final report

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Feasibility and Pre-Production development of integrated data capture/management and product handling in beef processing

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Abstract

This report describes the first fully automated data management and product handling system. The product handling system has been installed at Kilcoy Pastoral Company in QLD. This system utilises product handling to pack and transport chilled and frozen meat cartons to various locations in a warehousing system. Data must be stored and maintained throughout the process. Data flows from the abattoir control systems and is added to pallets of product. These sets of data are tracked and maintained throughout the system to account for all cartons in the process.

Executive summary

The automation of the load out area at KPC has seen a streamlined approach to the back end of the abattoir.

The system is a flexible way to move product through the loading area and can adapt to periods of chilled, frozen or mixed out feed.

The system is currently being operated by the staff at KPC and is handling the entirety of the product that is being sent to the room.

The product flow to the room has been changed since the projects beginning with the line being fed frozen and chilled product in separate shifts rather than at the same time. This limits the system throughput.

Data seamlessly flows from the KPC sortation system to the Handling system and is handed back to the warehousing system at the end of the process.

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1 Project objectives

The overall objective of the project is to demonstrate a production ready prototype and proof of concept for carton/pallet handling, sortation and delivery.

The specific project objectives have been:

- Design, develop, install and commission an integrated and automated product transfer system for pallet handling.
- Integrate pallet handling with the automated palletising system and KPC cold storage facility.
- Provide a fully automated and integrated pallet handling solution direct from the palletising room and delivery of completed pallets to individual cold storage locations.
- Provide KPC production and process advantages over traditional palletising and pallet handling solutions as listed.
- Undertaken industry open days and producer education days.
- Provide KPC post installation training and production support.
- Develop a post installation cost benefit analysis and dissemination video and report.

This project is the first step in a wider fully integrated and automated material handling approach to improve efficiencies, operator safety, traceability and reduced labour at KPC. This project will also develop skills and capabilities in KPC to cost effectively evaluate ideas to proof of concept.

2 Discussion

2.1 Overview of System operation

As can be seen from the layout image below the new palletising system consists of 4 robot cells each fed by 4 infeed conveyors. Each of these infeed conveyors can be assigned a separate SKU and hence 16 different SKUs can be palletised at any one time. Cartons are diverted onto each of these infeed conveyors off the main ring conveyor according to their SKU (read by barcode scanning cameras located on the main ring). The robots palletise each of these SKU's and the full pallets are removed from the pallet stand and transported through a Pallet Barcode Scanning System, a pallet wrapper, pallet labeller and then deposited at either the chiller or freezer infeed conveyors where they are removed by forklift and stored.

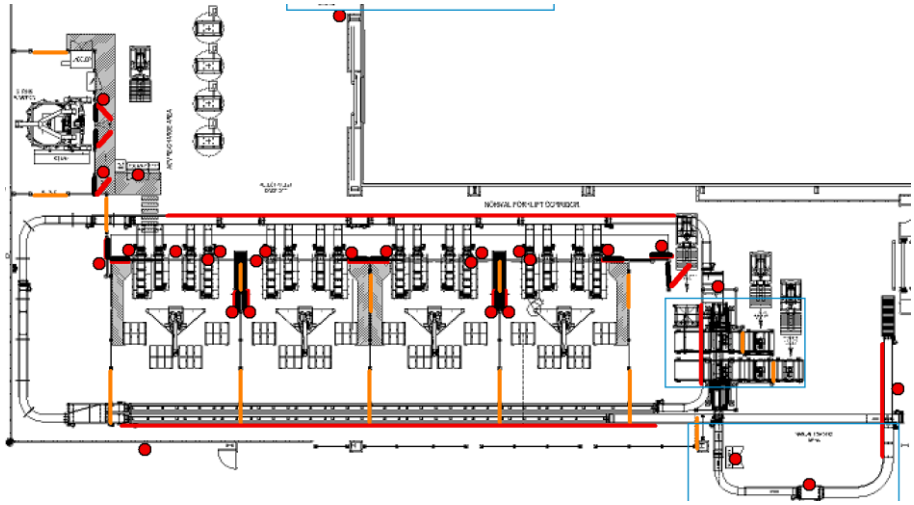

Fig. 1 Palletising System Layout

Fig. 2 Pallet stands with robot above

Fig. 3 Robot and gripper with cartons queued on infeed lanes ready for palletising

Fig. 4 Barcode scanning camera on the main ring, used to determine which infeed lane each carton should be diverted down.

Fig. 5 Divert gates used to diverted cartons off the main ring. This image shows the infeed conveyor set to receive cartons off the lower (chilled) ring conveyor.

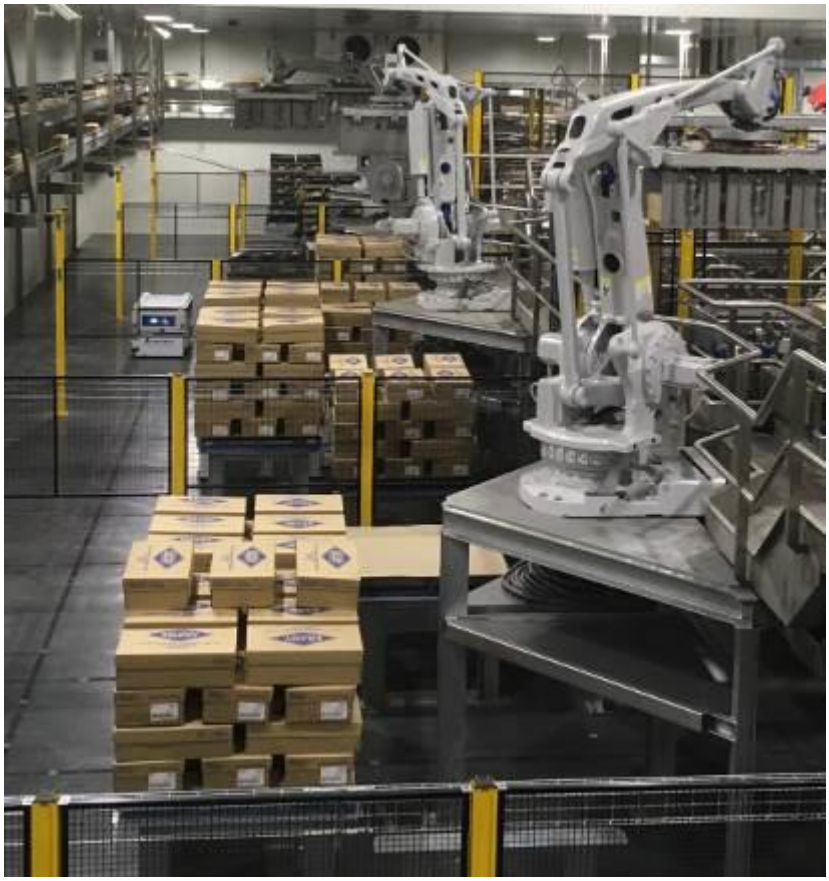

Fig. 6 Palletised cartons waiting to be transported to Whole of Pallet Barcode Scanner.

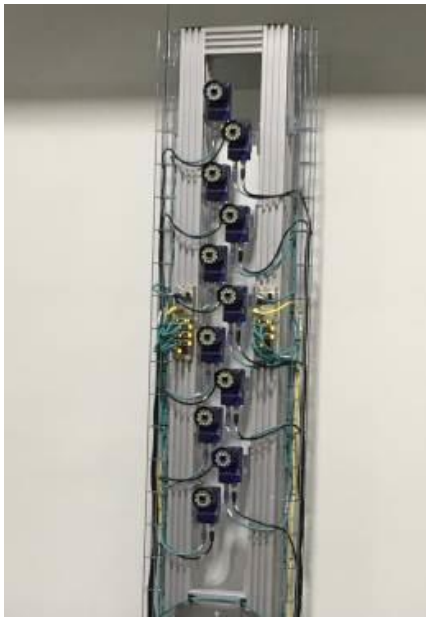

Fig. 7 Pallet Barcode Scanning System, consisting of 11 Barcode Scanning Cameras

Fig. 8 Completed pallet ready for scanning by the Pallet Barcode Scanning System

Fig. 9 Completed pallet being wrapped

Fig. 10 Wrapped pallet complete with pallet label deposited at entrance to freezer

2.2 Assignment of SKU's to lanes

The images below are screen shots of the code that interfaces with KPC's Inventory Management System (IMS). KPC operators allocate an SKU to each lane from their control room. The code in Fig. 15 shows the allocation of an SKU to each lane as received in the palletising software from the IMS. Fig. 16 shows the staus of lane 1 once allocated while Fig.17 shows the lanes with SKU's alocated on the operator HMI.

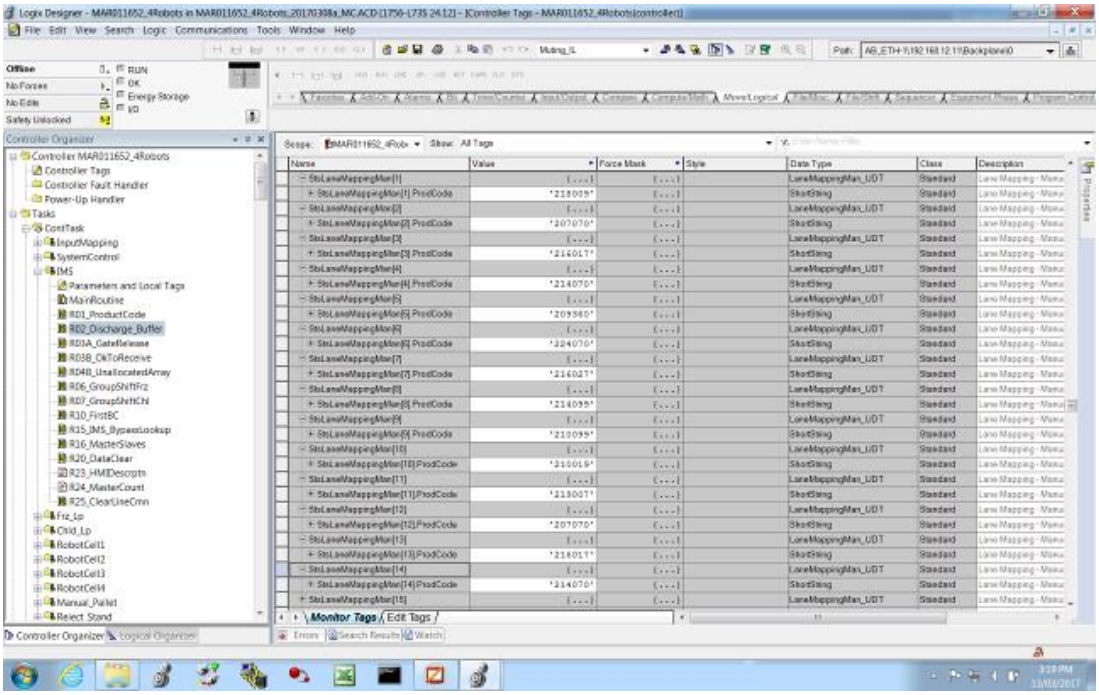

Fig. 11 Product – Lane Status (as selected from IMS)

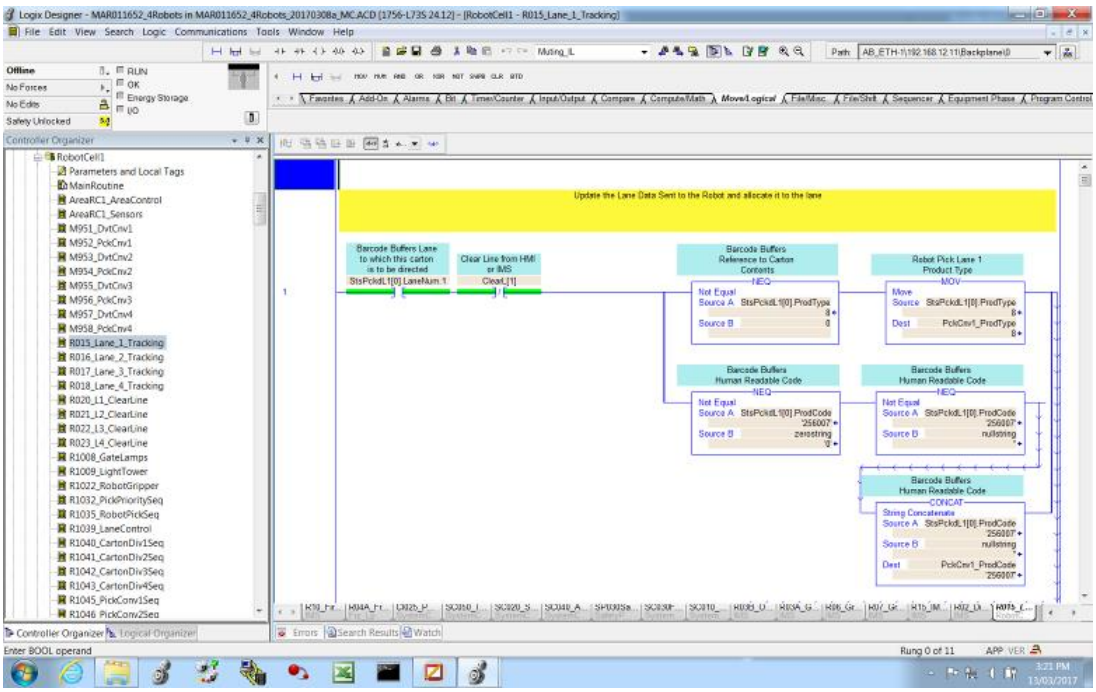

Fig. 12 Lane 1 Status

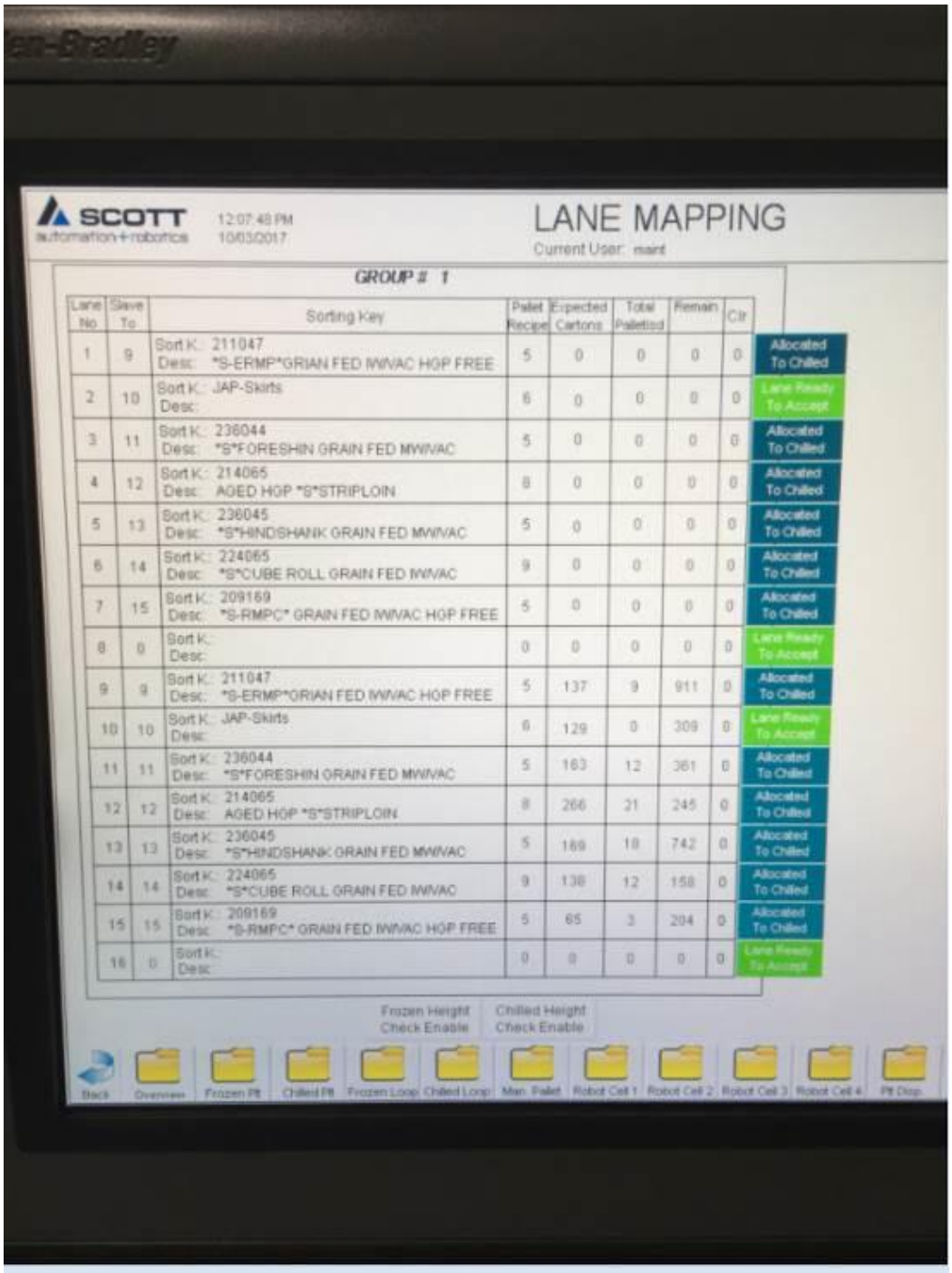

Fig. 13 SKU's allocated to each lane as shown on the operator HMI

2.3 Scanning of completed pallets, data verification and transfer to IMS

During the building of a pallet the robot system builds a data array of all the barcodes that are on the pallet. Once a full pallet of cartons has been palletised the pallet is transported to the Pallet Barcode Scanning (PBS) System . At this point the data array is copied to the PBS System and the pallet is rotated a full 360 degrees infront of an array of barcode scanning cameras (Video attached as an appendix to this report). The PBS System scans the barcodes and compares what it has been detected to the array that arrived with the pallet. If

- all the barcodes match, a 'Pass' signal is sent to the Palletising System PLC and the PLC transfers the data array to the KPC IMS along with a pallet number and the pallet is cleared to travel through to the wrapper and labeller. At the labeller a label is printed containing the relevant pallet number.

- the barcodes don't match a 'Fail' signal is sent to the Palletising System PLC and no information is sent to the KPC IMS System. The pallet is cleared to travel through the wrapper (without wrapping) and labeller and travel to the 'rework' stand where it is manually scanned and transported to the chiller or freezer as appropriate.

Below is the code used in the Palletising System PLC (Ladder Logic) and the Pallet Barcode Scanning System (Visualbasic.Net) that enables this transfer of data to occur.

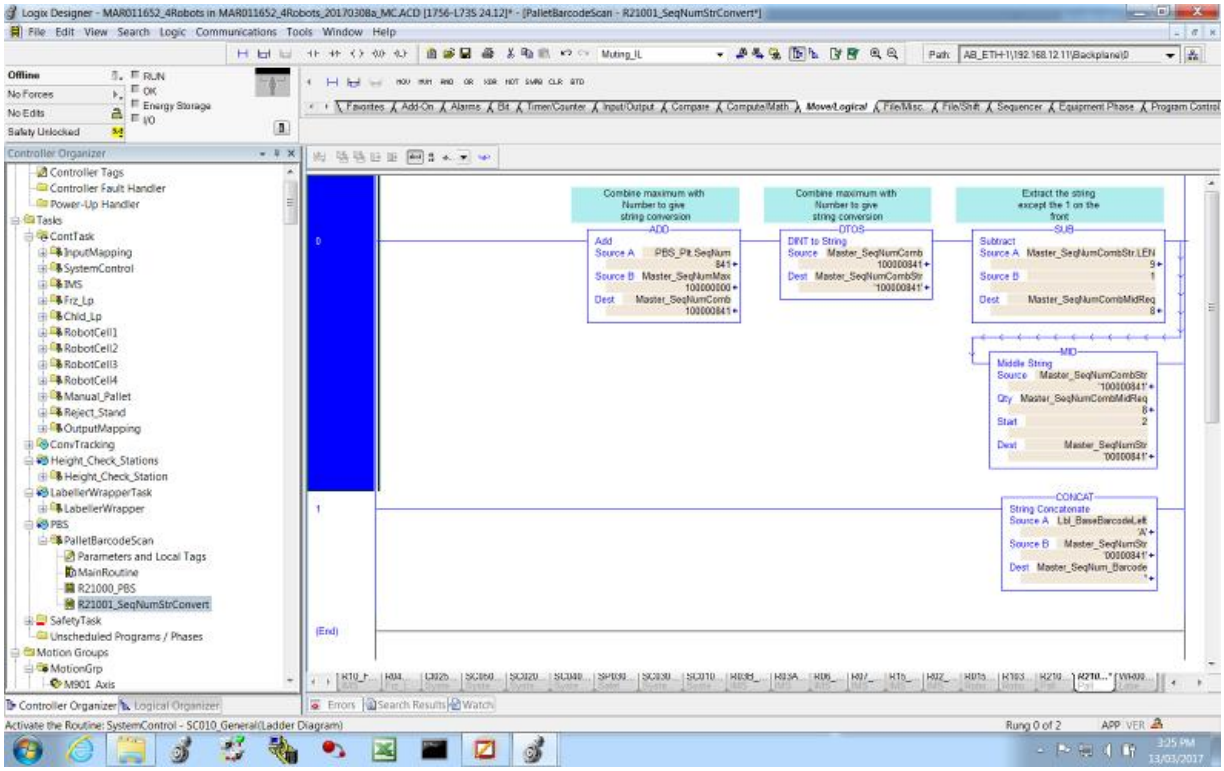

Fig. 18 Pallet Sequence Number to PBS - PLC Code

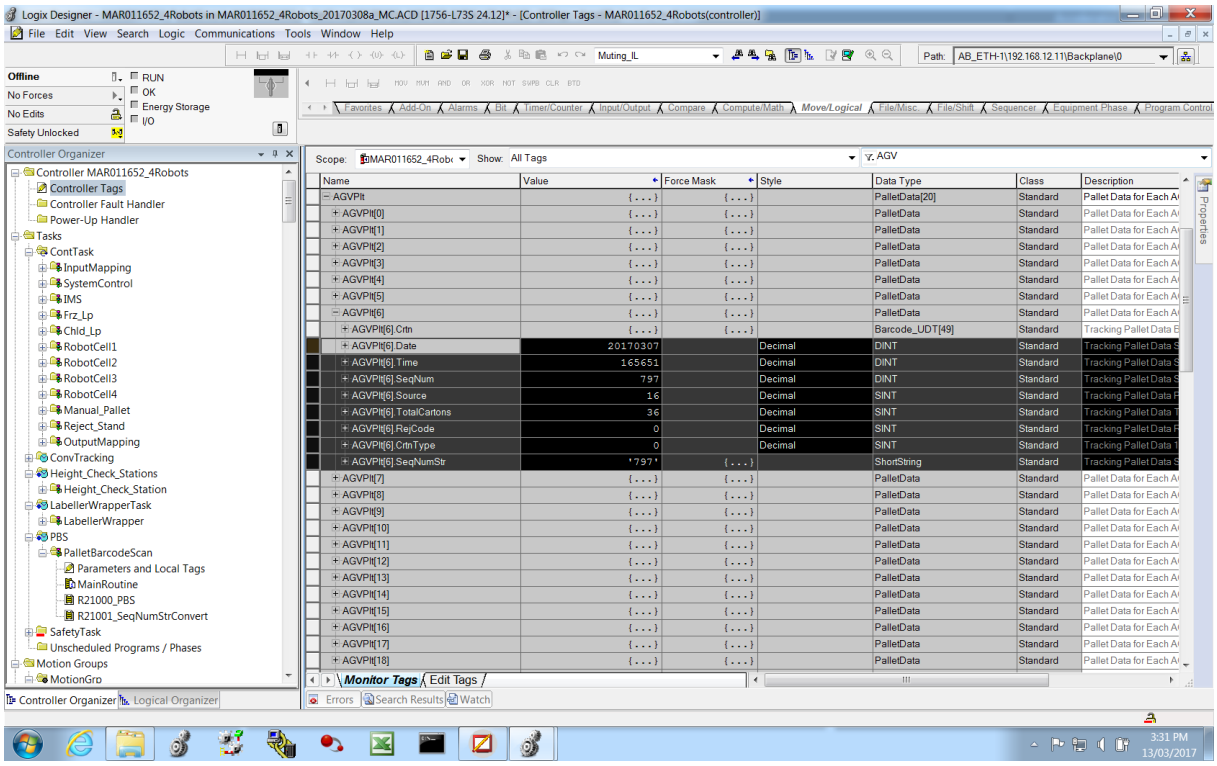

Fig. 19 Pallet Cartons on pallet – showing 36 cartons, date and time of robot palletising complete – PLC Code

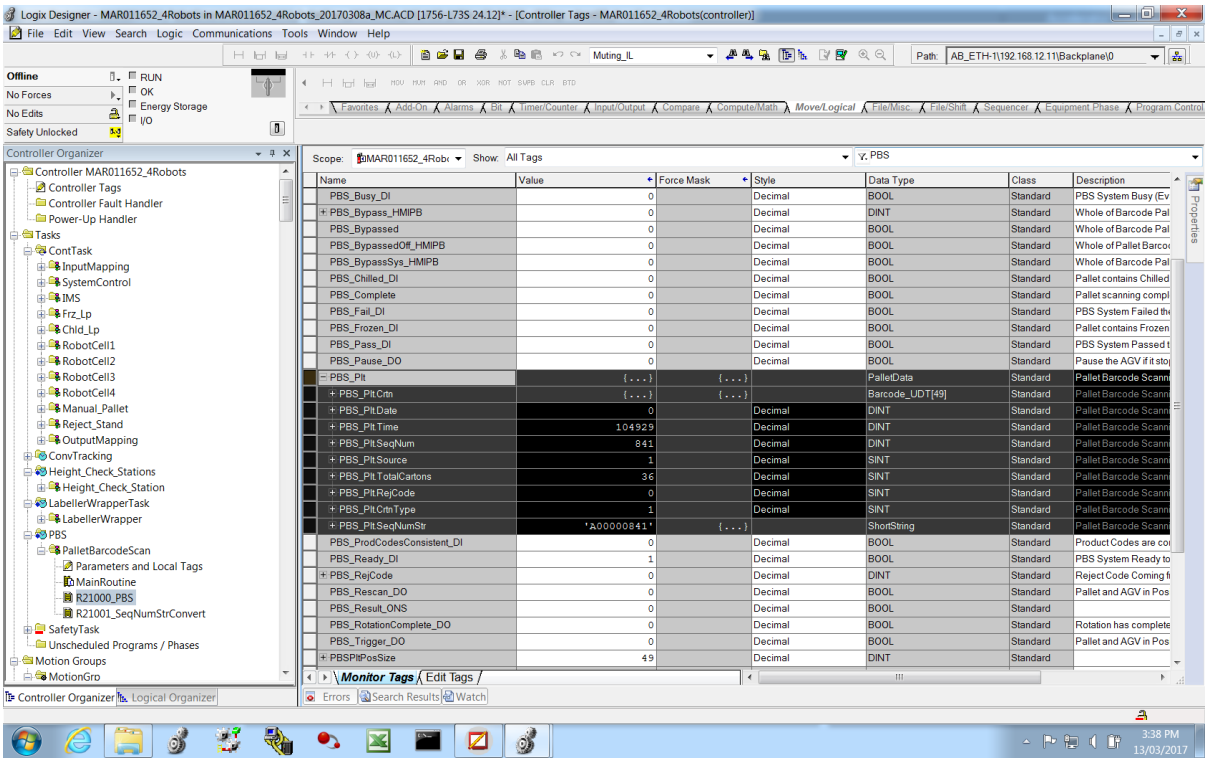

Fig. 20 Data from PLC to PBS for current Pallet at PBS complete with "Pallet Sequence No."- PLC Code

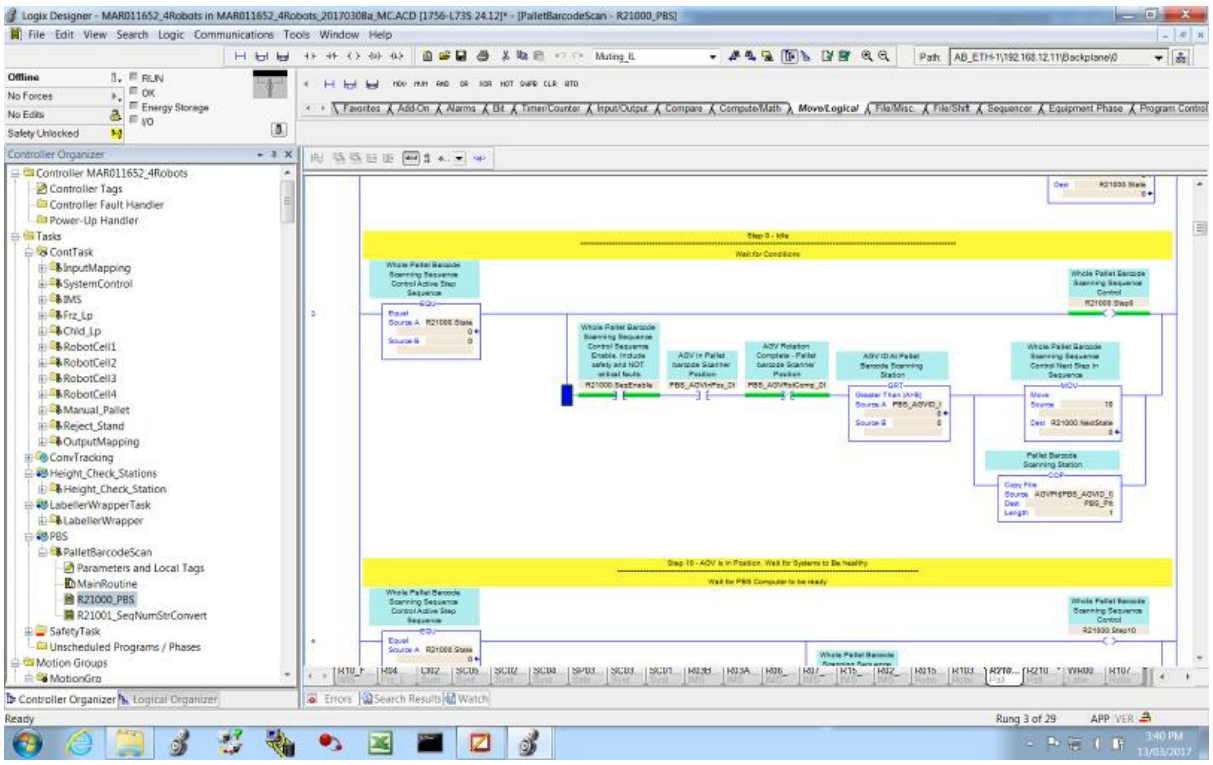

Fig. 21 PLC code waiting on next pallet to be in position to transfer data to PBS

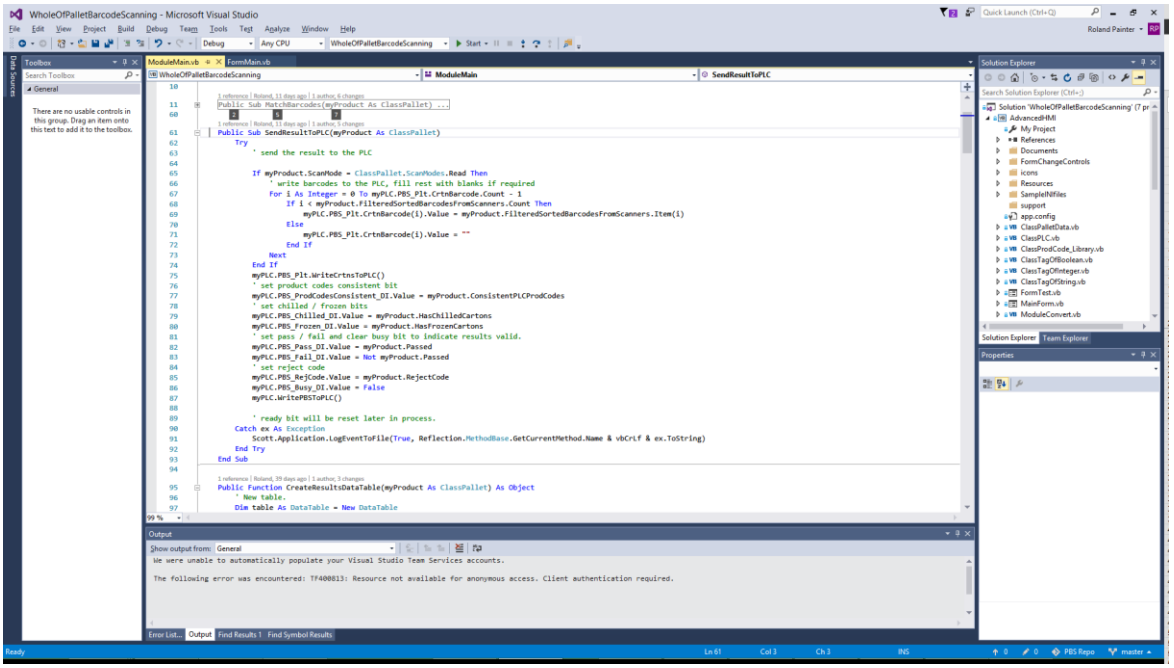

Fig. 21 PBS Code

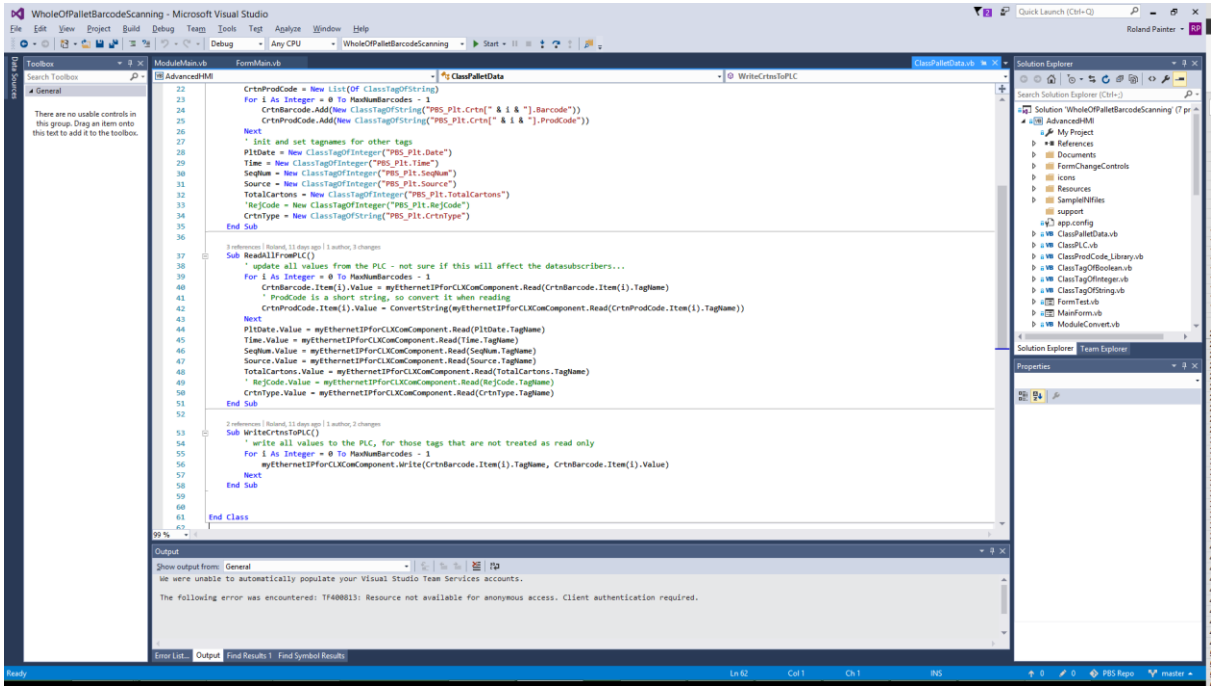

Fig. 22 PBS Code

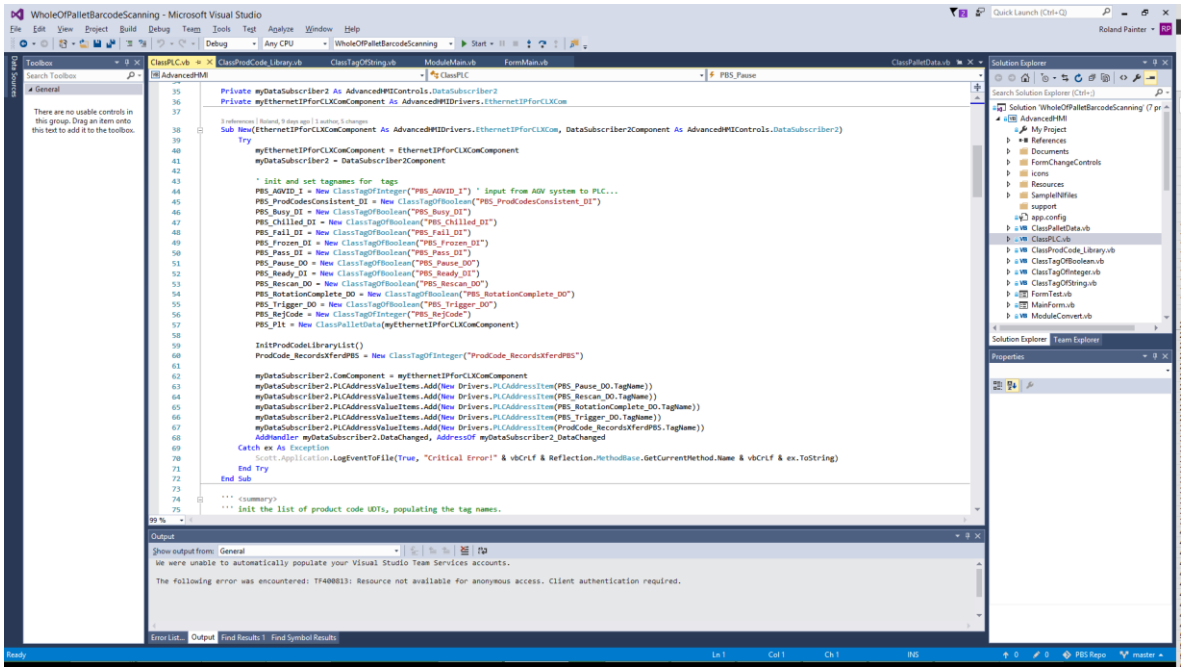

Fig. 23 PBS Code

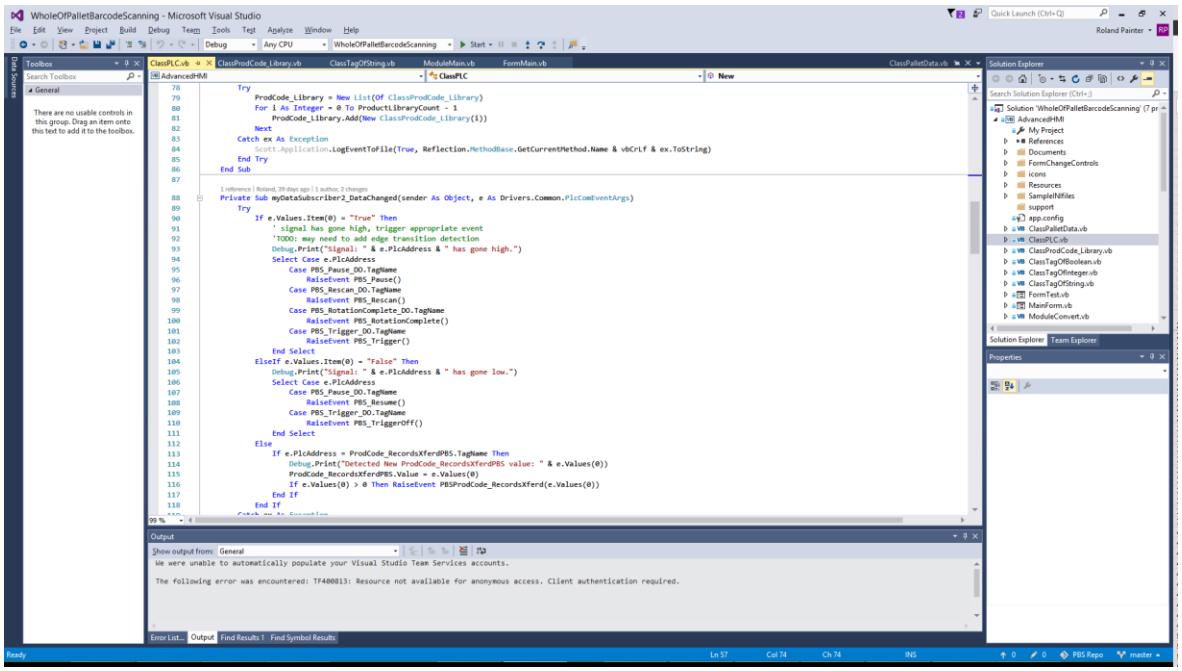

Fig. 24 PBS Code

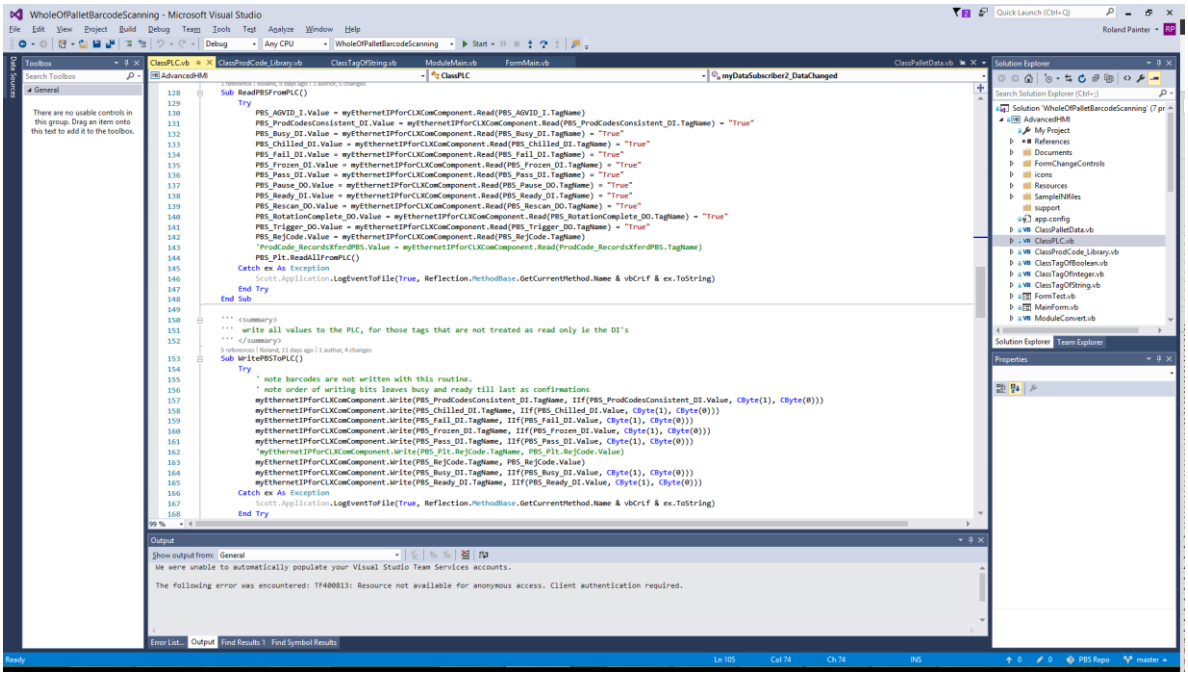

Fig. 25 PBS Code

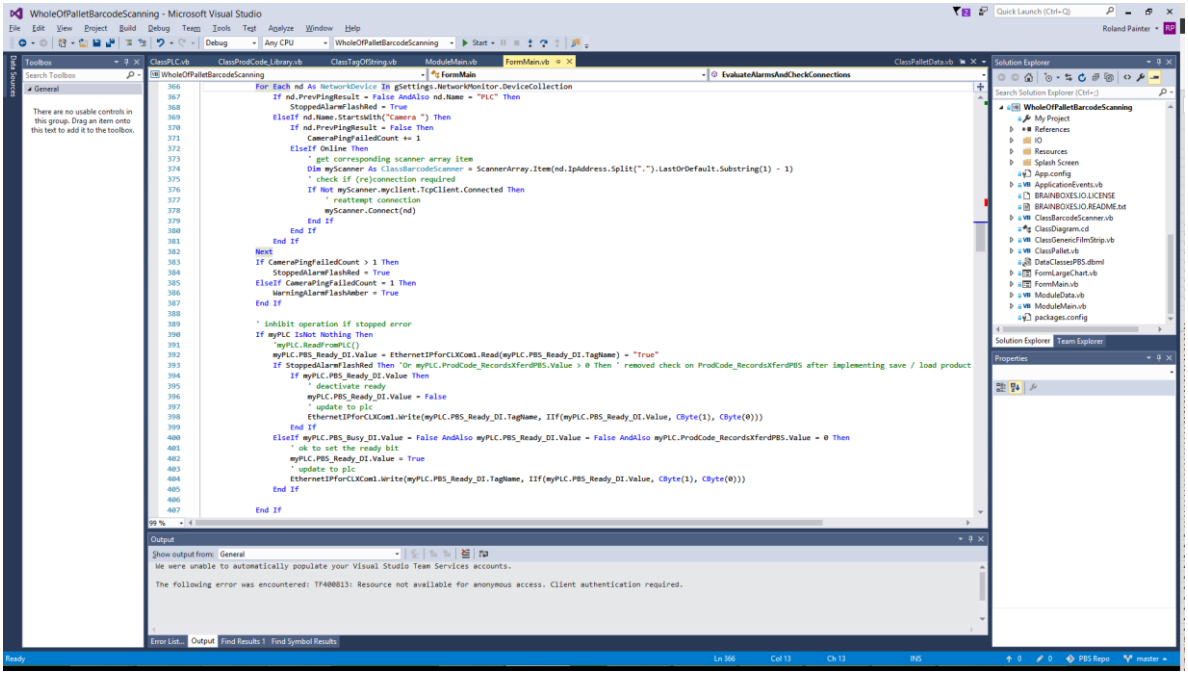

Fig. 26 PBS Code

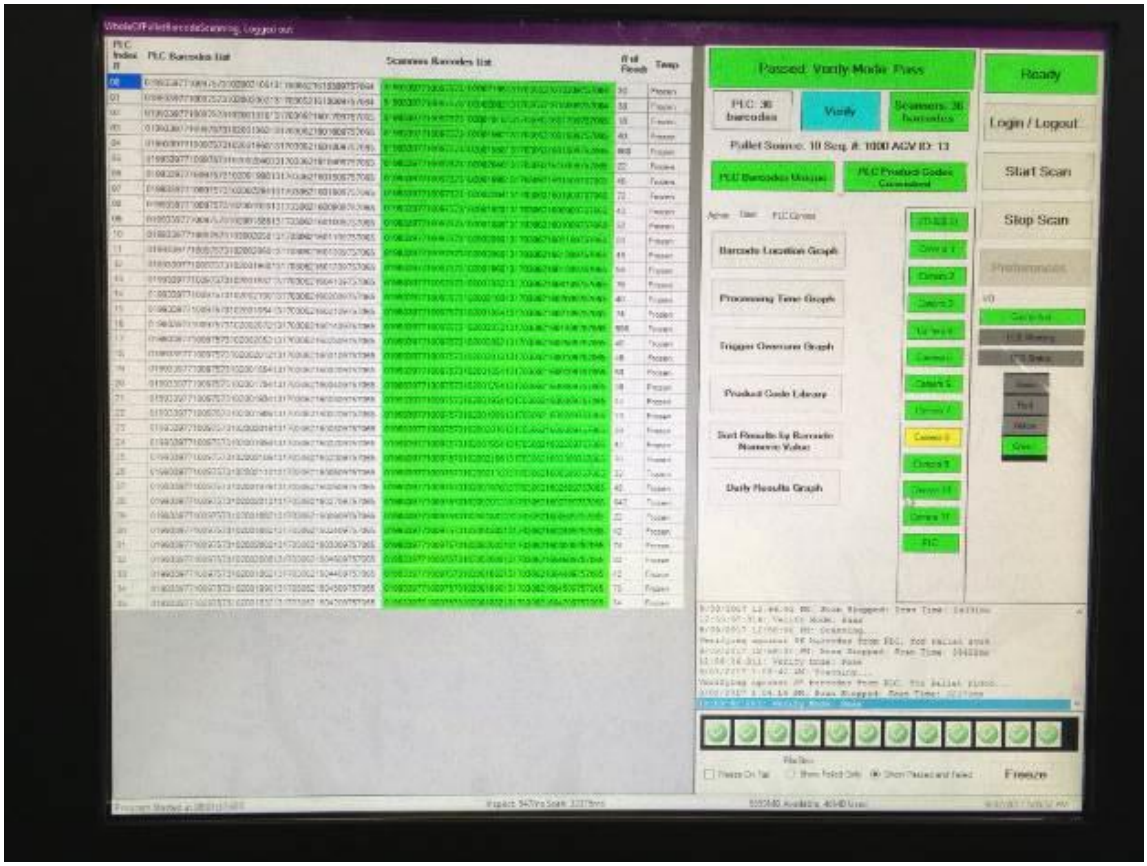

Fig. 27 HMI Screen confirming (in this case) all barcodes match.

3 Conclusions/recommendations

3.1 Success in achieving milestone

The system, as described in the previous milestone reports is now fully commissioned. All of the product handling and pallet transfers into and out of the system are being made automatically.

The robotic palletising system now functions with a minimum of operator intervention. The only interventions necessary are to remove cartons with damage from the system. Generally, cartons that deviate from the specification are ejected from the system automatically, but occasionally a carton is introduced that is vastly out of specification and must be removed manually. In this instance, the system detects the location of the carton and alerts the operator. The conveyor belts are stopped when this situation is detected to prevent damage.

Although the system is currently sorting and delivering all of the product that is being sent to it the maximum benefits are not being realised as KPC are not running the system in the way it was originally designed. When the system was originally designed it was supposed to process both chilled and frozen product at the same time. Currently due to the upstream sorting KPC have decided to run the line with chilled product on the day shift and frozen product on their night shift.

Training is complete for all necessary KPC staff. This includes:

- Operators

- Maintenance personnel.
- High-level overviews for management.

KPC staff now operate and maintain the system. Support is currently provided to KPC as required and is now being scaled back as KPC are now becoming confident with the system.

The KPC system has been used to show the industry what is achievable with today's technology. Many people throughout the meat industry have viewed the system namely:

- Representatives from JBS.
- Representatives from NH Foods.

The online publication Beef central has also featured the system in a report on 14th September 2017 and on 15th June 2018. A Video of the system has also been posted on YouTube with the permission of KPC. This video has had over 25000 views to date. The system has also been the focus of an email marketing campaign sent to our industry contacts as part of our industry awareness campaign during August 2017.