final report

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Shelf life of Lamb primals in domestic retail and export market

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Executive summary

Australian vacuum beef and lamb products have excellent shelf lives with beef reaching 160 days, and lamb reaching 90 days. However, lamb exporters struggle to justify to importing countries that TVC results above 1,000,000 cfu/cm^2 are normal in vacuum lamb products, which will have abundant shelf life remaining. In addition local retailers are still using micro counts as a means to justify the end of shelf life.

This project validated the lamb shelf life using microbiological and organoleptic criteria, and the MLA Shelf life model. The shelf life model will allow businesses to justify to other markets organoleptic quality as the main criterion for end of shelf life.

The project simulated 3 supply chains from establishment to distribution centres, then to further processing plants, and finally to domestic and export markets. Lamb cuts were stored at appropriate temperatures, times and included data loggers in each pack to verify actual temperatures at each stage of the chains before withdrawing replicates cuts for sensory and microbiological testing.
The results show that vacuum-packed lamb products within the domestic and export supply chains leave the plant with low bacterial levels and that these rise during the supply chains to the normal levels associated with the growth of desirable lactic acid bacteria, while providing ample shelf life for distribution in the retail and export customer supply chains.

The present study will:

- Inform the business on how the microbiological and sensory profiles of products can be monitored to validate that the supply chain will service customer requirements for shelf life.
- Assist the business's sales staff in dealing with domestic and export customers.
- Help export customer understand the role of bacteria in vacuum product using the individual reports and start dialogue.
- Form the basis for discussing with customers the possibility of reducing the testing requirements, based on accumulated data.
- Introduce the ability of the shelf life model to demonstrate the impact of temperature on shelf life to customers.
- Provide the opportunity for business's to propose the shelf life model as an alternative for ongoing testing requirements.

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1 Background

Australian vacuum beef and lamb products have excellent shelf lives with beef reaching 160 days, and lamb reaching 90 days. However, lamb exporters struggle to justify to importing countries that TVC results above 1,000,000 cfu/cm^2 are normal in vacuum lamb products, which will have abundant shelf life remaining. In addition local retailers are still using micro counts as a means to justify the end of shelf life.

This project will validate the lamb shelf life using microbiological and organoleptic criteria, and the MLA Shelf life model (as described in https://www.mla.com.au/globalassets/mla-corporate/research-and-development/program-areas/food-safety/pdfs/guide-to-data-loggers-and-the-shelf-life-model-v3.pdf). The shelf life model will allow businesses to justify to other markets organoleptic quality as the main criterion for end of shelf life. It will be used to break the perceived linkage between shelf life correlated with total bacteria count in product, and has the potential to change current supply chain practices such as a move from air freight to shipping, or storage conditions.

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2 Project objectives

The objective of the project is to confirm and validate the shelf life of chilled lamb product and use the data to prove the product can go beyond the imposed micro limits, other objectives within the project includes:

- Reducing shelf life validation requirements
- Support/change in shelf life validation requirements (eg TVC/Micro)
- Understanding and changing perception of the Japanese importer
- Presentation of the results to red meat industry at the MIQA conference.

3 Methodology

- Simulated two supply chains (retail ready and further processing) from the plant distribution centres or further processing or export market
- Stored cuts at appropriate temperatures and times and included data loggers in each pack to verify actual temperatures at each stage of the chains before withdrawing replicates cuts for sensory and microbiological testing
- A sensory team of six assessors from the QA Department undertook end of shelf life testing in the company laboratory.
- Tested cuts stored for important periods for Aerobic Plate Count (APC), Enterobacteriaceae and E. coli.

- Used the data logger information as inputs to the UTas predictive tool to model shelf life remaining

4 Results

4.1 Domestic supply chains

Cuts of lamb and mutton, mostly under vacuum to the food service trade, supermarkets and butchers were procured from an abattoir in Melbourne and an independent boning room in Melbourne. There are two supply chains:

1. Retail ready products supplied to supermarket distribution centres (DCs) and to other customers
2. Products for further processing supplied to processors in Victoria, New South Wales and Queensland

Table 1 shows a typical storage of Retail Ready products from processing to storage in a home refrigerator.

Table 1: Supply chain of retail ready products

Supply chain simulated	Days	Temperature (°C)
Slaughter/chilling	1	4
Hold on plant	4	-1.0
Transport to DCs	1	2
Store at DC	3	2
Transport to stores	3	2
Retail display/home storage	2	6

Table 2 shows the maximum storage of products from initial processing through to storage at further processing facilities; note that product may be held before further processing for up to 20 days from date of kill.

Table 2: Supply chain of products intended for further processing

Supply chain simulated	Days	Temperature (°)
Slaughter/chilling	1	4
Hold on plant	5	-1.0
Transport to processing facility	1	1

Storage at processing facility	13	0.5-1

4.2 Export air freight supply chains

Vacuum-packed lamb cuts shipped by airfreight destined for two export destinations: Japan and Europe in Unit Load Devices (ULDs) to maximise product packing and to minimise time of loading and unloading were procured.

Simulating commercial conditions, product is transported from the processing plant to the freight forwarder for loading into a ULD within 24 hours of boning and packing. At the freight forwarder the ULD is lined with an insulating blanket (Fig 1), a carpet of dry ice is laid, product is loaded and dry ice in cartons (ca 50kg) added on top of product.

Fig 1*: Insulated interior of UDL*

As seen from Tables 3 and 3a, product temperatures can vary considerably, depending on the distance of the data logger from the dry ice.

Times from launching the data logger to receival in the cold store of the customer can also vary, as can the remaining shelf life, though ample remains for retailing.

Table 3: Airfreight temperature:time and shelf life remaining in product to Japan (n=11)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	0	4.3	24
Minimum	-4.3	3.2	23
Maximum	3.7	6.3	27

Table 3a: Airfreight temperature:time and shelf life remaining in product to Europe (n=45)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	0.7	3.9	22.8
Minimum	-4.7	3.1	18
Maximum	6.2	5.9	25

4.3 Export sea freight supply chains

4.3.1 Japan

From Table 4 it can be seen that the average Australia-Japan journey is around 26 days from Melbourne to Japan, varying between 21 and 34 days.

Table 4: Sea freight temperature:time and shelf life remaining in product to Japan (n=166)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	-0.5	26.5	26
Minimum	-1.5	21	21
Maximum	2.5	34	34

Information from two Japanese supermarket chains (summarised in Table 5) states that product resides in the Japanese cold store/processing facility and is packed and released over the next 3-7 days for a final two-day retail period with a shelf life displayed at 72h.

Table 5: Typical cold chain from Australian meat establishment to Japanese supermarket

	Days	
	Minimum	Maximum
Container loading	0	0
Transport to vessel	1	2
Voyage to Japan	16	19
Customer cold store	3	7
Supermarket	2	2

Total	22	30

4.3.2 Europe

Australia-Europe routes are the longest and may involve trans-shipment in Singapore or Tanjung Pelepas for westbound voyages, or in Cartagena (Colombia) for eastbound voyages, resulting in an establishment-customer time up to 54 days. As may be seen from Table 6 predicted shelf life for some consignments was zero, resulting from long voyages (48 days) and "warm" temperatures (+1.9°C and +1.3°C). It should be emphasised that both consignments were retailed without any negative response.

Table 6: Sea freight temperature:time and shelf life remaining in product to Europe (n=21)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	-0.3	45.4	12
Minimum	-1.1	39	15
Maximum	1.9	54	0

4.3.3 USA

Voyages from Australia's east coast to USA west coast vary according to routing from 21-35 days, with a scheduled time to Long Beach and Oakland California averaging 26-30 days (Table 7). Remaining shelf life for the ten consignments monitored was 14-20 days.

Table 7: Sea freight temperature:time and shelf life remaining in product to USA (n=10)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	-0.98	27	22
Minimum	-1.77	26	24
Maximum	-0.03	30	18

4.3.4 China

No data loggers for products were recovered from Chinese customers and six voyages between Brisbane and Chinese ports are presented in Table 8.

There was great variation in abattoir-customer data, in terms of mean temperature aboard, transport time and shelf life remaining at 4°C.

Table 8: Sea freight temperature:time and shelf life remaining in product to China (n=6)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	-0.8	30	20
Minimum	-1.5	23	24
Maximum	0.4	33	15

In January 2016 the Australian industry provided Chilled Meat Supply Chain seminars in China to importers and gained feedback as to how long importers considered they needed to use a chilled consignment.

The information (Fig 2) documents the belief that extremely long shelf lives are expected of Australian chilled beef, temperature fluctuations through the cold chain notwithstanding; it may be that similar expectations exist for chilled lamb.

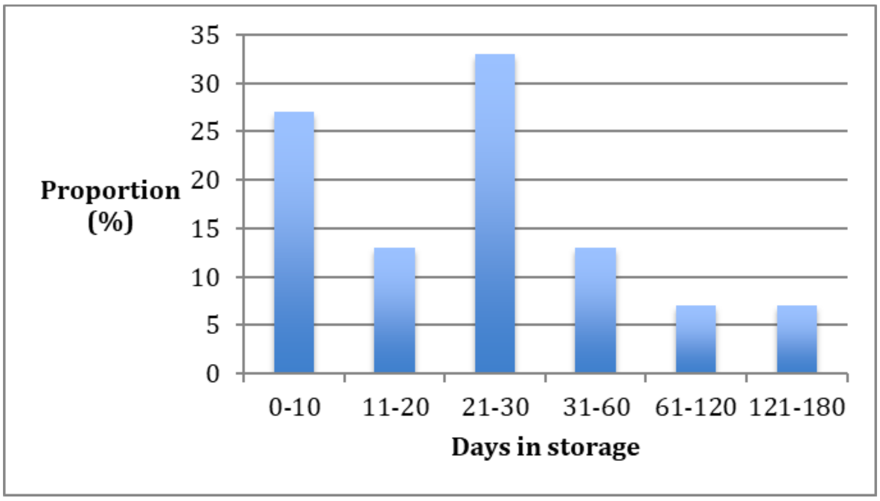


Fig 2: Expectations of Chinese importers on time needed to utilise a consignment of chilled meat from Australia

Chinese importers also listed perceived impediments to using chilled meat including:

- The storage and logistic facility are not mature enough
- Market competition
- No existing selling channel
- Hard to operate and control
- Hard to source the product
- The selling channel is not professional
- The risk is too high as the logistic system in China is not mature
- The logistic and storage are problems
- Without processing condition to keep the product quality, they are considering pre-pack

product.

4.3.5 Middle East

No data loggers could be recovered from customers in the Middle East and, in Table 9 are presented data from another exporter of vacuum packed lamb cuts.

A feature of the six voyages monitored was that mean temperatures were generally higher than for voyages monitored to the other four major markets. In addition voyage times were long, generally involving one week's delay in trans shipment in Malaysia or Singapore.

As a consequence, remaining shelf life at 4°C was between 6-18 days.

Table 9: Sea freight temperature:time and shelf life remaining in product to UAE (n=6)

	Mean temperature °(C)	Transport time (days)	Shelf life remaining at 4°C
Mean	0.8	33.5	8
Minimum	-0.5	19	6
Maximum	1.9	37	18

4.4 Supply chain 1 (retail ready)

4.4.1 Sensory results

A sensory team of six assessors from the QA Department undertook assessments in the company laboratory. Both products (Shoulder roast and Shanks) had been subjected to significant temperature abuse to simulate storage in the home fridge at 8°C for 5 days (Table 10).

Table 10: Mean attribute scores for retail ready cuts (n=5) by an informal sensory panel

	Mean scores for each attribute	
	Shoulder roast	Shank bone-in
Overall appearance	4.0	4.7
Vacuum	4.0	4.8
Colour after 5 minutes	4.8	4.7
Odour after 5 minutes	5.0	4.3
Average	**4.5**	**4.6**

On piercing the vacuum a slight confinement odour was noted for shanks, which disappeared after 5 minutes; slight colour loss under vacuum was reversed after 5 minutes when the bloom returned.

In summary, the panel considered both products acceptable, despite the temperature abuse incurred.

4.4.2 Microbiological profiles

Mean APCs exceeded $\log_{10}$ 7.1/cm^2 (10,000,000 cm^2) reflecting time spent at 8°C to simulate extended time (5 days) in the home fridge after 4 days in retail display.

Psychrotrophic *Enterobacteriaceae* also grew to exceed $\log_{10}$ 4/cm^2.

E. coli was not recovered from any of the five samples (Table 11).

Table 11: Microbiological condition of retail ready cuts (n=5) in a simulated supply chain involving significant temperature abuse

Cut	APC		*E. coli*		*Enterobacteriaceae*	
	Mean	SD	Prevalence (%)	Mean*	Prevalence (%)	Mean*
Bone-in shank	7.10	0.24	0	-	100	4.0
Shoulder roast	7.12	0.41	0	-	100	4.0

* The mean is of positive samples only

4.4.3 Predictions using the UTas tool

We interrogated the UTas predictor tool to determine how shelf life is affected by storage phases within the Retailers domain. The shelf lives remaining in the table below are the result of various temperature:time combinations following transfer of cuts from plant to the retailers DCs.

In this regime we used early temperature:time data from the kill floor through to load out for delivery to the DC, then inserted what we believe are realistic temperatures and times through to the consumer based on worst-case scenarios:

- Holding in the Retail chiller over a long weekend at -1°C
- Distribution to a DC in Western Australia at a mean temperature of 1°C
- Storing product back of house until needed in retail display: 4 days allowed
- Displaying for 3 days

A summary of elapsed time, temperature and predicted bacterial counts using the UTas predictor are included in Table 12.

Table 12: Temperature:time relations and predicted bacterial counts from date of kill to 20 days in the Retailers supply chain (UTas predictor tool)

Phase	Mean temperature (°C)	Time (d)	APC (cfu/cm^2)
Kill-load out	5 to -0.1	6	840
Transport to DC	1	3	2,800
Store at DC	2	3	14,000
Transport to store	1	1	21,000
Store back of house	2	4	182,000
Retail display	5	3	4,270,000
Total		20	

Under the above scenario the consumer is buying the product 20 days after DOK and has ample remaining shelf life, depending on the temperature of the consumer's fridge (Table 13).

Table 13: Predicted shelf-life remaining at various temperatures in the home fridge (UTas predictor tool)

Storage temperature in home fridge (°C)	Remaining shelf life (days)
3	18
4	15
5	12

4.5 Supply chain 2 (cuts for further processing)

4.5.1 Sensory results

An informal sensory team comprising six assessors from the QA Department undertook assessments in the company laboratory after 20 days of storage (Table 14).

Table 14: Mean attribute scores for cuts intended for further processing (n=5) by an informal sensory panel

	Mean scores for each attribute	
	Denuded racks	Boneless legs
Overall appearance	4.8	4.0
Vacuum	4.8	5.0
Colour after 5 minutes	5.0	4.8
Odour after 5 minutes	5.0	4.8
Average	**4.9**	**4.7**

On piercing the vacuum there was no confinement odour and colour was good after opening of the pack.

In summary, the panel considered both products acceptable.

4.5.2 Microbiological profiles

After 20 days storage mean APCs were $\log_{10}$ 2.88/cm^2 (758 cfu/cm^2) and $\log_{10}$ 3.57/cm^2 (3715 cfu/cm^2) for Denuded lamb racks and Butterflied (boneless lamb legs) stored for 20 days at temperatures and times typical of those in the supply chain to Retailers' processing plants in Victoria and NSW (Table 15).

Psychrotrophic *Enterobacteriaceae* were recovered from all 5 stored samples at mean $\log_{10}$ 0.81/cm^2 and $\log_{10}$ 1.38/cm^2 on Denuded racks and Butterflied legs, respectively (Table 15).

E. coli was recovered from 20% of Butterflied lamb leg and 60% of Denuded lamb rack samples, at extremely low concentration (Table 15).

Table 15: Microbiological condition of cuts intended for further processing (n=5) in a simulated supply chain involving significant temperature abuse

Cut	APC		*E. coli*		*Enterobacteriaceae*	
	Mean	SD	Prevalence (%)	Mean*	Prevalence (%)	Mean*
Denuded rack	3.57	0.41	60	0.20	100	0.81
Butterflied leg	2.88	0.54	20	-0.60	100	1.38

* The mean is of positive samples only

4.5.3 Predictions using the UTas tool

In Table 16 are presented inputs to, and predictions from, the UTas predictor tool based on ingoing APC of 100 cfu/cm^2. The APC at delivery to Retailers' NSW (furthest) DC is 1,890 cfu/cm^2 and the shelf life varies from 38 days (at mean storage of 2°C) to 12 days (mean storage 8°C).

Table 16: Predicted storage life of boneless VP shoulders – effect of temperature in retail and consumer phases

Storage in Retailers/consumer phases (°C)	Shelf life remaining (days)
2	38
4	24
6	16
8	12

4.6 Supply chain 3 (export)

4.6.1 Sensory analysis

A sensory team of seven assessors from the QA Department undertook sensory testing in the company laboratory after 1, 20, 47 and 50 days of storage.

On piercing the vacuum pack, there was noticeable confinement odour at the 47-day and 50-day tests, but this dissipated within 5 minutes and, within a few minutes of opening the pack, the colour returned to each cut.

The results show mean sensory scores were always greater than 4.0, indicating very acceptable sensory quality all through the supply chain.

In summary, the panel considered both products acceptable for the maximum 50-day time required in the specifications.

4.6.2 Microbiological profiles

We tested cuts stored for important periods for Aerobic Plate Count (APC) as an indicator of general process hygiene and for *E. coli*, a faecal indicator.

Mean Aerobic Plate Counts (APCs) varied through the storage trial, starting at $\log_{10}$ 2.4/cm^2 (280/cm^2) for both products at the packing stage.

On landing in Japan the count was $\log_{10}$ 4.16/cm^2 (14,400/cm^2) for boneless shoulders and $\log_{10}$ 3.2/cm^2 (1,585/cm^2) for shoulder racks.

At 30 days it is the practice of the customer to undertake a bacterial count, and this was done as part of our trial. At 30 days the APC was $\log_{10}$ 4.98/cm^2 (95,500/cm^2) for shoulder racks and $\log_{10}$ 3.46/cm^2 (2880/cm^2) for boneless shoulders.

After 47 days storage, the latest day when cuts would be used for further processing the APC was $\log_{10}$ 6.48/cm^2 (3,020,000/cm^2) for shoulder racks and $\log_{10}$ 6.09/cm^2 (1,230,000/cm^2) for boneless shoulders.

Finally, after 3 days retail display the APC was $\log_{10}$ 7.26/cm^2 (18,200,000/cm^2) for shoulder racks and $\log_{10}$ 6.09/cm^2 (1,000,000/cm^2) for boneless shoulders.

E. coli was recovered from 20% of shoulder racks and 15% of denuded rack samples, at concentrations ranging from 0.3-3.0 cfu/cm^2.

Apparently “high” counts (greater $\log_{10}$ 7.0/cm^2 (10,00,000/cm^2) are consistent with those obtained in vacuum-packed meat products stored under refrigeration for long periods, the vast proportion of which are Lactic Acid Bacteria (LAB) (Egan *et al.* 1983).

More recently, Kiermeier *et al.* (2013) showed that high counts in VP lamb cuts preceded end of shelf life by several weeks and that the major bacteria were *Carnobacterium*, a genus with probiotic qualities often found in yoghurt.

4.6.3 Remaining shelf life of retail products: predictions using the UTas tool

In Table 17 is presented predicted shelf life remaining to the consumer of retail products manufactured from boneless shoulders and shoulder racks. The available shelf life depends on the storage temperature of the home refrigerator but appears ample for consumption by Japanese consumers.

Table 17: Predicted storage life of retail packs prepared from boneless shoulders and shoulder racks – effect of temperature in consumer phase

Storage in consumer phase (°C)	Shelf life remaining (days)	
	Boneless shoulders	Shoulder racks
4	10	12
5	8	10
6	7	8

5 Conclusions/recommendations

5.1 Conclusion

The project achieved the set objectives and indicates that vacuum-packed lamb products within the Domestic and export supply chain:

1- Leave the plant with low bacterial levels and that these rise during the supply chains to the normal levels associated with the growth of desirable lactic acid bacteria.
2- Maintain a high level of sensory acceptability through the entire storage period.
3- Provide ample shelf life remaining for distribution in the retailers supply chain
4- Customers have ample time for using the product.

This proves product can achieve greater shelf life based on organoleptic as opposed to the current labelled shelf life, however the low bacterial specification set by customers restricts this.

5.2 Recommendations

- Use the individual report to support changes within the company and train internal sales staff for opportunity to increase remaining shelf life for customers.
- Help export customer understand the role of bacteria in vacuum product using the individual reports and start dialogue for customised specifications.
- Reduce or remove the amount of testing currently imposed by both domestic and export customers by using the report as a basis.
- Gain access and use the shelf life model to demonstrate the impact of temperature on shelf life to customers.
- Use the shelf life model as an alternative for ongoing testing requirements when no changes have occurred within the processing or product.
- Automation or easier access to the shelf life tool to avoid the need to download/copy paste.

6 Bibliography

Egan, A. & Shay, B. (1983) Long-term storage of chilled fresh meats. In: Proceedings 34th International Congress of Meat Science and Technology. pp 476–481.

Kiermeier, A., Tamplin, M., May, D., Holds, G., Williams, M. & Dann, A. (2013). Microbial growth, communities and sensory characteristics of vacuum and modified atmosphere packaged lamb shoulders. Food Microbiology, 36:305–315.

MLA, Meat and Livestock Australia (2016). Guidelines for developing a method for estimating shelf life of chilled raw vacuumed meat products. North Sydney 2049.

7 Appendix

7.1 Shelf life testing methodology

A. Temperature monitoring

A number of reusable data loggers (DS1921G Fob Fitted Thermochron) were inserted in packs and, at appropriate intervals were downloaded to provide data for insertion in the UTas Shelf Life Predictor tool (version 5).

B. Products tested

For the simulation study we stored packs of Bone-in shoulder racks and Boneless shoulders. Products were stored in various chillers to simulate movement of product through the supply chain as specified in Section 3 of this document.

C. Sensory testing

Assessment was by an informal panel of QA staff. All sensory assessments utilised ordinal scales from 0 (poor performance) to 5 (good performance) based on the national guidelines (MLA, 2016). Prior to opening, each pack was scored for vacuum and packaging integrity and for extent of purge. Each pack was opened with a small cut along the seal and the confinement odour scored, after which the pack was opened completely and the colour and odour assessed after 5 minutes.
Each assessor entered scores and observations on a score sheet as shown in Table A1. All scores and observations were recorded in an Excel spreadsheet,

Table A1: Criteria used by the taste panel when assessing vacuum-packed lamb cuts

Score	Drip	Vacuum	Appearance	Odour
5	None	Complete adhesion	Deep red colour	Fresh
4	Slight	Good	Light red colour	Slight sour/dairy
3	Acceptable	Moderate	Slight discolouration	Sour/dairy
2	Heavy	Poor	Poor colour	Strong sour/dairy
1	Extreme	None/blown	Severe discolouration	Off odours

D. Microbiological testing

7.1.1 Sponge sampling of cuts

After resuscitating a sterile sponge (Whirl-Pak Speci-Sponge) with 25 mL of chilled Butterfields solution areas (100 cm^2) cuts were sponged using firm, back-and-forth strokes both along and across each cut. Swabbed samples were maintained under refrigeration until laboratory testing, usually 1-2 hours after swabbing.

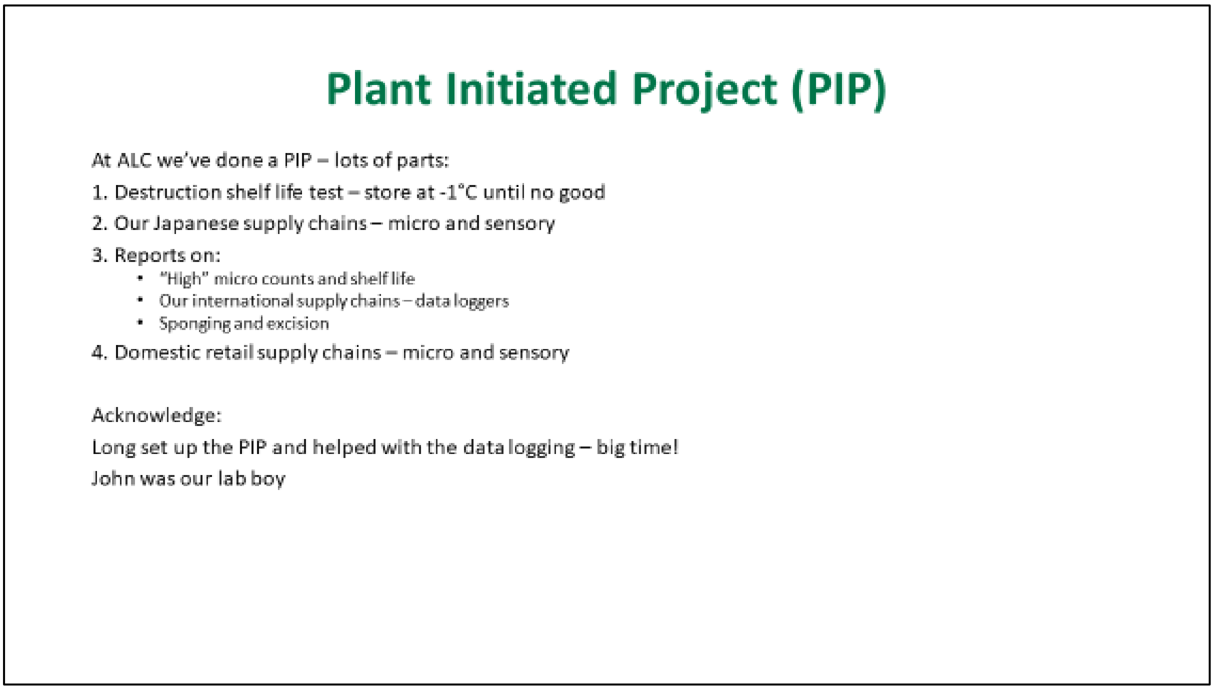
7.1.2 Determination of Aerobic Plate Count (APC) and E. coli

Bacteria were removed from the sponge by "squishing" sponges by hand massage in the sample bags for 30 seconds and, from the moisture expressed, serial dilutions were prepared in 0.1% buffered peptone water blanks (9 mL) using 1mL aliquots. Aliquots (1 mL) from each dilution were spread on Aerobic Plate Count Petrifilm (3M), *E. coli* Petrifilm (3M) and incubated at 25°/96 hours (APC) and 35°C for 48 hours (*E. coli*). Colonies were identified and counted as colony forming units (CFU) as per the manufacturer's instructions.

Counts/cm^2 of meat surface were converted to $\log_{10}$ cfu/cm^2 and the mean and standard deviation of the $\log_{10}$ cfu/cm^2 was calculated using Microsoft Excel software. When no bacteria were recovered from a sample the result was entered as below the limit of detection (0.25 cfu/cm^2).

7.2 MIQA conference 2019 (gold coast) Presentation

Presenters (presentation time 45min) – Angelique Raspin, Amanda Holt, John Sumner, Long Huynh



Roadmap

1. The current system for shelf life testing for domestic customers
2. A new deal

We'll do it conversation style

The way we are

Scope of testing

- Industry needs to do shelf life testing for:
  - Retail ready cuts
  - Cuts for further processing
  - Export products

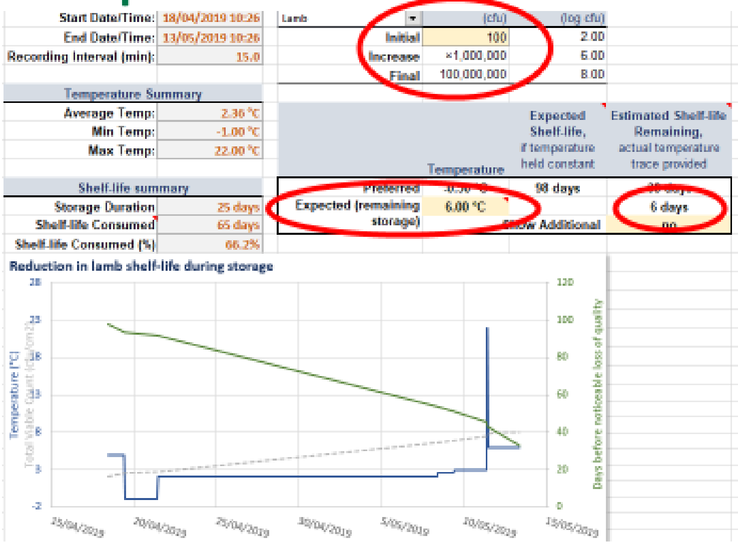
Frequency of testing

- Daily retention samples for each batch and type
- Quarterly at start and end of life
- Annually

Typical supply chain to retail display

Process stage	Temperature (°C)	Time (days)
Slaughter, boning	5	1
Transport to customer	-1	2
Further processing	2	17
Distribution	2.5	1
Retail	3	2
Customer purchasing	22	0.1
Customer	6	2

Mission impossible



Out of spec – Big time

Enterobacteriaceae	<1,000 cfu/g	≥1,000 cfu/g	≥100,000 cfu/g + Sensory
Escherichia coli	<100 cfu/g	≥100 cfu/g	≥100 cfu/g + Sensory
Standard Plate Count	<1,000,000 cfu/g	≥10,000,000 cfu/g	≥100,000,000 cfu/g + Sensory

The story so far

- You start with raw materials with a low count
- You comply with customer requirements for further processing
- You insert typical temperatures and times for the retail supply chain and customer use
- You've spent a grand on meat samples, about $1300 on micro plus staff time and couriers

AND YOU'RE OUT OF SPEC

AND YOU HAVE TO KEEP DOING IT

Shelf life and ESAM testing– What it costs us

Testing type (Micro only)	$/ Year
Shelf life	82,000
ESAM	115,000
Carton trim sample	45,000
Total	**$242,000**

The future - A new deal

We designed a PIP to help get a better system for:

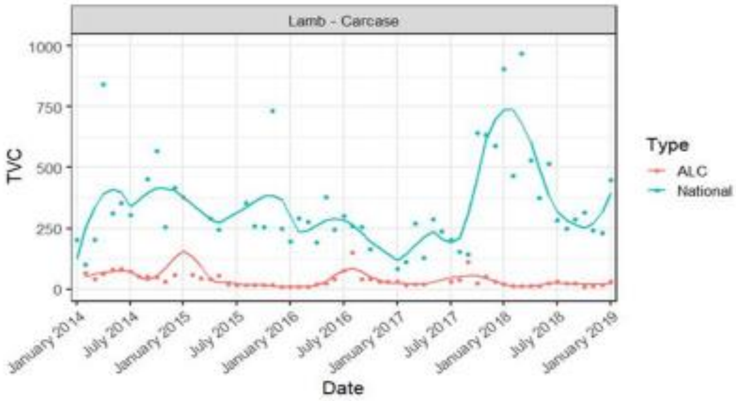
- Us
- Our customers
- Industry

This is what we did:

1. A baseline survey of our products
2. Validation of our supply chains (for Retail Ready, Further Processing and Export products)
3. UTas prediction to see how our shelf life and micro stacked up

Starting material - carcase hygiene - ESAM

Many improvements on plant – our APC looks OK



Baseline survey - cuts

- Ten cuts, five replicates
- APC, *E. coli*, *Enterobacteriaceae*

Cuts	APC (Mean log cfu/cm^2)
All cuts	2.0 (100)
Minimum (Bone-in Loins)	1.7 (50)
Maximum (Bone-in Shoulder)	2.5 (320)

We can safely use 100 cfu for the shelf life tool

Validating our shelf life – further processing

We stored Bone-in denuded racks and Boneless legs, simulating the supply chain from Colac to the retailer's further processing facility, where they can hold product for up to 20 days from DOK before processing it.

Supply chain simulated	Days	Temperature (°)
Slaughter/chilling	1	4
Hold Colac	5	-1.0
Transport to processing facility	1	1
Storage at processing facility	13	0.5-1

After 20 days we did sensory and micro testing and downloaded data loggers from each carton.

Validating our shelf life – sensory testing

We used the MLA's national guidelines

Score	Drip	Vacuum	Appearance	Odour
5	None	Complete adhesion	Deep red colour	Fresh
4	Slight	Good	Light red colour	Slight sour/dairy
3	Acceptable	Moderate	Slight discolouration	Sour/dairy
2	Heavy	Poor	Poor colour	Strong sour/dairy
1	Extreme	None/blown	Severe discolouration	Off odours

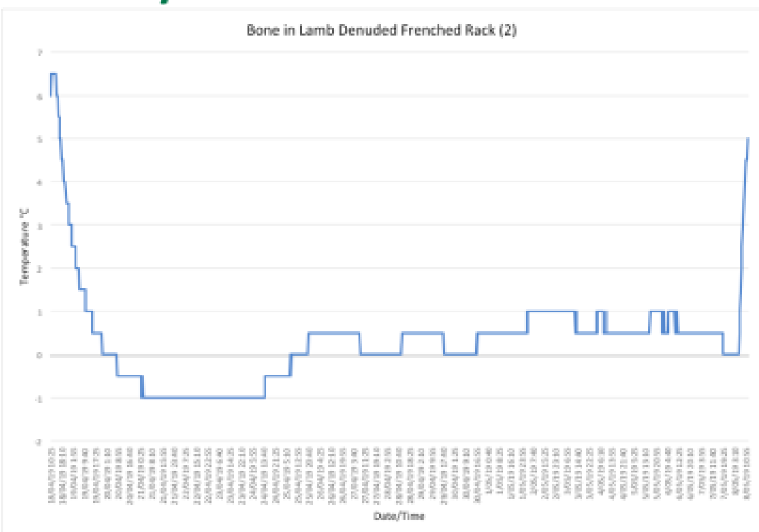
The sensory panel (5 QA staff) assessed the products (n=5) after 20 days and found it in excellent condition for further processing

	Mean scores for each attribute	
	Denuded Racks	Boneless Leg
Overall appearance	4.8	4.0
Vacuum	4.8	5.0
Colour after 5 minutes	5.0	4.8
Odour after 5 minutes	5.0	4.8
Average	**4.9**	**4.7**

Denuded lamb rack 20 days

Boneless lamb leg butterflied 20 days

Stored 20 days



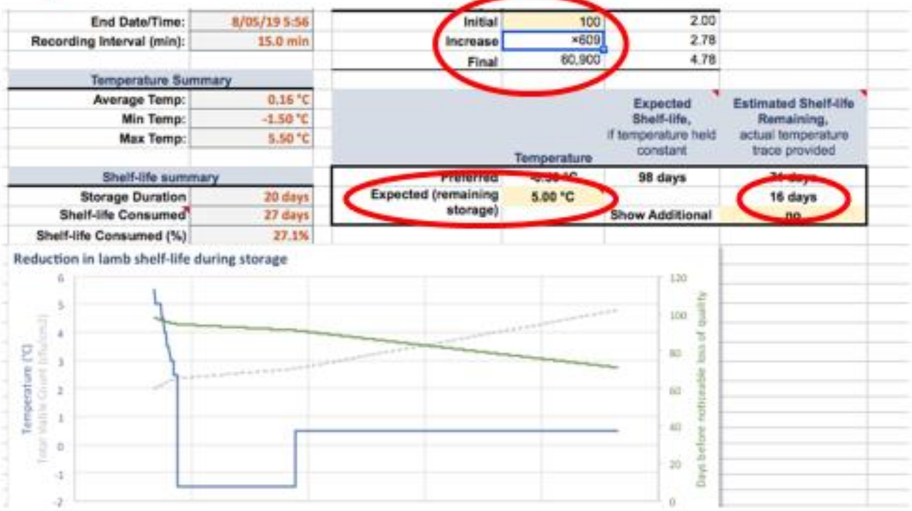
Validating our shelf life – Day 20 micro testing

We did APC, *E. coli* and *Enterobacteriaceae*

Cut	APC	*E. coli*		*Enterobacteriaceae*	
	Mean	Prevalence (%)	Mean*	Prevalence (%)	Mean*
Bone-In Denuded Rack	3715	60	1.6	100	6.5
Boneless Leg	758	20	0.3	100	24

* The mean is of positive samples only (cfu/cm^2)

U Tas prediction



Where to from here - A new deal from the retailers?

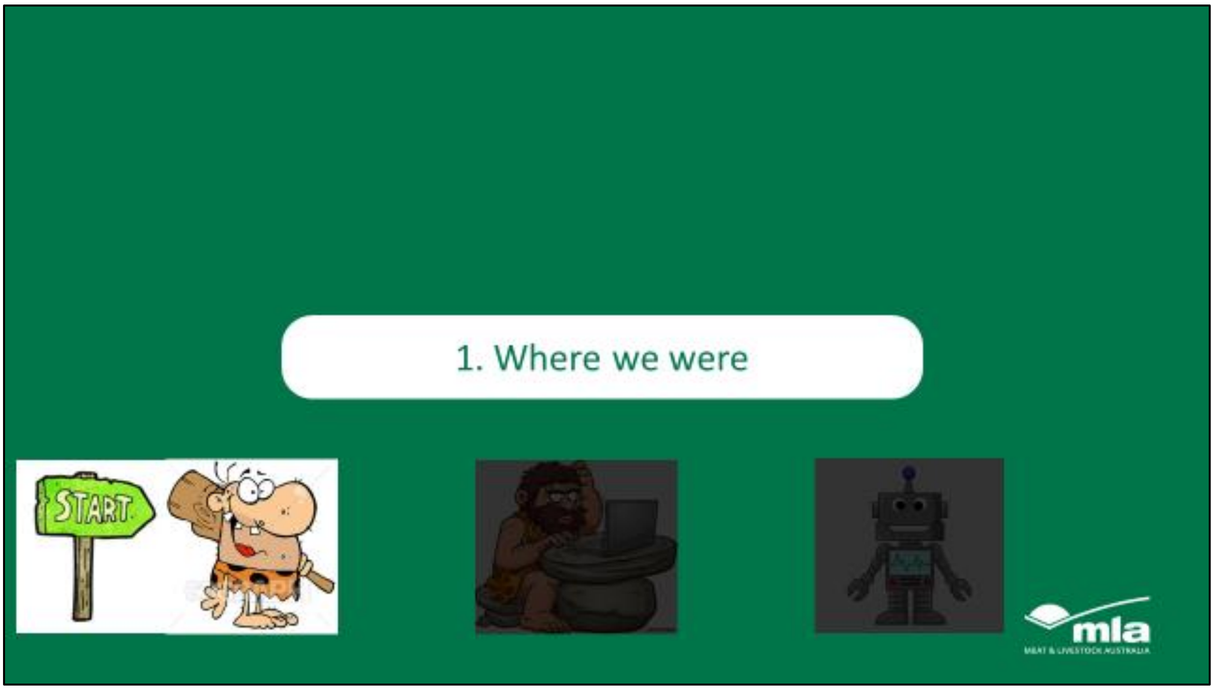
A system based on:

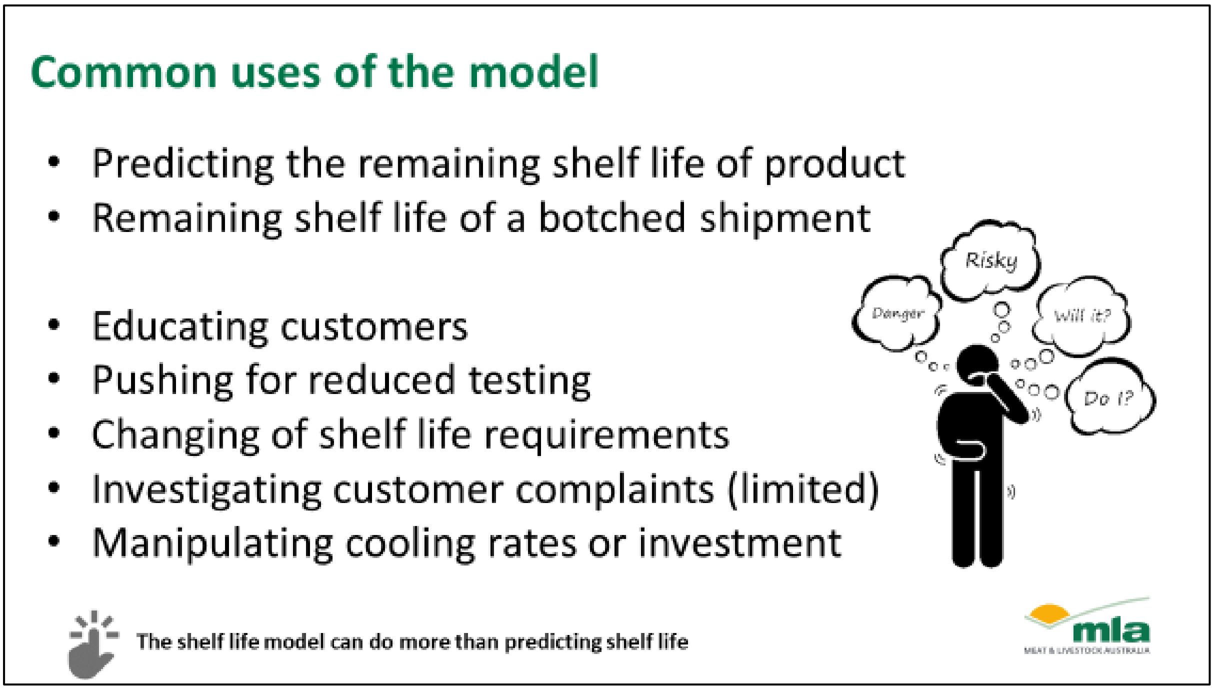
- A baseline to establish micro at the start of shelf life
- Specified product temperature and time in the supply and consumer phases
- Validating shelf life based on micro and sensory evaluation
- Periodic (Annual and Quarterly) verification using UTas tool

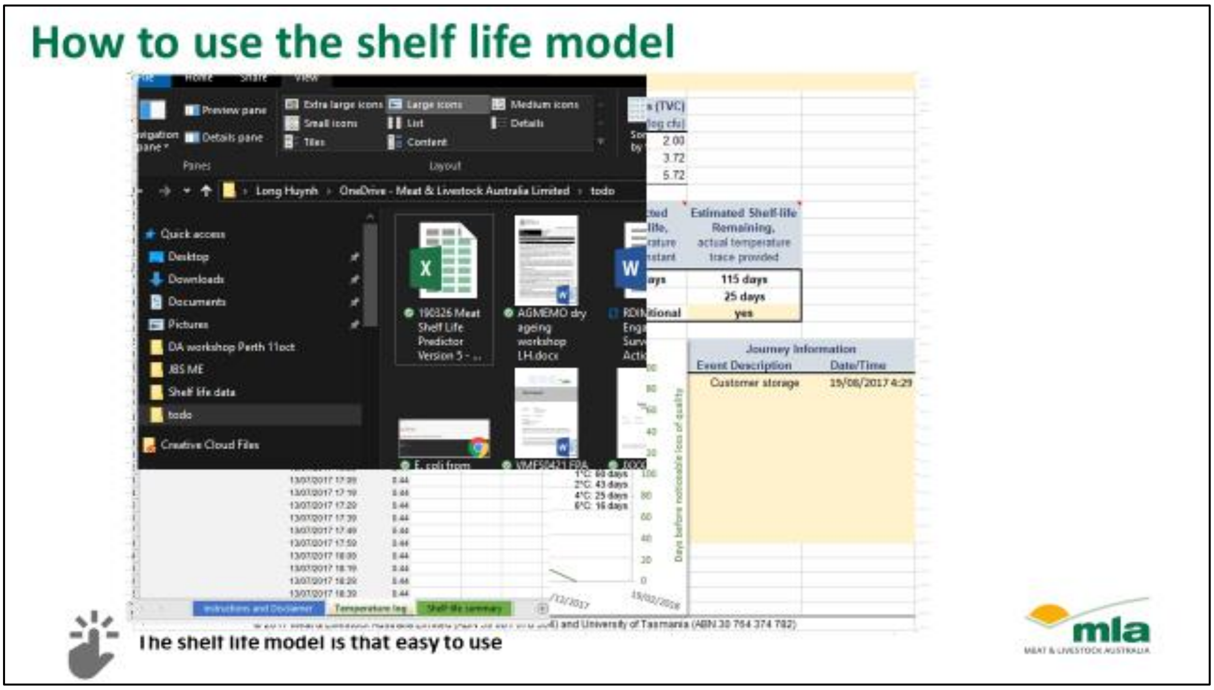
NO MORE FRIDGES FULL OF CUTS

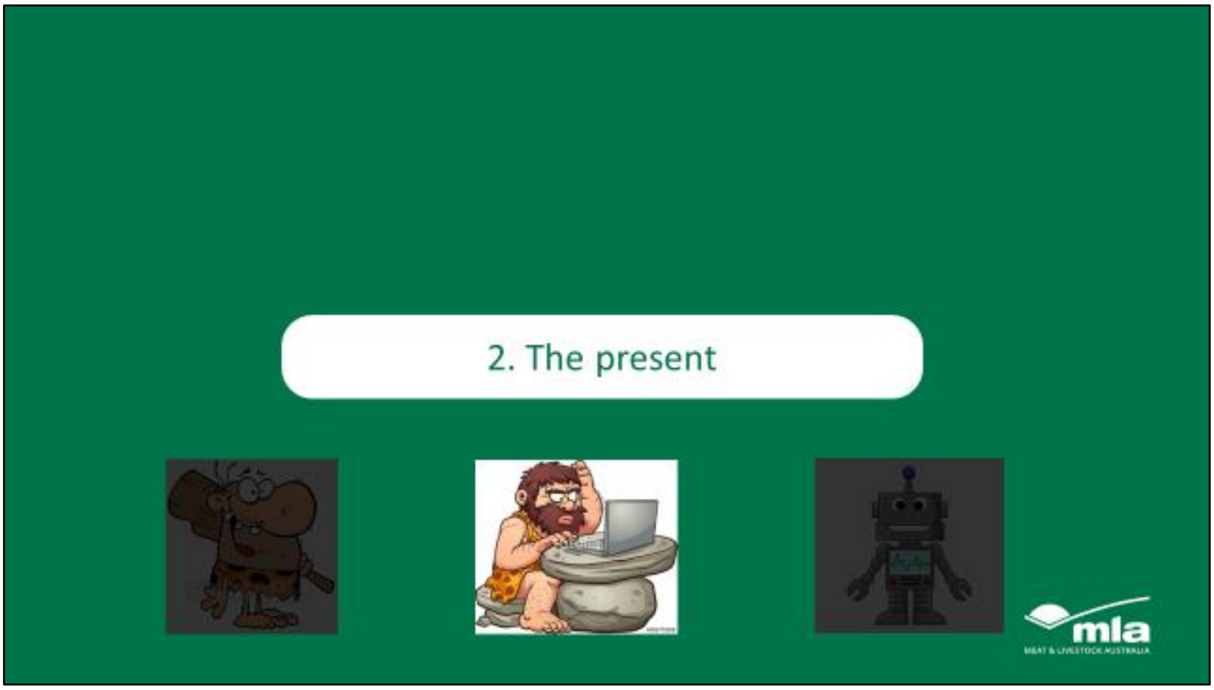
NO MORE COURIERS TO THE LAB

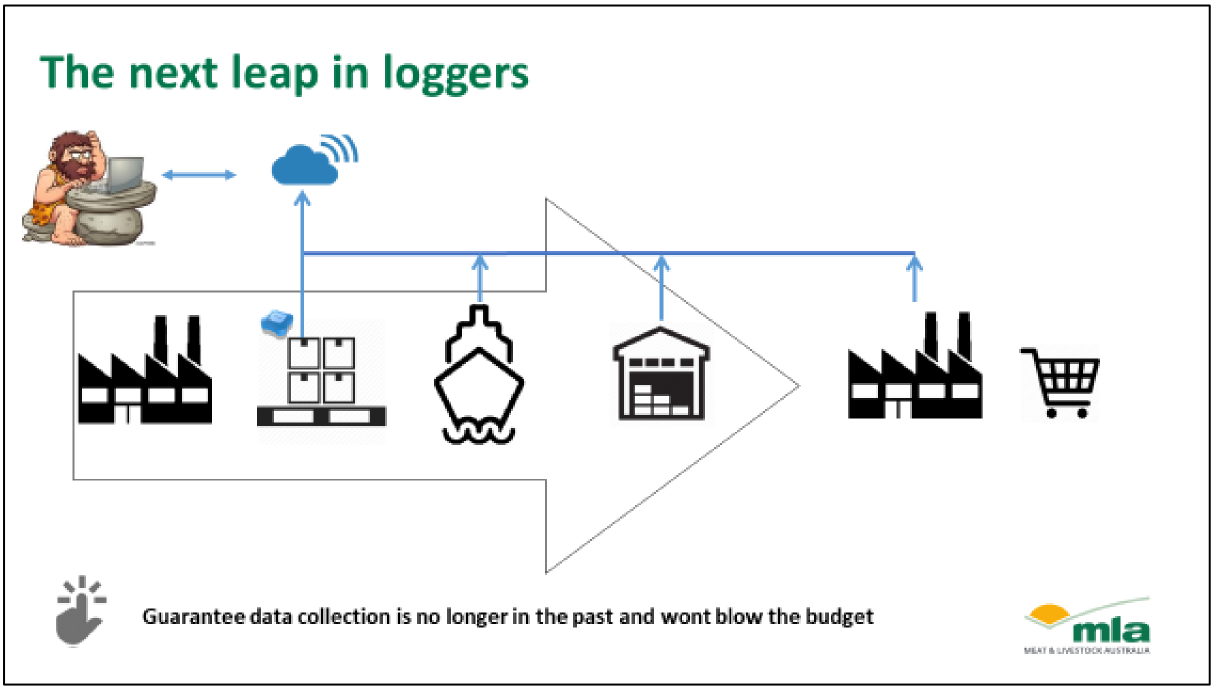
AND NO MORE BIG BILLS


1. Where we were
START
mla


Common uses of the model
• Predicting the remaining shelf life of product
• Remaining shelf life of a botched shipment
• Educating customers
• Pushing for reduced testing
• Changing of shelf life requirements
• Investigating customer complaints (limited)
• Manipulating cooling rates or investment
Risky
Danger
Will it?
Do I?
The shelf life model can do more than predicting shelf life
mla

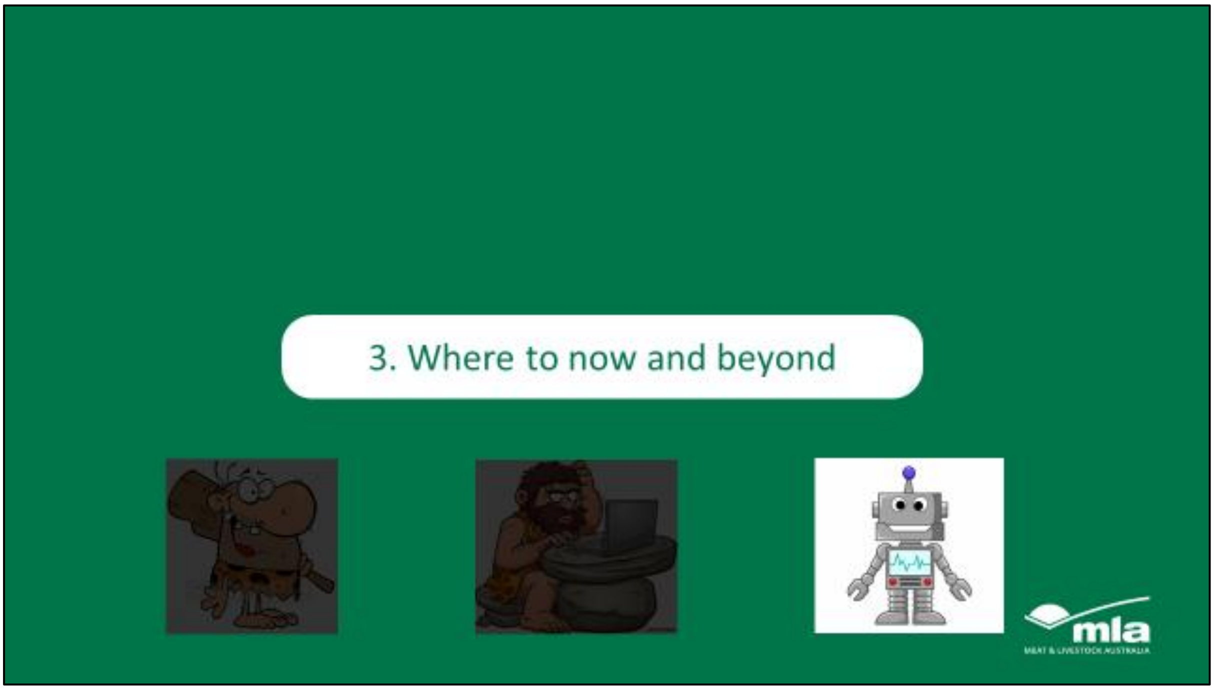

How to use the shelf life model
The shelf life model is that easy to use
mla
MEAT & LIVESTOCK AUSTRALIA

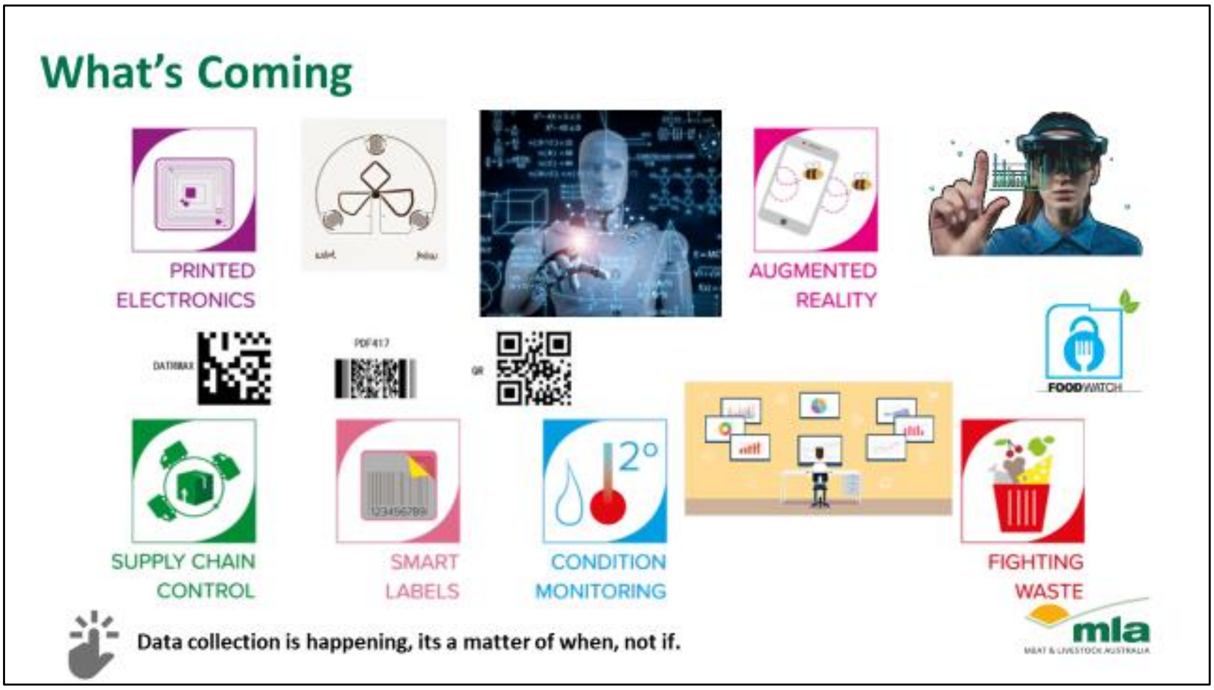

2. The present
mla
MEAT & LIVESTOCK AUSTRALIA


The next leap in loggers
Guarantee data collection is no longer in the past and wont blow the budget
mla
MEAT & LIVESTOCK AUSTRALIA


What else can you record?
Some loggers record more than just temperature
mla
MEAT & LIVESTOCK AUSTRALIA

Cloud Loggers	Monthly subscription fee	Logger cost
Reusable	$0 – 120	$150 – 300 (if lost)
Disposable	0	$50-100




What's Coming
PRINTED ELECTRONICS
AUGMENTED REALITY
PDF417
FOODWATCH
SUPPLY CHAIN CONTROL
SMART LABELS
CONDITION MONITORING
FIGHTING WASTE
Data collection is happening, its a matter of when, not if.
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Join us – we need your help
We can provide:
• Access to the Shelf life model and training
• Cloud loggers to track your supply chain or oversea markets
• Implement the model into the list of tools you use
• Testing scenario in your supply chain
• Rethink and redefine the current standards of Shelf life (Lets
• Resources and tools if you want to go solo
We need your help:
• Advice on: new low cost shelf life model (Label), Automated SL model in loggers
• Shelf life Model PLUS
Come on the journey with us – we need your help
mla
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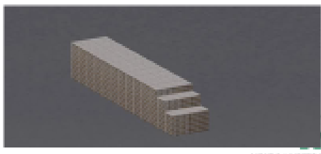
A glimpse of the future - Data automation

PO # XXXX7281XX

84	0.0	23
Remaining Shelf life	Average Temp	Shelf life left @ 4'C



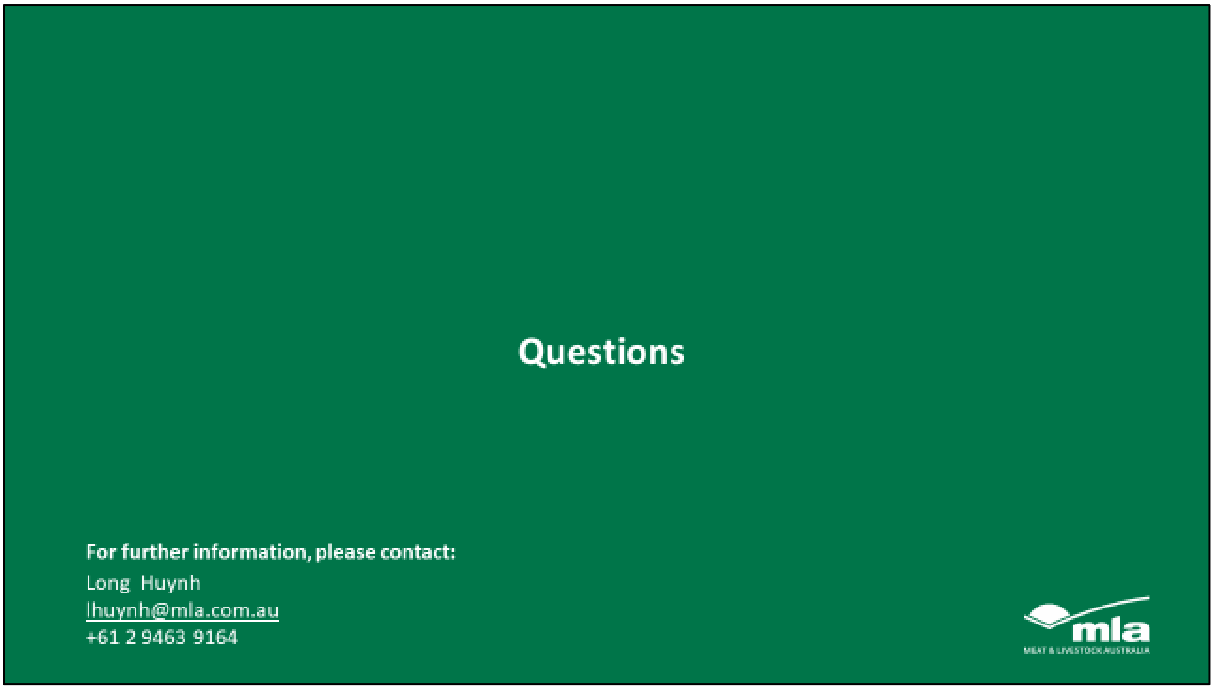
MLA Shelf life update

1. The shelf life model does more than predicting and is easy to use

2. Remote loggers allow tracking of cold chain through to customer for a realistic cost

3. We need your help to shape the future

Ensuring we are ready for the future


Questions
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