PHI Symposium Nov 2016

KOOS BOUWER CONSULTING

The development of the industrialization process for various ideas towards optimization of cargo freight capacity utilization (space, mass, packaging, refrigeration) in refrigerated shipping containers to reduce logistic costs while maintaining product quality.

22 November 2016

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POST-HARVEST INNOVATION PROGRAMME

a public-private partnership between

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

fpef SOUTH AFRICA
Fresh Produce Exporters' Forum

Background

- Logistics cost chain
- Shipping Cost
- Containerization

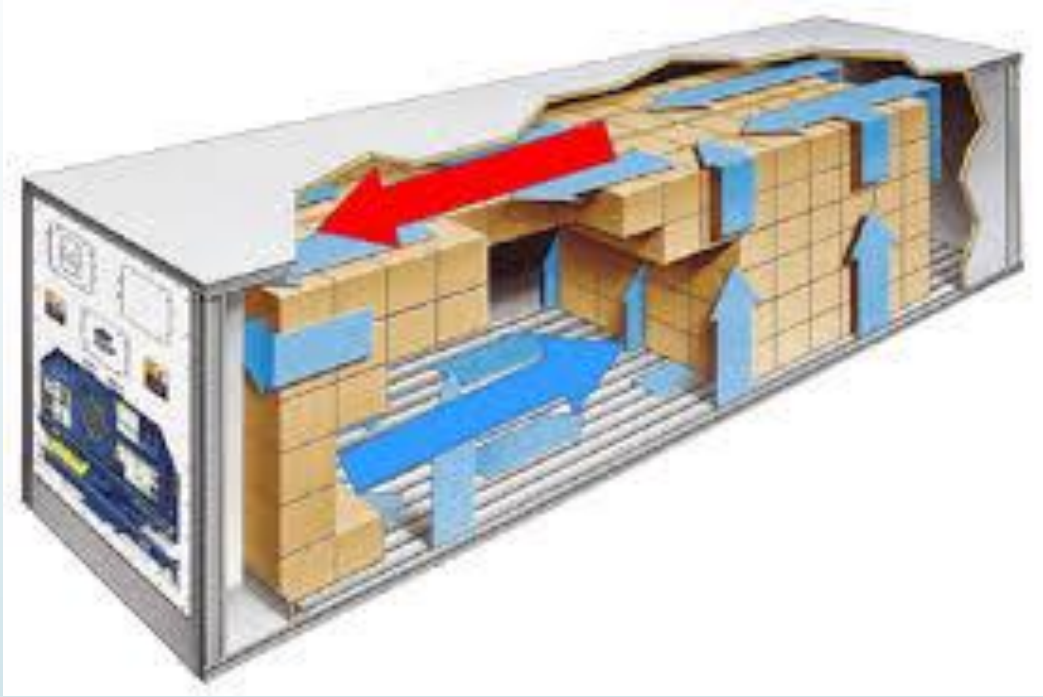
- Industrialization
- Many ideas
- Gap between technology and implementation

Project participants

- Koos Bouwer and Dr Malcolm Dodd
- Johan Strydom
- Logistics Students (Hons)
  - 2015: Janita Pieterse and Tertius Bruwer
  - 2016: Tessa Myburgh and Nicholas Bridge
  - Dr Leila Goedhals-Gerber (US)
- Industrial Engineering
  - 2016: Stephan Nel
  - Dr Louis Louw (US)
- Many other industry inputs

Reefer Container

- Most used: 40’ Hi cube
- Assume as given:
  - Dimensions (volume)
  - Payload restrictions (Tare)
  - Refrigeration capacity



Constraints

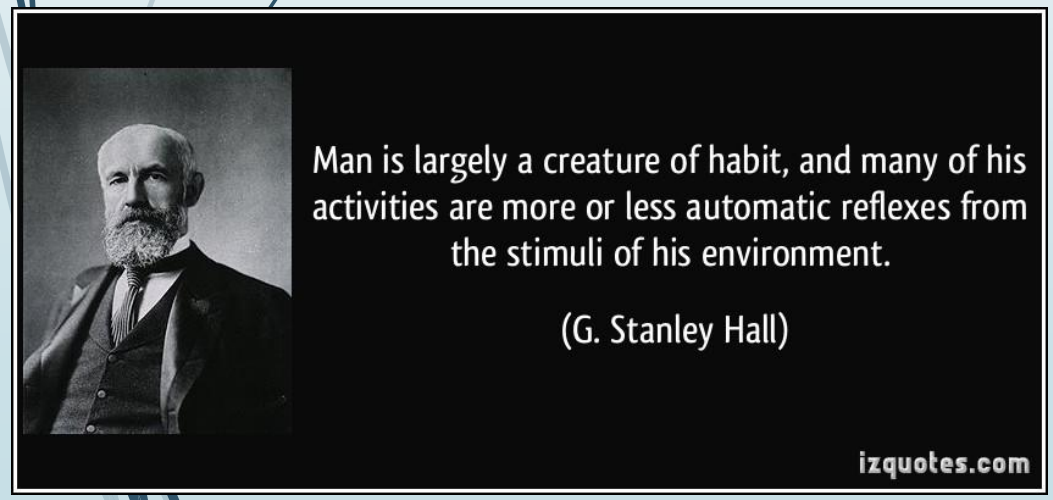
- Historical constraints
- The reefer container:
  - Internal dimensions and usable volume
  - Refrigeration capacity
  - Airflow dinamics
- Road freight constraints;
  - Total mass, axle mass
  - Dimensions: height, width, length (vehicle)
- Fruit quality (temperature, RH, fresh air)
- Material handling (total supply chain)

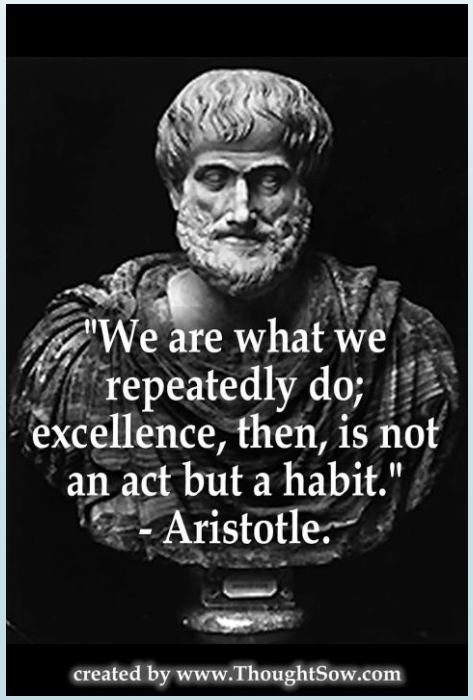
Constraints (…2)

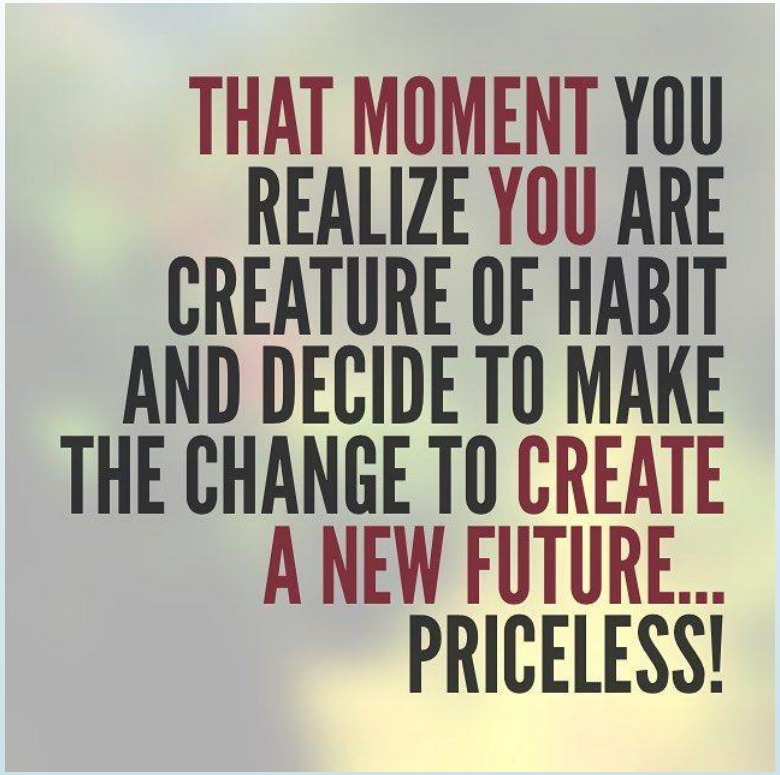
- Packaging
  - Modular units (size and weight)
  - Palletization (size)
  - Refrigeration airflow
  - Product marking and branding
  - Environmental impact of packaging material
- Economic forces
  - Cost of change
  - Freight rates
  - Packaging changes
  - "Share the harvest"

Historical Overview

- Palletization
- Containerization
  - Vertical airflow
  - Space utilization
- HI Cube Containers
- Ref. Johan Strydom

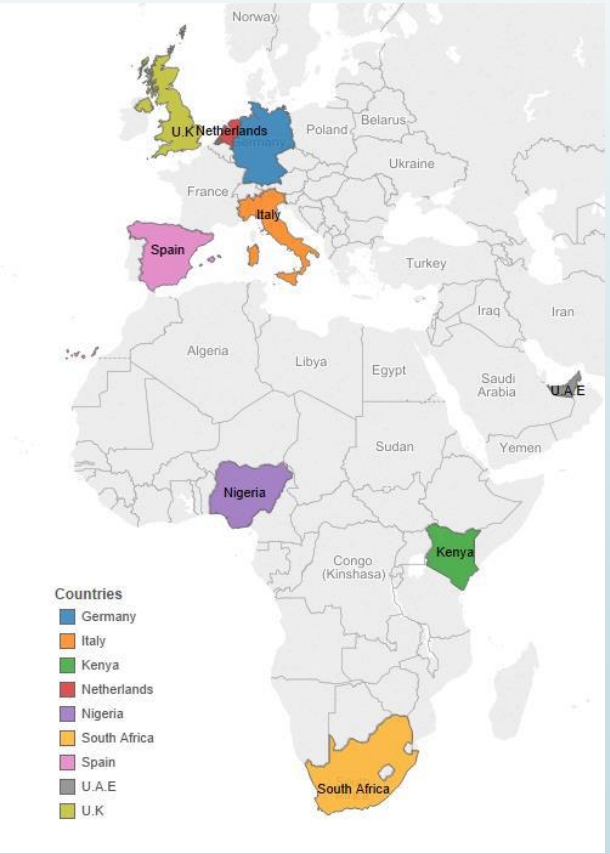




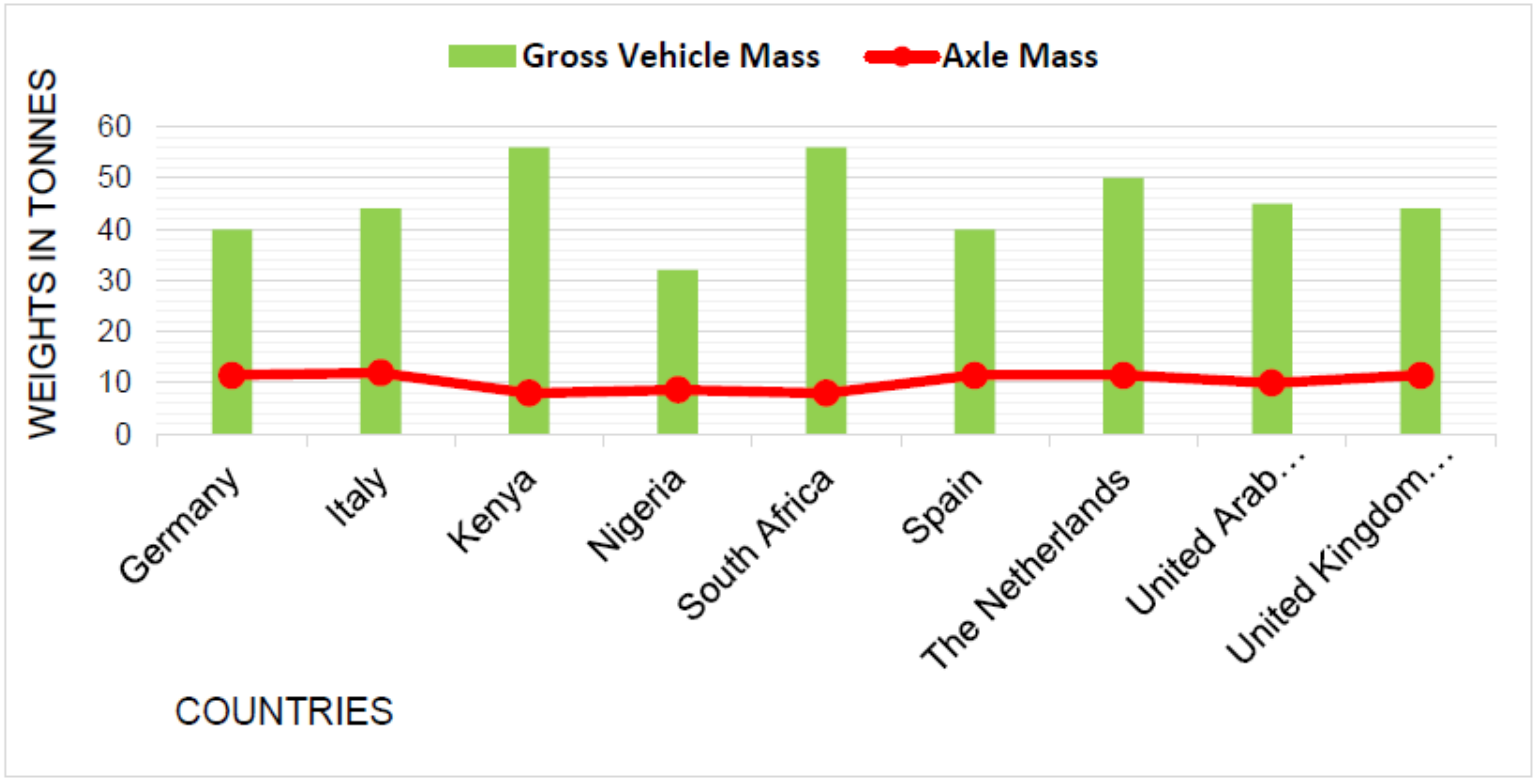


Road Transport Constraints

- Logistics students (Hons): 2015
- Janita Pieterse and Tertius Bruwer

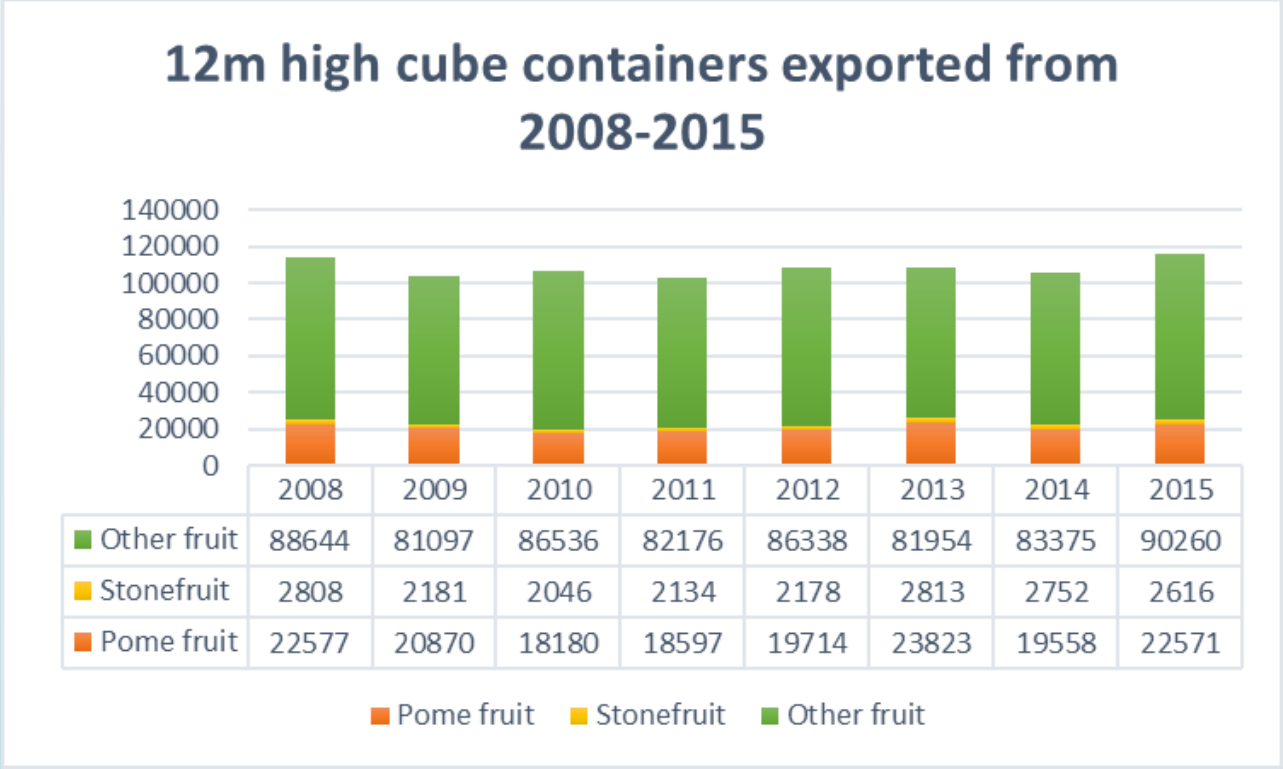


COUNTRIES	MAXIMUM DIMENSIONS AND WEIGHT OF VEHICLES				
	HEIGHT	WIDTH	LENGTH	GROSS VEHICLE MASS	AXLE MASS
	METERS			TONNES	
Germany	4.00	2.55	18.75	40	11.50
Italy	4.00	2.55	18.75	44	12.00
Kenya	4.20	2.65	22.00	56	8.00
Nigeria	3.25	2.59	18.29	32	8.64
South Africa	**4.30**	**2.60**	**18.50**	**56**	**8.00**
Spain	4.00	2.55	18.75	40	11.50
The Netherlands	4.00	2.55	18.75	50	11.50
United Arab Emirates	4.20	2.60	20.00	45	10.00
United Kingdom (U.K)	4.95	2.60	18.75	44	11.50



Macro Container Analysis

- Logistics Student (Hons): Nicholas Bridge (2016)
  - Global reefers: Approx. 4m (FEU)
  - South African Fruit Exports: 115 000 (FEU)
  - Pome Fruit: 22 500 (FEU) 2015
  - Stone Fruit: 2600 (FEU) 2015



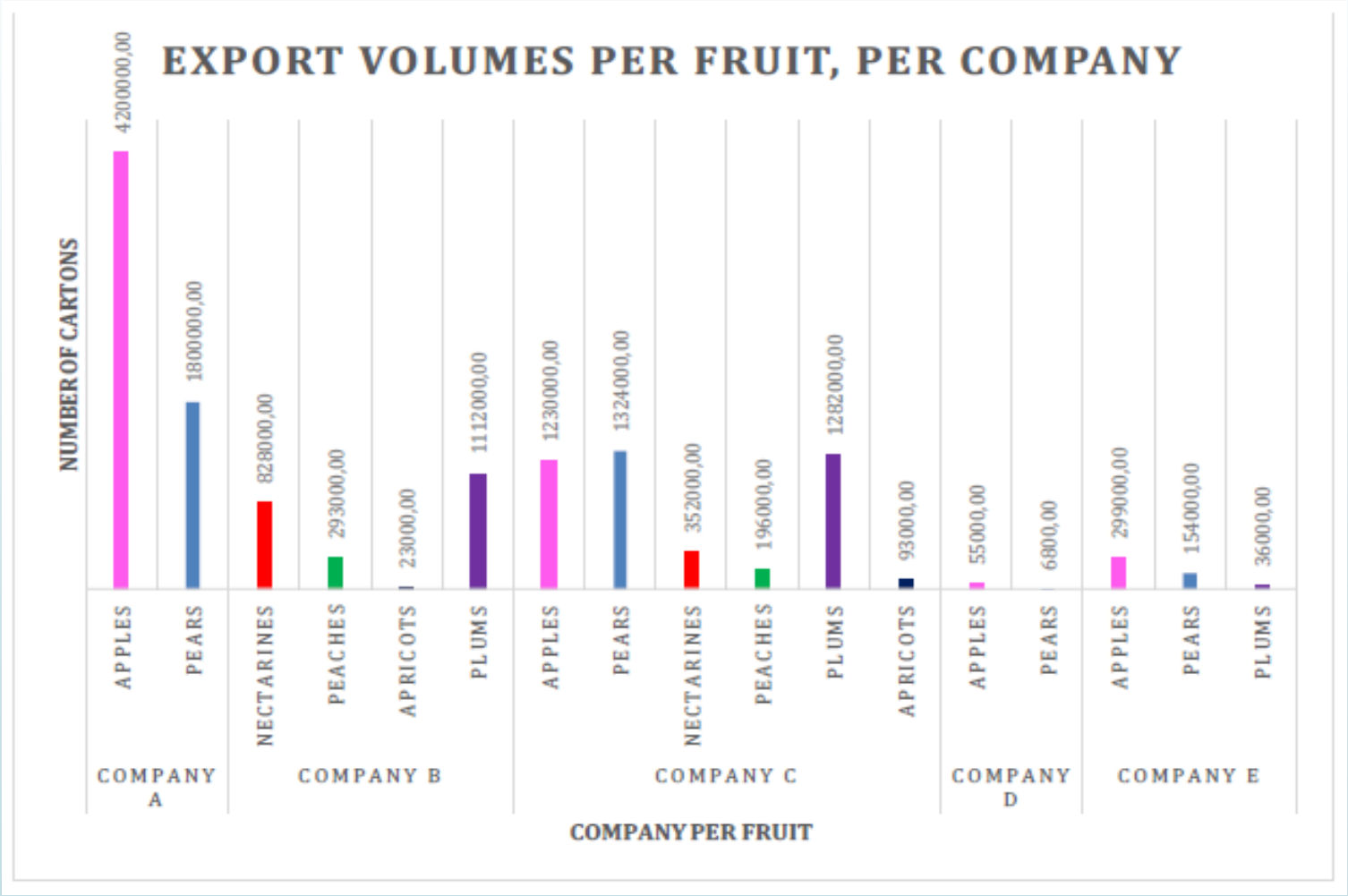
	2008	2009	2010	2011	2012	2013	2014	2015
Other fruit	88644	81097	86536	82176	86338	81954	83375	90260
Stonefruit	2808	2181	2046	2134	2178	2813	2752	2616
Pome fruit	22577	20870	18180	18597	19714	23823	19558	22571

Reefer Cost Chain

APPLES	Region							
	UK	EU	Russia	USA	Canada	Middle East	Far East	Nigeria
	London Gateway	Rotterdam	St. Petersburg	Newark	Montreal	Jebel Ali	Port Kelang	Apapa
Costing per container (12m high cube)								
Transport from Cold Store to Port	4298	4298	4298	4068	4298	4298	4068	4735
Port Costs (Terminal Handling, etc)	6371	6321	6353	10019	6378	6479	10069	10372
Levies	1953	1953	1953	2142	1953	1953	2142	2139
Deep Sea Shipping to Destination Port	61760	68524	72000	87463	78417	45161	38982	48957
Port Costs (Terminal Handling, etc)	13557	15200						
Customs, duties, etc	28391	22400						
Transport from Port to Wholesaler/Retailer	5624	4400						

Micro Container Analysis

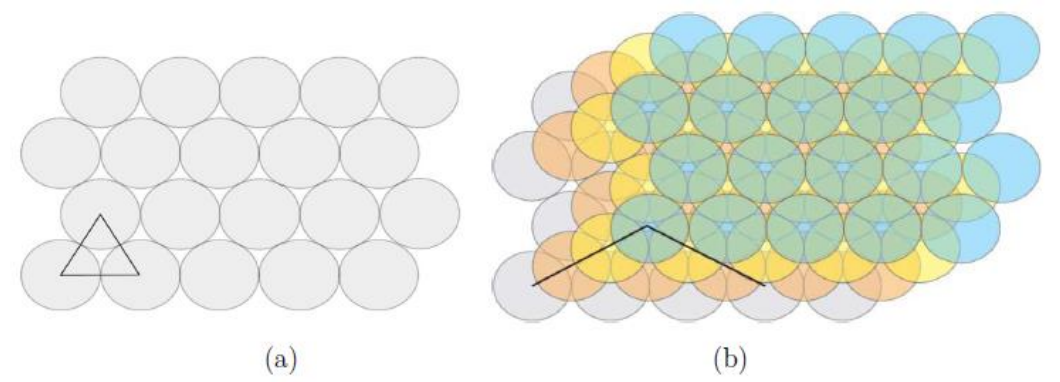
- Logistics Student (Hons): Tessa Myburgh (2016)

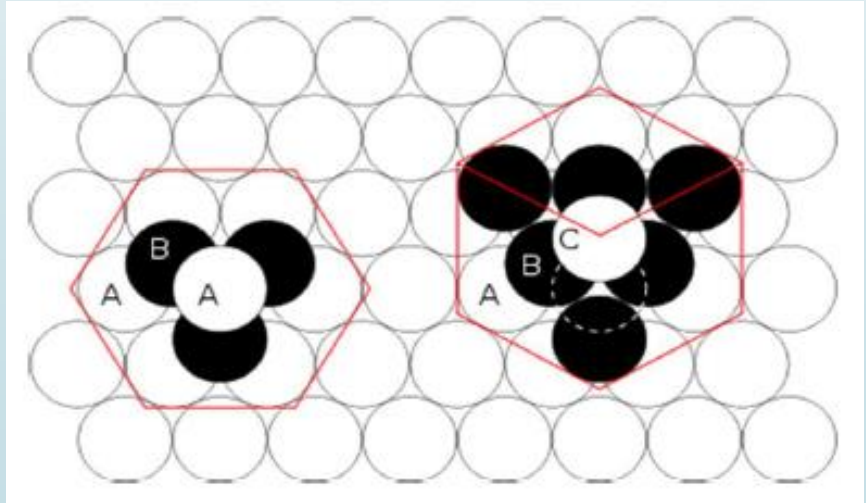


Container load Optimization

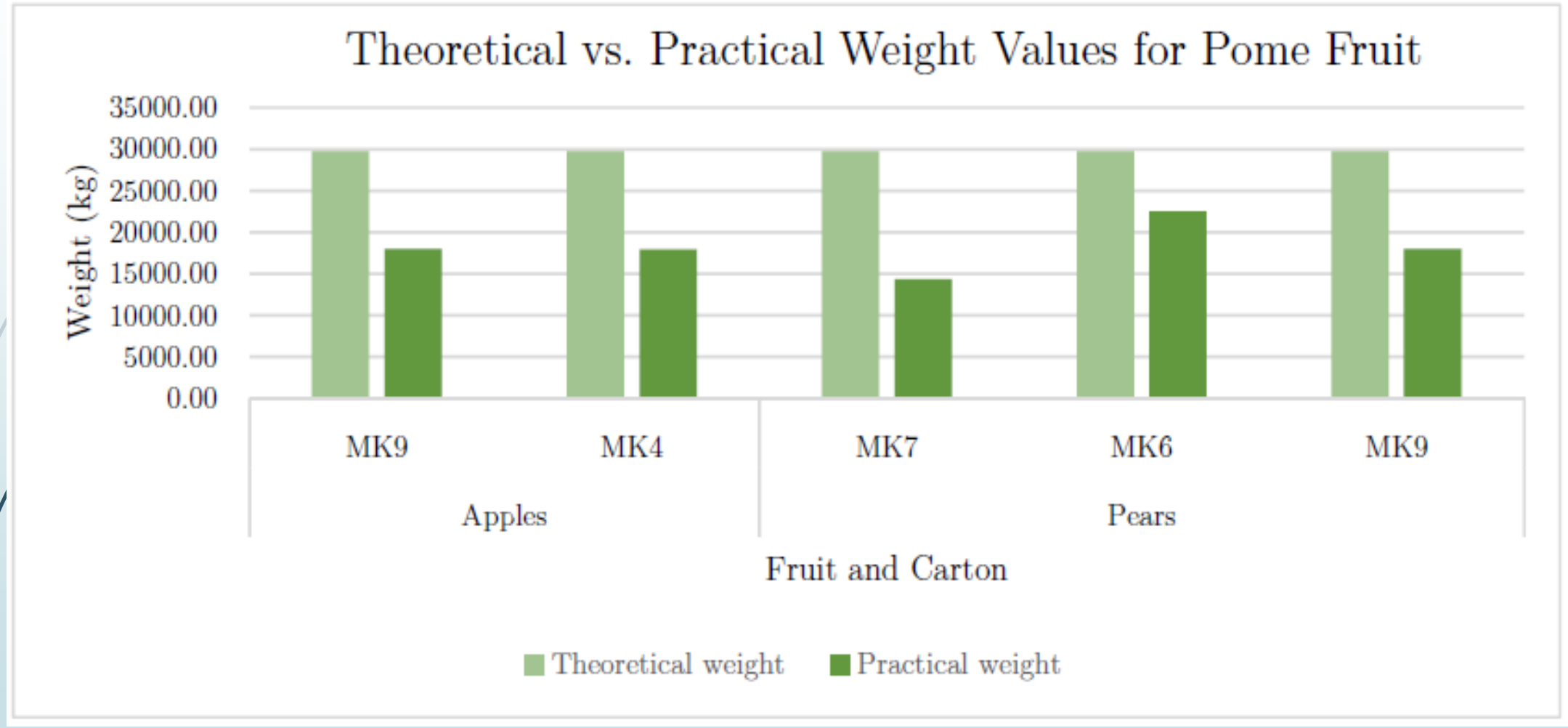
- Industrial Engineering student: Stephan Nel (2016)

- No Restrictions: 28 ton apples in 40'Hicube
- Improve with Optimal sphere packing: 38 ton
  - Kepler's Conjecture
  - Face Centred Cubic (FCC)
  - Hexagonal Close Packed (HCP)



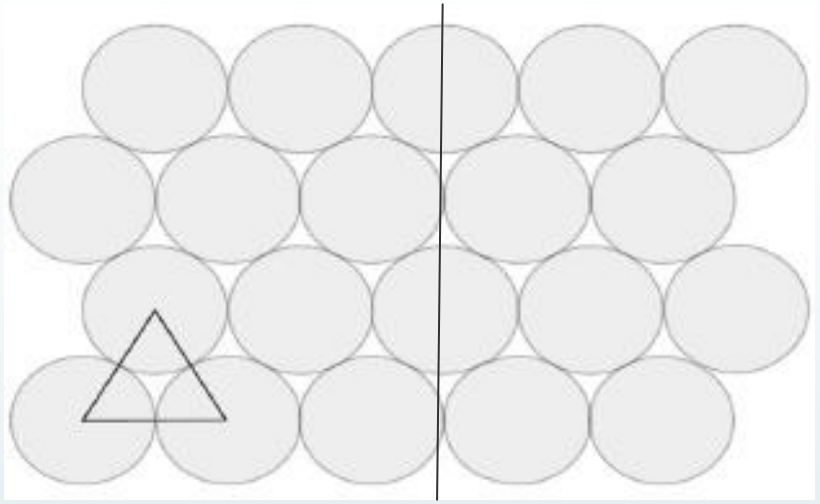


Current Container Utilization: Pome



Reasons for Difference

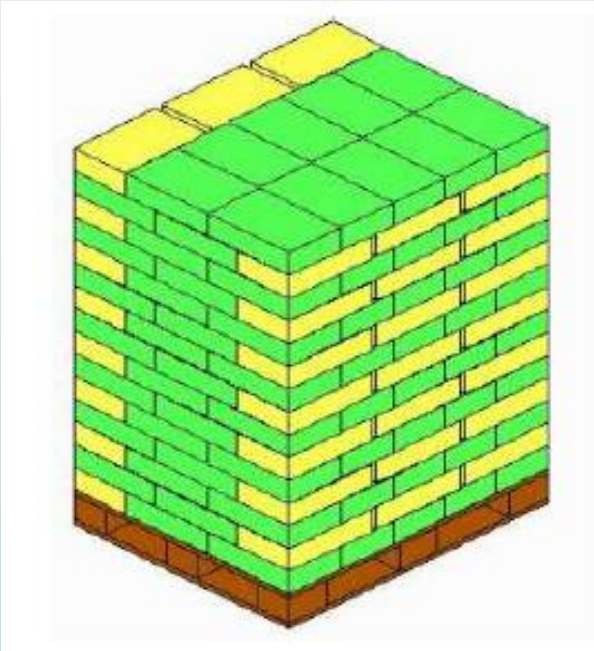
- Edge effects
  - Fruit loss
  - Quantity of edges in container
    - Mk9 carton: 30 x 5 x 15
  - Thickness of edge
    - Telescopic (double)
    - Air gaps
- Material handling time
  - Pallet bases
  - Carton sizes
- Fruit Bruising

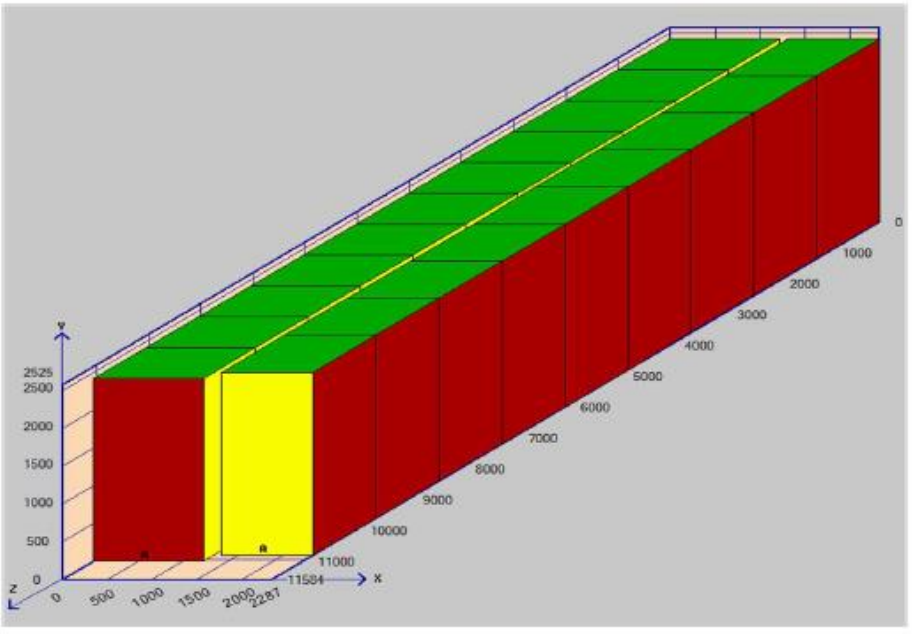


BREAKTHROUGH !

Packing module optimization

- Goal software (Gower Optimal Algorithm Ltd)
  - Pallet manager – Optimal pallet loading
    - Pallet loading problem (Ops Research)
  - Cargo Manager – Optimal container loading
    - Container Loading problem (Ops Research)





Opportunities: Pome Fruit

- Option 1: Euro Pallet or 21 pallet: Save 2.5%
- Option 2: Reduce weight of packing material: Save 3%
- Option 3: Reduce pallet height: Save 4-6%
- Option 4: Optimal carton size (bigger cartons, less edge-effect)
- Option 5: Optimal pallets: (e.g. 2200 x 1200) Save 15 – 17%
- Option 6: Combinations of above: Save up to 25%

Saving %:	5%	10%	15%
Net Farm Income	**+8%**	**+16%**	**+24%**
Pome Industry	**R135m**	**R270m**	**R405m**

Action Plan

- Challenge historic habits and standardization

  Escape from the comfort zone and implement innovative ideas

- Need Multi-disciplinary systems approach

  Exporters, packaging designers/manufacturers, packhouses, refrigeration, information systems, logistic handlers, etc.

  Some supply chain links may cost more and is a barrier for the whole to benefit

- Can only be managed from Industry Organization

  (FPEF, Hortgro, SATI, etc.)

  Need somebody to act on behalf of the whole so that everybody can benefit - "Share the harvest"