M37
ISIS RAIL YARD HANDLING SYSTEM

By

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Abstract

The Australian sugar industry, like most other industries that are predominately export-reliant, is subject to global economic pressures, which means it must remain competitive to be viable in the market. Management has had the vision to prepare a long-term strategy for the future direction of the factory. This drive for efficiency is the primary reason that this important stage in the delivery cycle was implemented.

With Isis Mill now receiving 100% of cane consignments electronically, this provided the foundation for the full automation of the rail receivals and yard-handling procedures. The complete automation of the consignment, transport and processing cycle at Isis Mill has been an ongoing, long-term plan that has been implemented in relatively small increments over an extended period. Identifying individual deliveries, as they proceed from the field to the factory and then tracking these through the processing stage, is critical for grower payment based on product quality, essential for determining factory efficiency and necessary to provide productivity feedback to the farm.

A significant component of this development was the fitting of RFID tags to the rail fleet. The electronic identification of the rail bins as they arrive and proceed through the various stages in the factory process is essential for the reliable operation of this system. Automation of the full yard and tip areas was also part of the upgrade. The bin consignment details are transferred to the factory server as they are harvested in the field. When the bins arrive in the mill rail marshalling area, they are matched to the consignment details using RFID. Once these deliveries have been recorded and reconciled, they are tracked from the full yard marshalling area through to the tip and processing stage.

Introduction

This paper provides a description of how this system was implemented and details of the advantages gained as a result of this installation. The new system was based around a full graphical mimic that provides a visual representation of the full yard, bins and the status of the complete delivery cycle, from the field to the mill processing area. To cater for all anomalies, incorporated into the mimic is a range of procedures for the correction and allocation of cane that has been mis-consigned or bins not correctly identified. With a factory crushing well in excess of a million tonnes and a bin fleet of more than 1800 bins, there will always be exceptions that need to be corrected.

System Design Considerations

The combination of being able to reliably identify the cane bins as they arrive at the mill site using RFID tags and being able to capture the consignment details as they are harvested played a significant role in automating the full yard handling operations.

In this stage, for the full bin storage and tipping areas to function effectively, it was essential that all of the delivered cane was correctly identified before being processed. Therefore, a major effort went into making sure that all of the cane in the full yard lines was fully accounted for, before these deliveries proceeded to the weighbridge tip.

The approach taken to achieve this was to produce a mimic providing a comprehensive representation of the current state of the system in real time. The Full Yard Mimic was developed to provide a full overview of the consignment, delivery and processing cycle as the cane deliveries progress from the field to the factory. It provides the functionality that permits the operator to make amendments to the system to cater for minor occurrences, such as a faulty RFID tag or incorrectly entered consignment information in the field, as well as efficient batch entry in the event of major hardware failure, such as a RFID reader or harvester's tablet going offline.

Implementation

When the cane bins arrive at the mill, they are moved into the full yard for storage. As these bins arrive, they pass over an RFID reader, which is mounted at the entrance before the lines branch into the individual full lines. The full line number that is being fed is known at this point. From the RFID read, the Bin ID is checked against the bins in the telemetry field queue and a match between these two bins is attempted. Should this match be successful, the consignment ticket details are used for the bin in the full yard line; otherwise, if unsuccessful, the bin remains unconsigned (suspense).

The four full yard lines merge to feed the Tip Queue line, which allows the bins to move from this storage facility to the weighbridge tip. A second RFID reader is mounted at the merge of these four lines and the bin is again identified as it proceeds from the full line to the Tip Queue. An optical sensor monitors the bin movements as it passes this point; this is designed to notify the operator should it fail to read the RFID tag fitted to the bin. This ensures that all of the farm details are assigned to the correct bin so that both payment and productivity details are allocated correctly.

Mimic display system

The primary goal of the mimic (Figure 1) was to represent all four full yard lines, the tip feed line and tip area itself, depicting every bin on each line in physical order.

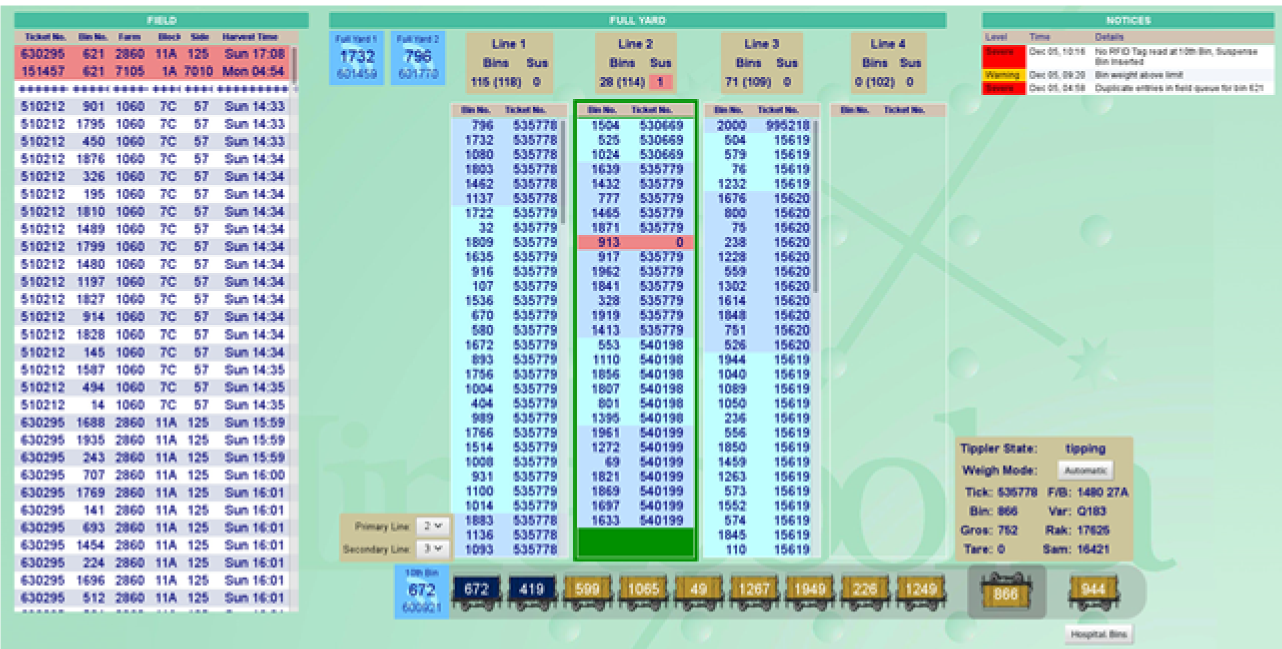

Fig. 1 – Mimic display.

Each bin is briefly identified on the display by its bin number and the consignment ticket number to which it belongs. Quick access to details such as the farm and block number are obtained by hovering the mouse pointer over a bin. Comprehensive information about the entire consignment is accessed through the context menu that pops up when right-clicking the mouse on a bin.

The mimic can run in two modes. Operator Mode is only available to the weighbridge/traffic officer, and allows amendments to be made. There is also a Monitor Mode that is available to anyone, which restricts the user to passively viewing the mimic.

The mimic application runs in any modern web browser; the user needs only to enter the application's web address into their browser. This is convenient for a wide range of personnel to keep abreast of the state of the system.

Field display

The field display (Figure 2) lists all of the bins that have been consigned from the field using telemetry. The ticket number field is prefixed with the harvester number. When these are displayed in Red, it indicates a duplicate bin, which is usually from a different harvesting group. Typically this would mean that one of these bin numbers has been incorrectly entered. The user can highlight a row, view the details and has the facility to edit or remove this entry from the field queue.

FIELD					
Ticket No.	Bin No.	Farm	Block	Side	Harvest Time
630295	621	2860	11A	125	Sun 17:08
151457	621	7105	1A	7010	Mon 04:54
++++++	+++++	++++	++++	++++	+++++++++
510212	901	1060	7C	57	Sun 14:33
510212	1795	1060	7C	57	Sun 14:33
510212	450	1060	7C	57	Sun 14:33
510212	1876	1060	7C	57	Sun 14:34
510212	326	1060	7C	57	Sun 14:34
510212	195	1060	7C	57	Sun 14:34
510212	1810	1060	7C	57	Sun 14:34
510212	1489	1060	7C	57	Sun 14:34

Fig. 2 – Field display.

Full yard display

The full yard display consists of four lines that are used for storage. Two RFID antennas are mounted at the entrance to the full yard and the bins are identified as they pass this point. A line selector identifies which full line these bins are being transferred into. As these bins are recorded, the system examines the bins in the field queue and attempts to match the bin on the line to the telemetry details. Bins that have been matched have a ticket number associated with them; bins not matching have a zero ticket number and are shown in red (suspense).

Each line has a summary box at the top, showing the number of bins on each line, the line's capacity (in parentheses), and the number of suspense bins. The line currently being pulled to the tip queue is highlighted with a green border.

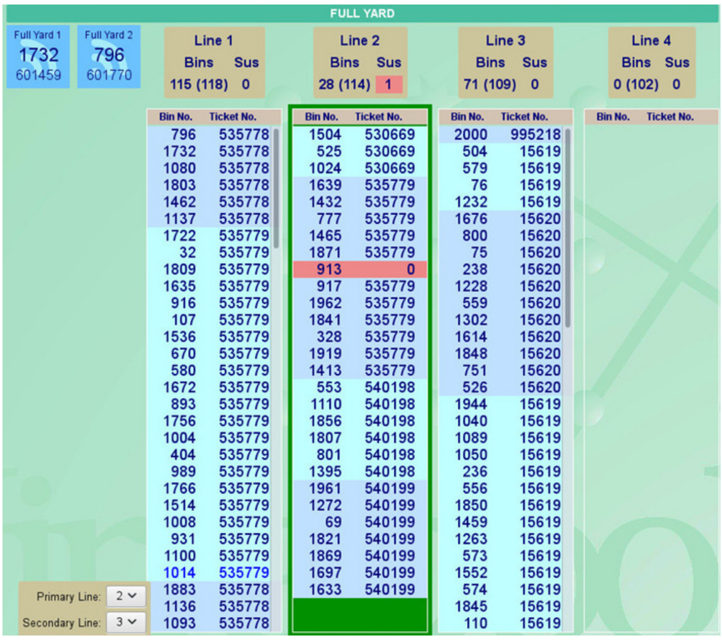

Fig. 3 – Full yard display.

Tip queue display

The tip queue display (Figure 4) shows the ten bins between, where the four full yard lines merge and the tip. Suspense bins and those that have an unknown bin number, are shown in red. Blue and yellow indicate normal bins, whilst a transparent bin indicates that no bin is present.

The Tippler Information box, displays tippler status (spotting, grossing, tipping, taring). The Weigh Mode status may be changed from Manual to Auto. Manual mode allows manual weigh entries to be carried out.

Fig. 4 – Tip queue display.

Notices display

The Notices section (Figure 5) displays notifications generated by the system to inform the operator of anomalous events. This feature has proved to be extremely useful to the operations personnel. There is also an audible alarm that accompanies a notification event. There are three notice levels: Severe - red, Warning - yellow and Normal – green.

Warning	Oct 15, 17:44	Missed tag at tip
Normal	Oct 15, 16:08	PLC online again
Severe	Oct 15, 16:08	PLC offline

Fig. 5 – Notices display.

An example of the Notices window is shown in Figure 6.

Level	Time	Details
Severe	Dec 05, 10:16	No RFID Tag read at 10th Bin, Suspense Bin Inserted
Warning	Dec 05, 09:20	Bin weight above limit
Severe	Dec 05, 04:58	Duplicate entries in field queue for bin 621

Fig. 6 – Example of Notices window.

***Other** features*

Hospital Bins: The operator can enter the number of a damaged bin for the system to automatically redirect to the hospital bin line beyond the tip.

Line Selection***:*** The full line, which is set to feed the line to the tip, can be selected by the operator. Operators have the option of setting the primary and secondary lines, which indicates the order that the bins arrive onto the tip queue.

RFID Antennas: They are depicted at the full yard entrance and tenth bin tip position. When a bin's tag is identified, the reader label flashes and displays the bin and tag number. Should an RFID reader go off-line, a red cross is displayed over the antenna symbol.

Sample Rationalisation: Bins can arrive at the mill in a different order from how they were harvested, due to the high percentage of cane that is being transferred from the field to the rail sidings by road transport. Typically, these bins are delivered to a Loading Pad and then transported to the rail siding. It was for this reason that a Yard Queue Manager process was developed to rationalise samples delivered from the same farm. Prior to this process being implemented, 25% of the deliveries of three bins or less were not sampled. With this process running, this was reduced to 10%.

Conclusion

This mimic display application has been in operation for the last two seasons, with a range of refinements being implemented over this period. The benefits derived from this system are listed below:

- The mimic provides a complete overview of the current state of the full yard and feed areas at all times.
- The system ensures that all cane is accounted for in the full yards before arriving at the tip and has reduced lost time and virtually eliminated cane allocated to suspense.
- The system has significantly reduced (almost eliminated) the amount of data entry carried out by the weighbridge clerk.
- The system ensures that no surprises arrive at the weighbridge in the form of an unidentified bin.
- The system promotes the more effective use of the combined Traffic Office/Weighbridge Clerk position.

Future Considerations

The next stage of the complete automation of the consignment, transport and processing cycle that will be examined will be the delivery cycle from the field to the mill yard. At Isis Mill, 50% of the cane is transferred from the field to rail sidings using road transport. As an interim step, these bins are first delivered to a designated Loading Pad, where they are stored before being transferred by road transport to a rail siding. Although the stock levels of full cane bins is known at all times, knowing the location of these bins at a point in time is far more difficult; it is this task that this next process will focus on. Transport costs, both road and rail, are a significant component in the overall production costs in the milling process. Consequently, any improvement in efficiency of either transport method has significant potential. The next phase of this automation process will be concentrated in this area.

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