

How to fit in more fruit

When refrigerated shipping rates shoot up by 25%, an obvious solution is to fit more fruit into a container. Is it possible? Yes. Is it easy? No.



- 1** Koos Bouwer, project leader.
- 2** Packaging must look good, protect fruit from physical harm, and allow optimal airflow.
- 3&4** Optimal use of pallets and cartons can save 15–17%.
- 5** The project team members are (standing, from left) Prof. Malcolm Dodd, Stephan Nel, Koos Bouwer, Nicholas Bridge, (sitting) Dr Leila Goedhals-Gerber, Tessa Myburgh and Dr Louis Louw.

TRANSPORT AND FREIGHT charges are a significant portion of the total cost chain for fruit exports. Therefore, when a big shipping lines implemented a worldwide, across-the-board increase in containerised refrigerated freight rates of around 25% in 2014, the industry had to take action.

It is not as if the industry has ignored transport logistics in the past. Research was done and innovations developed but, unfortunately, in too many instances the gap between idea development and solution implementation on a commercial scale was not bridged.

An example of this lack of follow-through is the implementation of two changes that, over the past 15 years, have had a significant impact on the logistics of exporting fruit. These are the swing from break bulk to containerised shipping and the introduction of hi-cube pallets.

Both changes were introduced without proper solution development. For example, the packaging design and palletisation of fruit exported in containers are still based on the

break bulk solution for optimum cooling. While the approach works inside the containers, it is not optimised as far as functionality, product quality and cost go.

According to Koos Bouwer, an industrial engineer and independent consultant to the fresh fruit industry, this inability to properly implement solutions is depriving the industry of the much-needed competitiveness it should gain as a result of innovative logistics developments.

Following the price increase bombshell, Koos initiated a comprehensive study funded by the Post-harvest Innovation Programme and industry to investigate the opportunities to export more fruit per container to save on shipping costs.

The work was structured according to four objectives:

1. Define an optimised refrigerated container solution.
2. Determine factors that would constrain implementation.
3. Develop the optimisation solution and industrialisation process for implementation.
4. Provide an action plan for the implementation.

Working with Koos were Dr Malcolm Dodd, Johan Strydom and five students.

Saving	5%	10%	15%
Net farm income	+8%	+16%	+24%
Pome industry annual benefit	R135m	R270m	R405m

This table quantifies the savings for apple exports. Even a conservative 5% saving will lead to an 8% increase in net farm income and an annual benefit of R135m for the industry.

Method and materials

The first step was to define the expected outcome of an optimised refrigerated container solution in order to maximise the weight of fruit that can be shipped in a container.

The constraints and variables that may impact a better solution were researched and documented as follows:

- the internal volume space of the container,
- road freight regulations in South Africa and export destinations,
- the optimisation of modular packaging units like pallets, cartons and pallet bases for better volume usage inside the container,
- the impact of packaging design on refrigeration airflow inside the container,
- the refrigeration capacity of the container,
- fruit handling during cold-storage racking, container stuffing, and road and sea transport,
- the need to maintain fruit quality with good packaging and refrigeration solutions,
- the environmental impact of the solution,
- the finite nature of resources, such as water and wood for carton manufacturing and fossil energy for refrigeration,
- the impact of the size and appearance of cartons on point of sale marketing displays,
- the necessity to break historical habits that are no longer valid, and
- economic forces in the export value chain.

Five researchers gathered valuable information as part of the first phase of the project:

- Johan Strydom, a consultant, compiled a historical overview, covering the period from around 1960 to the present day.



- Tertius Bruwer and Janita Pieterse, both honours students in Logistics, researched and analysed the road transport regulations and constraints locally and for a selection of overseas countries to which fruit is exported. Tertius covered the USA and Asian countries, while Janita looked at Europe and Africa.
- Another honours student in Logistics, Nicholas Bridge, was tasked to research and analyse the volume of refrigerated



PROJECT TITLE

Industrialisation of container optimisation solutions

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DURATION
Two years

PHI PROGRAMME & INDUSTRY CONTRIBUTIONS
R429 000 & R156 000

LEAD INSTITUTION
Koos Bouwer Consulting CC

BENEFICIARY
The entire fruit export industry

FOCUS AREAS
Logistics, agricultural engineering, container and cold-storage technology

HUMAN CAPITAL DEVELOPMENT
Four BComm (Logistics) Hons students and one BEng Hons Industrial Engineering student

PUBLICATIONS
One

PRESENTATIONS AND PAPERS
Six





container shipments to determine the size of the industry, and the portion used by pome fruit and stone fruit. He also compiled a cost chain from data obtained from a sample of exporters.

- Using information supplied by a sample of exporters, Tessa Myburgh, also a Logistics honours student, analysed the packaging configurations currently used in container shipping.

Further industry consultation took place in the form of interviews with packhouse managers, exporters, packing material suppliers and logistics handlers.

All the input information was given to

Stephan Nel, a fourth-year student in Industrial Engineering, who applied optimisation techniques to improve container utilisation.

Stephan's work was the heart of the project. By following a zero-base approach, he determined the maximum quantity of fruit that could be loaded into a container, with no airflow or packaging restrictions. These values were compared with the actual volume of fruit currently loaded.

Results and recommendations

The historical overview highlighted the impact that palletisation, containerisation and the move to hi-cube containers has had on logistics handling methods. Many exporters continue to use the original packaging and handling methods, despite them not being regularly reviewed to keep up with the changing environment. Such habits create resistance to change.

The information obtained by the Logistics students was a very important input towards solution development. The constraints in transport regulations, shipping container sizes, the cost chain, current shipping volumes and packaging configurations are now well researched and documented for future reference.

The optimisation of container utilisation showed that a theoretical 29 tonnes of apples could be loaded in a container without any restrictions. In practice, only 14 to 18 tonnes of apples were being loaded, and only 18 to 22 tonnes of pears. Stone fruit showed a better utilisation, but also had room for improvement. The results were clear: the answer to more cost effective shipping lies in container optimisation.

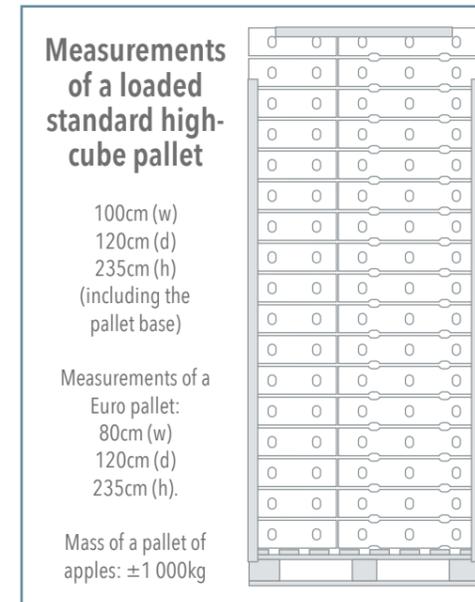
The following savings opportunities were identified:

- **Option 1: Euro Pallet or 21 pallets – save 2,5%.** This option is already used for avocados and will be the easiest to implement.
- **Option 2: Reduce weight of packing material – save 3%.** This includes the weight of cartons and pallets.

- **Option 3: Reduce pallet base height – save 4–6%.** Existing pallets with a base height of 158mm can be replaced with slip sheets or lower profile pallets.
- **Option 4: Optimal carton size (bigger cartons, less edge effect).** Bigger cartons reduce the edge effect and therefore the space cartons take up inside the container.
- **Option 5: Optimal pallets – save 15–17%.**
- **Option 6: Combinations of above – save up to 25%.**

Most of these options need further detail design of packaging and cargo handling methods before full-scale implementation will be possible. Some options will only apply to certain markets where agreements on cargo handling methods can be negotiated.

The development of an action plan for implementation recognises that the fruit export supply chain includes a variety of service providers, and that the introduction of the solutions may benefit some, while disadvantaging others. The latter is a big reason why previous implementation attempts have failed.



The best way to overcome this reality is for a central managing body to take ownership of the implementation. A more detailed action plan can only be developed once all the role players have been brought on board behind a shared vision and goal.

The task at hand is considerable, but it pales in comparison to the cost benefits the whole industry can derive from the improved utilisation of refrigerated shipping containers.

Specifications of reefer containers suited for fruit

40ft high-cube reefer
 Temperature range: -30°C to +30°C
 Cargo space: 67m³
 Humidity control: 65% to 85% (in chilled mode)
 Bottom-air delivery: Yes
 Fresh air exchange: Adjustable from 0–285m³/hr.
 Refrigerant used: R134a
 Max payload: 29,480kg
 Dimensions: 40' x 8' x 9'6"
 1240 x 245 x 292cm

Source: <http://maersklinerefer.com>

Janita Pieterse (1) and Tertius Bruwer (2), both honours students in Logistics, researched and analysed the road transport regulations and constraints locally and for a selection of overseas countries to which fruit is exported.

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South Africa exports about 2,7 million tonnes of fruit, valued at R30 billion, to 92 countries each year.

