Continuous Assurance

Smart agri-food supply chain of the future

Dr Robert Barlow | 15th February 2023

Australia's National Science Agency

DATA MANAGEMENT PLATFORM

1

CSIRO Missions

Goal

Trusted Agrifood Exports

Growing Australian agriculture though premiums for agrifood exports

Delivery vehicles

Improving market access
Modernised, evidence based standards for meeting the requirements set by importing countries

Automating export compliance
Digital compliance process incorporating remote data capture technologies

Verifying credentials
Establishing national provenance infrastructure to validate where/how food was produced

Underpinning

Customer trust

Sensors and technology

Data-sharing

2

Food safety & quality management

- Australia has a reputation for providing agri-food products globally that are clean, green and wholesome
- Trust in Australian agri-food products is critical

- Policies, procedures and processes designed to deliver safe and suitable foods
  - Legislation, regulations, standards, guidelines, and clients

- Food safety and quality audits
- Internal compliance evaluation – QA/QC

"Buyers often believe that auditors are performing a full verification of every product and process of food production" (Doug Powell)

3

Things can go wrong
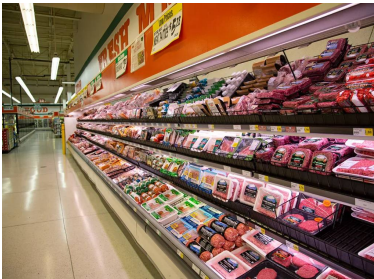
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Current situation

- Supply chains generate and collect substantial volumes of data each day that are currently under-utilised to assure processes are compliant and safe and suitable products are produced.

- Data is rarely collected on a continuous basis (automated, digital). Often it's collected manually and provides a snapshot of the system's performance.

- Datasets are often siloed and are poorly leveraged within the business for continuous improvement opportunities.

5

Future state – Continuous Assurance

- The permissioned sharing of connected datasets, insights and analytics would enable industry, auditors, regulators and credentialing bodies to work together to improve both domestic and export market access.

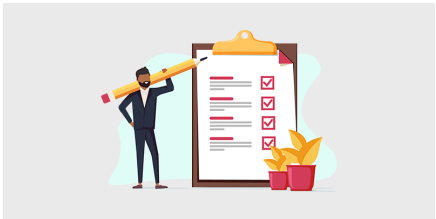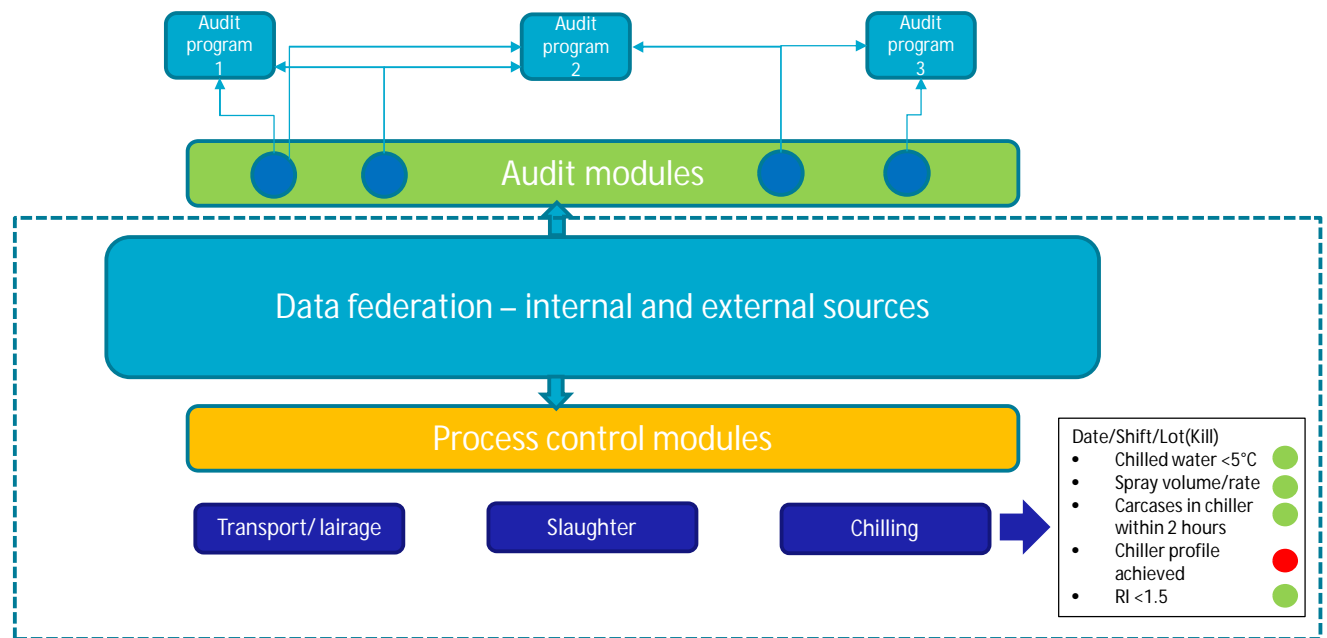| Loss avoidance	• Risk mitigation • Lag indicators shift to lead indicators
Reducing duplication	• Measure/analyse once and report to many
Premiumisation of products	• Continually assured products • Brand differentiation, new markets

6

CA – operational hygiene

- Current
  - QC Officer observes 3 x 5 mins/shift
  - QC checklist
    - PPE & apparel checks
    - Hand-washing
    - Boot scrub/wash

- Might assess 30/500+ staff

- Future
  - AI and camera observes 24/7
  - Results for each individual in 20 mins
    - Identity
    - PPE & apparel
    - Hand-washing (all aspects)
    - Boot scrub/wash (all aspects)
    - Jewellery, watches, unacceptable items
    - Transit time

- All staff, every shift, every day
  - Weekly compliance reported

7

Continuous Assurance – red meat

Audit program 1   Audit program 2   Audit program 3

Audit modules

Data federation – internal and external sources

Process control modules

Transport/ lairage   Slaughter   Chilling

Date/Shift/Lot(Kill)
- Chilled water <5°C
- Spray volume/rate
- Carcases in chiller within 2 hours
- Chiller profile achieved
- RI <1.5

8

4

Continuous assurance - MVP

- Demonstrate the ability to federate data sources from disparate locations and systems to enable enhanced insights, trends and analytics.

- MAP these activities
  - SOPs, SWI's
  - Where, what, how

| Connect the present | Address the gaps, opportunities to add sensors/automate/digitise | Expand and scale |

- Two distinct categories
  - Measurement-based
  - Human behaviour-based

9

Compliance Mapping – what & where

10

Compliance Mapping - how

Animals being transported	Animals at lairage	Slaughter	Offal	Chiller	Grading / marshalling	Boning room

Animals being transported
- Time of truck departure - date and time recorded on NVD - scanned into system
- Time of truck arrival - date and time written on NVD (free form) - scanned into system
- Route taken by truck, including any stops - not currently recorded — Real-time
- Environmental conditions during journey temperature and humidity available from BOM — Real-time
- Which animals are transported - NLIS ear tag scan on load, PIC number on NVD - NVD scanned into system

Animals at lairage
- Time off feed to not exceed 32 hours from departing property - date and time (departure) on NVD. Kill time in system
- Time from departing property to slaughter not to exceed 36 hours - Departure time on NVD and kill time recorded at knocking box
- Ante mortem inspection to occur within 24 hours of arrival (12 hours for some product claims e.g EU). Data recorded — Real-time
- Lairage temperature - not currently captured?? - opportunity for BOM plus in shade sensors — Real-time

Slaughter
- Date and time of slaughter recorded against NLIS # — Real-time
- Handwashing water must be 34-46°C - measure by QC — Real-time
- Sterliser temperatures must exceed 82°C - manual checks by QC — Real-time
- All sterilisers fed from centralised source - output temps not recorded — Real-time
- Time from slaughter to HSCW / chiller entry must not exceed 2 hours — Real-time
- Bodies not scanned into chillers and therefore time of slaughter unknown, trialling QR scanning system on hooks — Real-time
- Temp, humidity, air flow of slaughter floor not measured - possible opportunity?? — Real-time

Offal
- Sterilisers (including viscera table wash) must exceed 82°C - manual checks by QC
- Pericardium cannot exceed 3hr rinse cycle - 3 rinse cycles can be completed in 5 mins.
- Chilled offal shall be <5°C within 23 hours or further refrigeration is required
- Trim (tripe/bibles) - temp to be below 30°C
- Glycol system maintains chilled water at <4°C - possibly captured in system — Real-time
- Lower offal room maintained at <10°C — Real-time
- Offal into VRT within 2 hours of slaughter

Chiller
- Glycol system maintains chilled water at <5°C - possibly captured in system. Also note difference to offal room. — Real-time
- Carcases must enter chiller within 2 hours of slaughter (we slaughter or QR scanning of hooks). Don't have accurate accounting for which animals are in which chiller — Real-time
- Chiller temperatures - measured in real time (outlet air) — Real-time
- Deep butt and surface probes available in all chillers - collected in system. Not used for RI. Instead graders smash transdermal cryotip which are used for RI — Real-time
- Grader RI confirmation - Tinytags and manual
- Spray chill pattern - seen on system. Flow rate/volume of water used per chiller not recorded. Verified via weight comparison during marshalling — Real-time
- Temp/some - sends SMS if pull down or table temp exceeds 9.5°C for 30 mins, variance between probes exceeds 2°C, pull down temp not met in 6 hours. If temp is below +4°C. If temp is >4°C below setpoint — Real-time

Grading / marshalling
- Carcase surface temps and RI confirmed by graders - reported in system
- Carcase temps confirmed as <10°C prior to boning
- Eye muscle temps measured as part of pH measurement - recorded in system with pH — Real-time

Boning room
- Carcases scanned into boning room. Boning room entry time is known — Real-time
- Carcase hook wash and steriliser baths >82°C - manual checks by QC
- Boning room temperature must be <10°C. Real-time data stream (2 sensors -see below) to SCADA but not reported on. QC measure multiple times throughout shift — Boning room temp sensor — Real-time
- Shrink tunnel must be >82°C - QC view readout on tunnel
- Time in boning - can be determined by noting first body in/carton out and last body in/carton out for each boning run — Real-time

11

Mapping compliance – time & temp

Animals being transported	Animals at lairage	Slaughter	Offal	Chiller	Grading / marshalling	Boning room

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12

Multi-modal sensing

- Multiple sensing modalities improve activity recognition accuracy and robustness
  - LiDAR (long range), Time-of-Flight camera (close range), RGB camera, infrared camera, accelerometer, Bluetooth localisation
- Benefits
  - Accurate measurement of the interactions in physical environment – human behaviour/actions
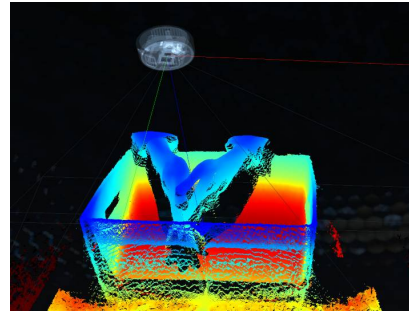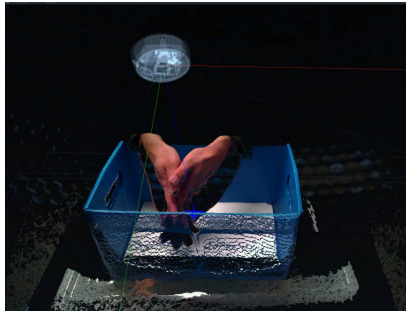
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Lightweight solution – time-of-flight camera & jetson
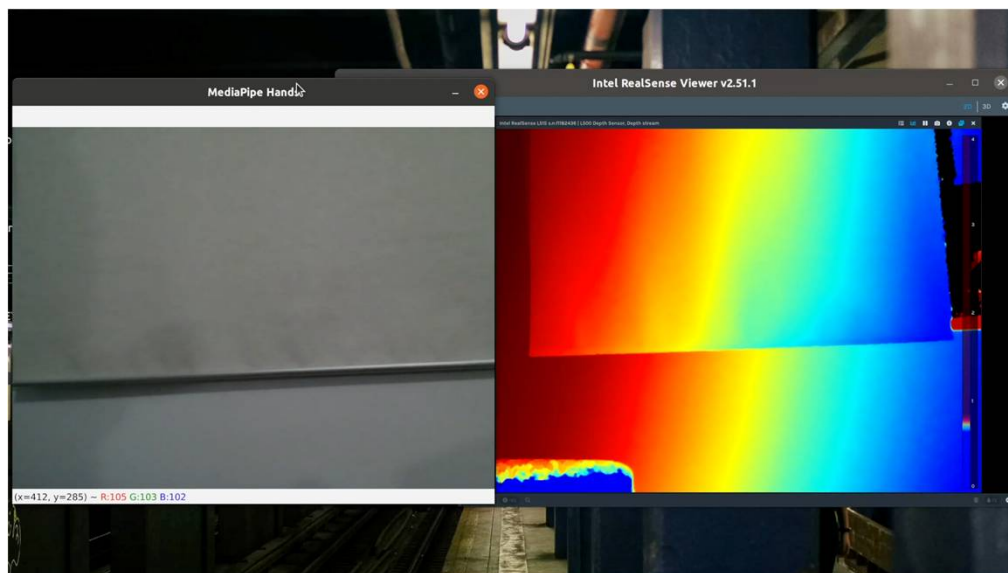
14

Benefits of CA

- Leverage existing and new data on a continuous basis

- Provide trust (confidence, explainable) in data and outcomes

- Generate confidence for decisions and reuse of data and commercial outcomes

- Less reactive interventions replaced with proactive measures

- Reduction in duplication and effort of physical audits

- Lift the industry by **working with** regulators to be continuously assured

- Facilitate automated sharing of trusted data and outcomes to auditors, regulators and credentialing bodies to enhance market access

15

Thank-you

Dr Robert Barlow
CSIRO Agriculture & Food
Group Leader – Food Quality & Safety

Robert.Barlow@csiro.au
www.csiro.au

Australia's National Science Agency

16