Final Report

Modular pallet project

Project Code
2022-1039

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Contents

1.0 Executive Summary

This project was to evaluate the feasibility of a new sustainable meat logistic solution for conveying cartons of meat product into storage and depalletizing by mechanical means for loading into refrigerated containers. By making the finished product in modular format, it could be repaired on site saving on full replacement costs. It was also to have versatility in that it could be configured to accommodate both chilled and frozen cartons. Being made of nonporous materials it would be more acceptable to the industry than wooden products.

The design was to improve forklift efficiencies in loading containers as the cartons could be lifted from the pallet at the same side as the pallet is conveyed.

The first process was to construct a full-scale prototype pallet from wood to ensure the principles required could be met.

The next step was to produce detailed design drawings of the components needed to allow for the “tooling” to produce the separate parts. Once completed two sets of components were manufactured, assembled and then forwarded to the plant for a trial to be undertaken. As a result of this trial there were certain suggestions made to improve the practicality of the pallet. These changes were as follows;

- The distance between the two outside bottom cross rails was insufficient to allow the pallet to be placed safely into the racking;
- The two outside stringers needed to be flush with the ends of the top and bottom cross rails to avoid catching on fixed objects;
- It was asked if the total width of the trial pallet could be narrowed so that 2 pallets would fit into a refrigerated container side by side;
- The nylon “pin” used to fix the components together were not strong enough. The top rail became unstable;
- It was found that the compound used in the manufacture of the components was more brittle than expected and as a result more damage was caused to parts than expected.

Two further trial pallets were manufactured using a changed compound with a slight increase of rubber component to reduce the brittleness. This revised pallet suffered less damage than previously experienced. The other changes made as identified above were made and all proved to be correct. 100 pallets of this design have been delivered to the plant for use in production as they require. The unexpected disadvantage was the finished weight of the pallet. It is approximately 50% heavier than a standard wooden pallet currently used. The weight could potentially be addressed by creating the 2 heaviest sections, the 4 stringers and the 4 top rails with cavity sections. Another alternative would be to look at moulded components with a different means of securing each section. Either way, a detailed investigation would be required before any commitment could be made to proceed.

There is no doubt that this design will be of great benefit throughout the industry in providing improved safety, improved efficiencies, less cost and a more versatile product for use in processing areas.

2.0 Introduction

- This concept came about by observing the operations of the forklift drivers when loading frozen cartons of product into refrigerated containers,
- The method used to remove the cartons from the wooden pallet onto the forklift tines could be considered dangerous to operators, potential damage to the product and damage to the pallet.
- The process creates unnecessary noise and dust,
- The process is time consuming in that it requires numerous forklift movements which in itself creates wear and tear on machinery,
- Efficiencies are there for the taking.

3.0 Project Objectives

The specific objectives were to;

- Evaluate the feasibility and in-house business case of a new sustainable meat logistic solution,
- Design a proof of concept sustainable and develop detailed specifications and plans to construct a POC carton palletising solution,
- Build POC solution in readiness for pilot validation trials,
- Through a series of pre-production trials, validate the functionality and robustness of the sustainable pallet solution over an extended trial period,
- Provide efficiencies in the mechanical loading of frozen product into refrigerated transport.
- Provide a sustainable alternative means of storing and transporting cartoned product.
- Provide the specification and footprint of the finished product.

4.0 Methodology

- Design a Proof of Concept (POC) sustainable and develop detailed specifications and plans to construct a POC carton palletising solution,
- Build POC solution in readiness for pilot validation trials, The first prototype was constructed from timber and used to validate the process. (Ref Appendix 9.1)
- Through a series of pre-production trials, validate the functionality and robustness of the sustainable pallet solution over an extended trial period, as a result of the trialling of the first prototype there were some design changes made for various reasons.
- Provide the specification and footprint of the finished product.

5.0 Project Outcomes

- The initial meetings held between the Management at the plant and the manufacturer outlined the needs of the business and what conditions the product had to withstand.
- A Design Engineer was engaged to create the concept from which “Tooling” could be manufactured. Ref Appendix 9.2
- A “trial” pallet was produced based on the December 2022 drawings and sent to the plant for comment. Ref Appendix 9.3
- It was found that the space between the 2 outside bottom rails were too narrow and did not allow the pallet to set correctly onto the racking without precise positioning by the forklift driver.
- It was also requested if the dimensions could be adjusted to accommodate the pallets being able to be used for storage in refrigerated containers. Standard pallets cannot be placed side by side in a container. This required the width to be reduced to 1130mm and the length left at 1160mm.
- It was also found after strength testing that the required weight of 2500kgs at static could not be supported with 3 “stringer” rails, so a 4th rail was introduced to the design. The 2500kgs has been determined by calculating 42 cartons @ 27.2kgs per pallet and in the preloading area it is quite often seen where 1 pallet is placed on top of another. Ref Appendix 9.4
- Another trial pallet was produced with the above changes and using a nylon “pin” to hold components in place. This method was found to be unsuccessful as the “pins” were not strong enough.
- The best method of securing the components was then determined to be a 90mm wood screw which would not rust.
- It was also found that the compound of material used was more brittle than originally sought as pieces broke off the edges and a stringer was broken without any knowledge how it occurred.
- In view of this, a request was made to the manufacturer to reduce the brittleness by adjusting the additives. This was done and a further 2 trial pallets were sent to the plant for testing. One pallet was of the revised compound and the other was the original compound. It was found that the revised compound performed better than the original mix.
- In view of the above changes, the final design was settled. Ref Appendix 5
- As a result of the developments to date, 100 units were ordered from the Supplier (SDI Plastics, Beenleigh QLD) and these were delivered to the plant.
- A plant visit was arranged to take photos of the pallets in production.
    - The pallet positioned on racking, Ref Appendix 6
    - The pallet with cartons positioned, Ref Appendix 7
    - 2 pallets loaded into a refrigerated container. Ref Appendix 8
- A cost analysis has been put together and is contained in Appendix 9.10. This shows the cost of hiring wooden pallets against the cost of purchasing the Modular Pallet outright. There are some costs which are difficult to quantify such as the reduced hours of forklift wear and tear where a study of times taken to load a container show an average time saved per container is 15 minutes. The operator savings are shown in the Appendix. Also, there is a saving on the need to use the cardboard “slip sheets” which are required for

wooden pallets. To quantify this is difficult as they are used over and over until they are deemed ineffective to protect the cartons from the wood.

- SDI Plastics, Beenleigh QLD, have all the requirements needed to supply this product to the industry. Their contact details are.

  SDI Plastics, 11 Quindus St. Beenleigh. QLD.

  PO Box 1421 CARINDALE QLD 4207

  P: 07 3807 8666

  F: 07 3807 7866

  E: kulbir@sdiplastics.com.au
- As the materials used in the composition of this product are man-made or recycled rice husks, the environmental impact is to be compared against using hard wood timber which is sourced from trees.

6.0 Discussion

The concept of the Modular Pallet has proven to be a success. The manner in which the cartons are removed from the pallet has shown to be a more efficient way to mechanically load refrigerated containers. The use of this nonporous “man-made” material has removed the need to use cardboard “slip sheets”. This alone is a saving in monitory value and also employee time.

The finished weight of the pallet has become a concern. It was originally planned to bring the pallet in at around the same weight as a standard timber pallet, however the material used in the extrusion process has proven to be heavier than expected. In saying this, good safe handling practices within plants should not see employees manhandle empty pallets. That is what forklifts are for. The finished weight is approximately 50% heavier than a convention wooden pallet.

As part of the extrusion process, there is a “lip” on the leading edge of the “cross rails” and this edge on the bottom rail is exposed to the forklift tines has a tendency to be hit if care is not taken causing a small “chip”. This can be eliminated if the manufacturing process is changed from extrusion to moulding. (This is expanded upon in the Conclusions / Recommendations).

The overall design has proven to be successful and will deliver savings in the following areas;

- Loading times for refrigerated containers can be reduced by as much as 20% following time and motion studies;
- The ROI is estimated to be approximately 2 years based on the average daily hire costs for wooden pallets, the saving in cardboard slip sheets, the cleaning of the floor areas of wooden fibres and dust.
- The saving on the use of cardboard “slip sheets” due to the fact the material used in nonporous;
- The reduction in forklift movements as a result of being able to pick up the load from the same side as the pallet is conveyed; Ref Appendix 9
- The reduction in wood dust in and around the storage areas;
- The reduced risk of safety issues with fewer forklift movements.

7.0 Conclusions / Recommendations

During the last plant visit discussions were had on the outcome of the Project.

It was agreed that the concept in principle is workable, it will be time efficient and a benefit to the process of storing, conveying and depalletizing frozen cartons. It will also have benefits for storing and conveying cartons of chilled product by changing the formatting of the pallet by removing the 4 “top rails” and inserting a total of 5 “cross rails” on the “stringers”. This will give added support to the centre of the chilled cartons.

The change in dimensions also has an added benefit in that the pallets are able to be stored in refrigerated containers side by side. This is a practice at times when cold storage capacity is limited.

The resultant weight of the pallet was not expected. The composition of recycled materials, (recycled polypropylene, rice husks and rubber) along with the extra “stringer” have all added to the weight. This issue can be addressed by creating the “Stringers” and “Top Rails” (the 2 heaviest components) as a cavity module. Another alternative would be to look at the concept of moulded components which could potentially allow for a different concept in “locking” the components together. Either way this would require new “tooling” to be carried out as the existing “tooling” only allows for the extrusion of the material.

This being said, it can be claimed that the concept, design and assembly of the pallets for this Project has proved to be workable. The savings in time, monetary value and general improved standards have been demonstrated. The benefits to the industry could be widespread.

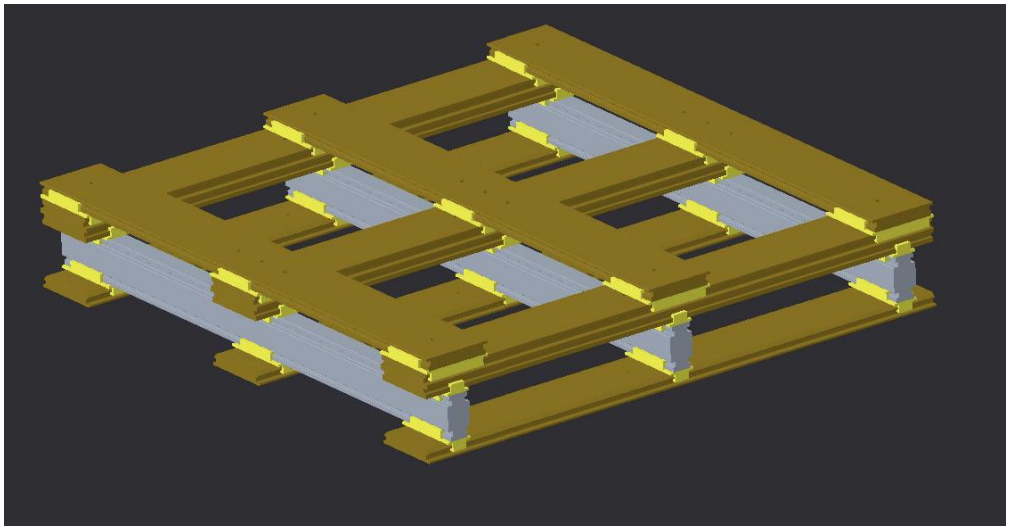
A second Project of this nature using all the knowledge gained to date could deliver an even better outcome. It is a matter of determining if the industry deems it necessary.

8.0 Bibliography

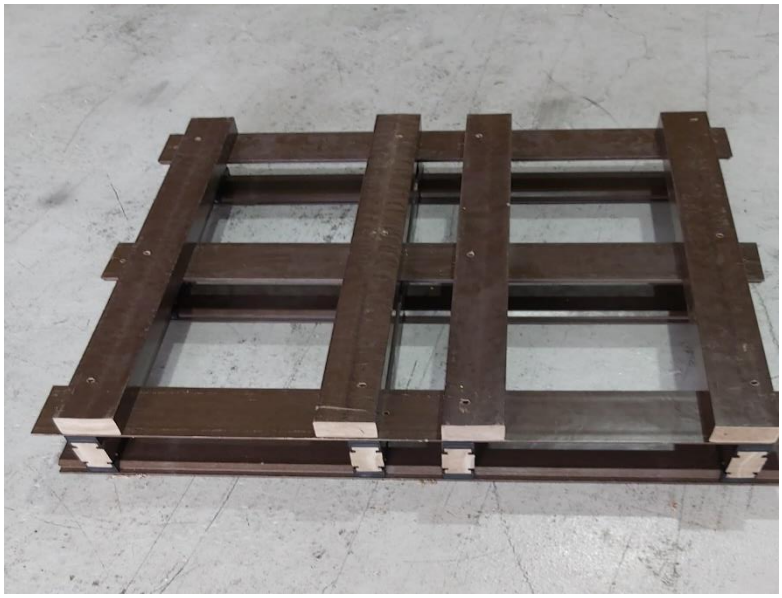
9.0 Appendices

Appendix 1

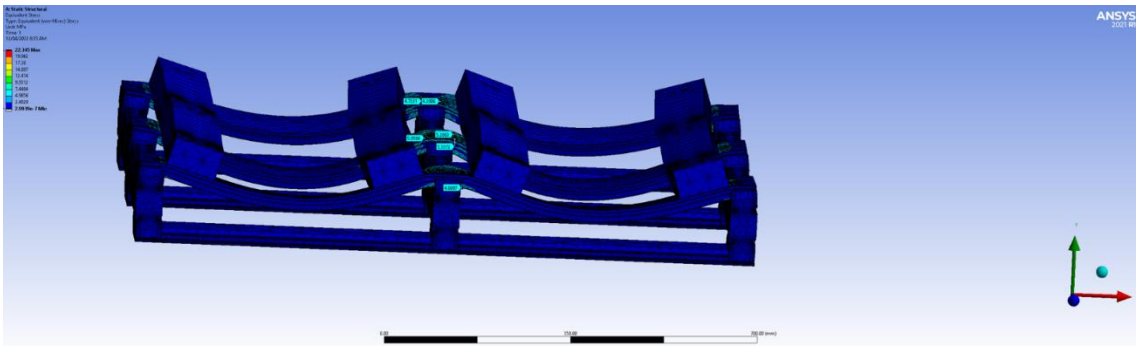
Appendix 2



Appendix 3



Appendix 4



Appendix 5

Appendix 6

Appendix 7

Appendix 8

Appendix 9

Appendix 10

Cost model	**Wooden pallet - v - Modular pallet**								
Cost to Hire wooden pallets									
	Cents per day		days pa	Cost pa per pallet	Total pallets	Rental years	Total cost 2 yrs		
Daily hire	0.155		365	$ 56.58	3000	2	$ 339,450		**$ 339,450**
Cost to purchase Modular Pallets									
Cost per unit				$ 220.35	3000		$ 661,050		
% loading for repairs			0.1	$ 22.04	3000		$ 66,105		
Total costs								$ 727,155	
Savings			$ / hr	hrs / week	weeks pa	Years			
Labour cleaning 1/2 unit		0.5	36.42	38	48	2	$ 66,430		
				days/week					
Forklift labour (hrs per day)		2.5	39.76	5	48	2	$ 47,712		
Total savings								$ 114,142	
Net costs									**$ 613,013**
R O I (years)									**1.81**

Notes:	
1	Above costs based on 3000 wodden pallets on hire.
2	Daily hire rate for wooden pallet is estimated based on past known rates.
3	Cost per modular unit based on cost of trial pallets.
4	10% allowance for repairs is an estimate.
5	Labour cleaning saving is based on only half a unit required to clean floor area due to reduced dust and wood fibres.
6	Forklift labour saving is based on 15 minutes saved per container loaded for 10 containers per shift.
7	Labour rates are estimated based on past known rates.