- Retrofitted pneumatic assembly to account for loader ½ on dock, ½ in container
- Tidied up controls to streamline layer count input
- Tidied code removing obsolete functions
- Sustaining approximately 7 trays/min

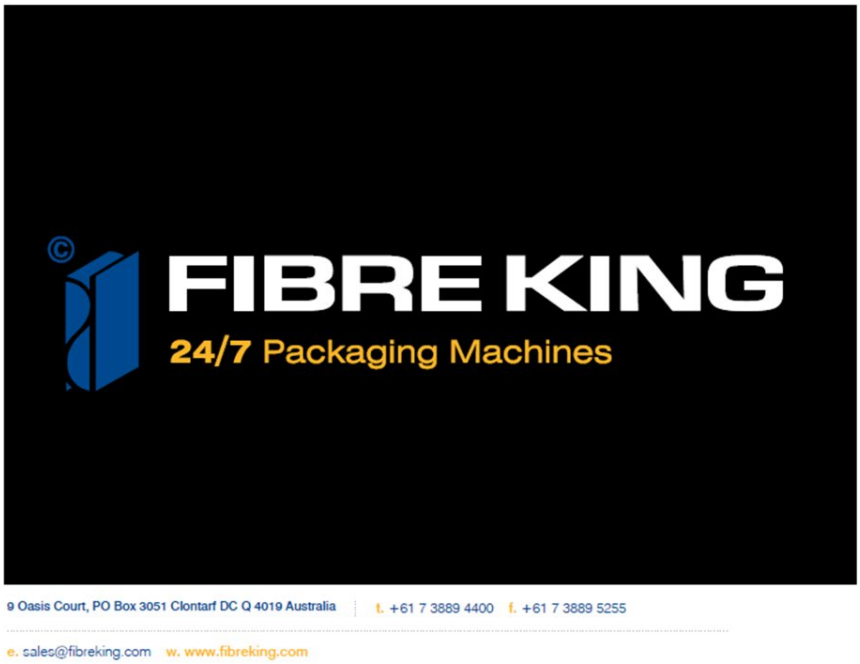
MK 3 IMPROVEMENTS

- Add additional laser sensors to better control delivery height
- Add servo motor to turner assembly removing need to "Re-Cock" between turns
- Change feed in orientation from wide to narrow face leading
- Further refine control
- Look to sustain 11-12 trays/min minimum
- Allow greater clearance between machine and container
- Reduce overall weight of loader

FIBRE KING

QUESTIONS

FIBRE KING



END OF REPORT