Trace-2-Place

Regtech Landscape Analysis

April 2024

Landscape Analysis of Regulatory Technology Applications for Agrifood Traceability

CERRF
CENTRE FOR REGIONAL AND RURAL FUTURES

DEAKIN UNIVERSITY

AgriBusiness Connect

This publication is a Landscape Analysis of Regulatory Technology Applications for Agrifood Traceability conducted in 2023-24.

Authors
Rose Elphick-Darling, Dr Patricia McLean

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Executive Summary

The Traceability RegTech Landscape Analysis is an important step in creating a context for the Agrifood Connect Trace-2-Place project. This project is funded through the Australian Department of Agriculture, Fisheries and Forestry (DAFF) National Agricultural Traceability Strategy RegTech Uplift grant round.

This report provides a scan of developments in RegTech applications used for traceability in Agrifood supply chains. It does not aim to collate all the many applications and solutions that have been developed in Australia and globally, as there are myriad tools, technologies and features that are currently being deployed, and more emerging.

The Landscape Analysis does however aim to provide examples and document their potential for widespread deployment, potential to standardise across agrifood products/ cross-commodities, activities and value chains, features and models.

Deakin University Centre for Regional and Rural Futures has undertaken the analysis through desktop research and the conduct of interviews with regulators, industry peak bodies, rural research and development corporations, and solution providers.

Objectives of the research were to

Understand the regulatory trends related to traceability in agrifood supply chains, and opportunities for regulatory technologies to be deployed to support compliance.

Identify applications, platforms and systems that support industry in traceability and compliance activities.

Outline the challenges and opportunities in adoption of regulatory technologies, and the potential for cross-commodity/sector deployment.

Key findings of this research are as follows

1. Regulation impacting agricultural traceability is evolving to embrace compliance with domestic and international market regulatory requirements, industry certification and product credentialing. For traceability, there is expressed demand to utilise the capability for ESG reporting and end consumer interface with primary producers.

2. Regulators are making progress in streamlining compliance platforms and working with industry to embrace technologies. The sheer volume of regulation was exemplified in cross-border trade, with reportedly 29 agencies with a role at the border, more than 200 pieces of cross-border trade regulations and 145 federal ICT systems.

3. The structure of commodity-based regulation in the agricultural sector may hamper cross-cutting data standards and traceability formats such as the Critical Tracking Event (CTE) and Key Data Element (KDE) frameworks and utilisation of global data standards.

4. There are many available technology solutions being deployed in the Agrifood industry, however they are not well integrated or lack the application scope to sufficiently create whole-of-supply-chain line of sight for compliance. They are often focused on a specific challenge or require separate integration services.

5. Identified gaps in the traceability regulatory technology ecosystem relate to digital infrastructure, physical communication, and data coverage. This digital infrastructure also includes industry standards, and reference datasets that can be drawn into solutions.

6 Solution providers report the frustration and cost generated by the lack of industry standards, data standards, and common language and formatting for agricultural traceability, particularly as businesses are required to demonstrate compliance with international standards and achieve interoperability between systems.

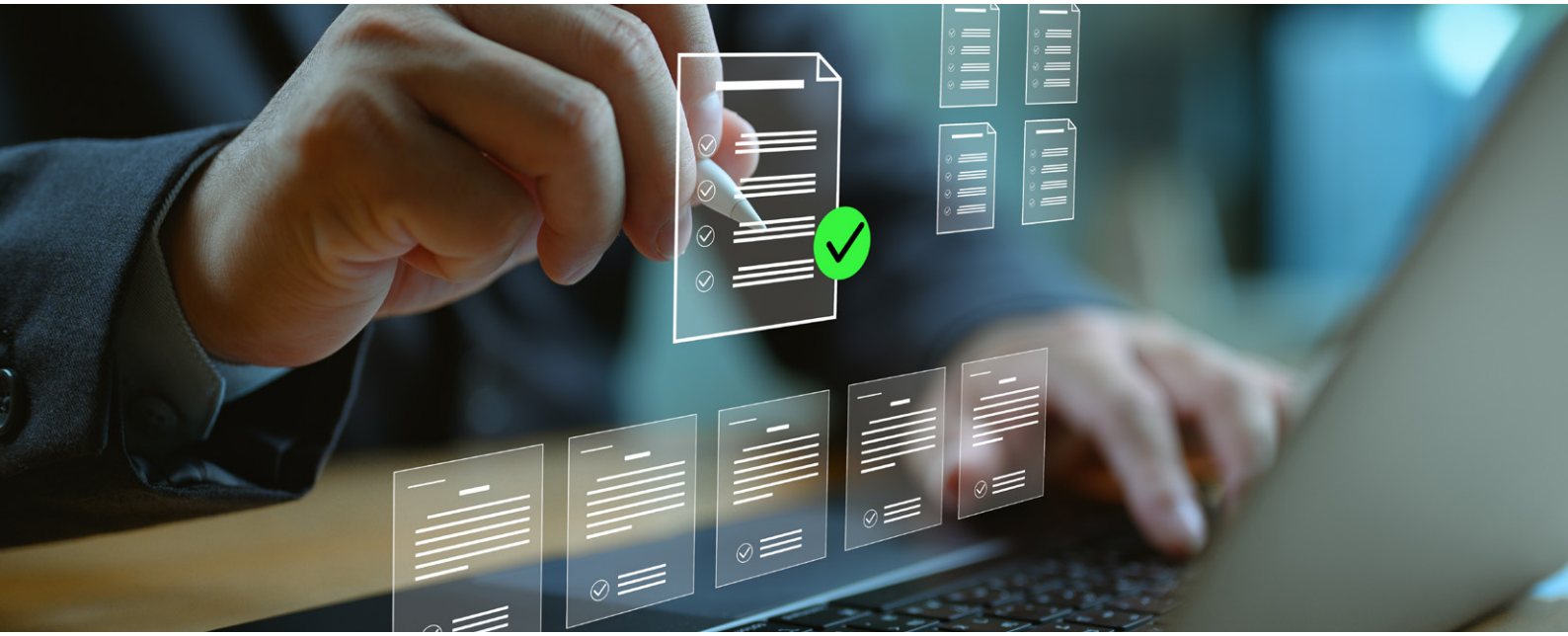
7 The scale of the Australian agrifood regtech traceability market is relatively small and can be described as nascent, so startups and scaleups tend to be global-facing, and in need of investment. The venture capital model they access, often coined the Silicon Valley model, is predicated on short term return on investment and proprietary features to create a "unique" product to accelerate returns. However, a gap between this form of investment and the longer-term investment in AgTech needed for Australian Agribusiness represents around half of the investment needed to support Australia's 2030 $100 billion Agrifood target (Campbell 2022). This conundrum creates a dampening effect on standardised, industry-wide models and systems for agrifood traceability and the RegTech solution providers.

8 In other jurisdictions we found co-investment in incubators and accelerators that operate to develop industry-level solutions, jointly funded through governments, major technology firms and Agrifood corporations. This model may drive greater standardisation and support maturity and longevity of regtech solutions servicing agrifood supply chain businesses.

9 Opportunities for cross-commodity RegTech applications were identified, based on the foundational need for a framework of critical tracking events and key data elements and data standard and language adoption. These opportunities relate to digital batch scanning of farm chemicals, integrators and data exchange, rapid on-site testing for species and food safety, on-farm and in-transit biosecurity monitoring, animal welfare and health lifetime status (digital twin) and linked geospatial and entity identifiers. The technology and applications are available and are being adopted by larger agribusinesses.

10 Greater support for uptake by family farmers, often SMEs, will be required to identify the return on investment they can capture through adoption of RegTech applications and to overcome their reticence to share data. For many producers, information asymmetry between supply chain parties holds back the uptake of integrative tools that would support regtech at the supply chain level. Commodity-based, Free-on-Board terms of trade dominate Australia's Agrifood export, so producers often have little incentive other than destination market compliance, to share traceability data, as it is unlikely to impact their return on a commodity trade.

11 An education program would be beneficial in progressing the understanding of data-sharing protocols being utilised by traceability applications, showing what the data is, how supply chain partners are notified, and how that data is being protected in this process. The lack of trust in data sharing is limiting take-up of traceability tools.



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Introduction

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Key to the success of RegTech applications is their ability to meet the needs of the regulator and the regulated and to deliver value for the public as well as the value chain businesses. RegTech is not confined to industry compliance technologies or applications. It encompasses technology uptake by regulatory agencies in their compliance interface activities with industry.

2.1 Objective

A key objective of the Landscape Analysis is the identification and assessment of standardisable features of traceability RegTech applications, devices and platforms that can be applied across agricultural industries, supply chains and commodities to increase value and expand export market access.

2.2 Method

Steps completed in conducting the Landscape Analysis include

1 Confirmation of regulatory requirements related to traceability that apply to Agrifood products in key export commodity groups and domestic supply for -

Grain, pulses and oilseeds | Red meat and livestock | Dairy | Seafood | Wine | Horticulture

2 Identification of current and "under development" regulator platforms, applications, 3rd party suppliers of regulatory compliance data for traceability.

3 Identification of current industry applications, codes and standards for which producers already supply traceability data.

4 Identification of potential for standardisation of definitions and data fields across commodity types.

5 Identification of innovative solutions available for standardised data collection and ingestion by regulators.

6 Identification of challenges to standardisation and use of industry data relevant to data security, data sharing and privacy.

7 Production of a RegTech Landscape Analysis report, providing context for the beef supply chain RegTech proof-of-concept being undertaken by Agribusiness Connect.

3

Definitions and Glossary

3.1 RegTech (Regulatory Technology)

"RegTech can be described as the use of technology to better achieve regulatory objectives. It enables regulators to implement regulation more efficiently and effectively, delivering on the basic principle that regulations should achieve their objectives at the lowest possible cost. More broadly, RegTech refers to technology used for: "... regulatory monitoring, reporting, and compliance to help businesses comply with regulations efficiently and in a cost-effective way."

RegTech has been defined by the Institute of International Finance as 'the use of new technologies to solve regulatory and compliance requirements more effectively and efficiently'.[1]

RegTech refers to the use of new technology in regulatory monitoring, reporting, and compliance to help businesses comply with regulations efficiently and in a cost-effective way. It is industry and technology-agnostic and is being used across a range of different regulatory environments and industries. RegTech also refers to the use of new technology by regulators to enable a more efficient and effective regulatory environment. RegTech solutions can be applied in any industry with regulatory and compliance requirements." ACMA, 2021

It is notable that RegTech may be used by regulators in the activities e.g. compliance platforms or may be an investment made by the regulated to minimise the cost and optimise the value of compliance reporting.

"Recently, government regulatory agencies have begun collaborating with RegTech providers with the goal of enhancing regulatory performance. As a result, RegTech is now being applied both by private sector obligation holders required to comply with government regulations and by public sector regulators seeking to monitor regulated entities and ensure appropriate compliance is routinely occurring."

Bolton and Mintrom (2023) suggest that adoption of RegTech by regulatory agencies can create public value supporting more thorough monitoring of regulated activities and promoting compliance, supporting more systematic identification of emerging risks and potential harms, and reducing the costs of regulation to government and enforcement agencies as well as the regulated.

1 Institute of International Finance, 'Regtech in Financial Services: Solutions for Compliance and Reporting', 2016.

3.2 Supply Chain Traceability

The International Standards Organisation defines traceability as:

"The ability to trace the history, application or location of an item".

NOTE: When considering a product or a service traceability can relate to the origin of materials and parts; the processing history; or the distribution and location of the product or service after delivery.[2]

Food Standards Australia New Zealand (FSANZ) defines traceability as:

"... the ability to track any food through all stages of production, processing, and distribution (including importation and at retail). Traceability should mean that movements can be traced one step backwards and one step forward at any point in the supply chain. For food processing businesses, traceability should extend to being able to identify the source of all food inputs such as raw materials, additives, other ingredients, and packaging."

The **Global Food Traceability Center** defines traceability as is the systematic ability to trace the path of food ingredients and/or finished products throughout their entire lifecycle, using previously captured and stored records. These records catalogue key data elements (KDEs) at critical tracking events (CTEs).

Traceability may be achieved along a supply chain by combining the one-up/one down information from individual businesses. However, it may not constitute a visibility capability for that particular supply chain. The data may be required to be held for regulatory purposes but not necessarily shared with other businesses in the chain to create visibility of the product. Gaining visibility along the entire supply chain can improve speed and accuracy of food recalls by having a complete set of information on where the product has been, who has handled the product, unique identification of the product (what) and when it was produced, transformed, aggregated and disaggregated as it is physically moved along the supply chain.

2 ISO 9000:2015 – Quality management systems – Fundamentals and vocabulary.

3.3 Glossary of terms

Acronym	Acronym meaning	Definition
API	**Application Programming Interface**	Code that enables two software programs to communicate
AI	**Artificial Intelligence**	Artificial intelligence is a field of science concerned with building computers and machines that can reason, learn, and act in such a way that would normally require human intelligence or that involves data whose scale exceeds what humans can analyse. AI is a set of technologies that are based primarily on machine learning and deep learning, used for data analytics, predictions and forecasting, object categorization, natural language processing, recommendations, intelligent data retrieval, and more. (Google)
	Big Data	Big data primarily refers to data sets that are too large or complex to be dealt with by traditional data-processing application software. Big data is a combination of structured, semi-structured and unstructured data collected by organisations that can be mined for information and used in machine learning projects, predictive modelling and other advanced analytics applications.
	Cloud Computing	"a growing amount of data are being stored in what is known as the cloud. Cloud computing is defined by the US National Institute of Standards and Technology as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." (NIST Cloud Computing Program, 2019) Some of the prominent providers of cloud computing services include but are not limited to Amazon Web Services, Google Cloud Platform, Microsoft Azure, VMWare, and IBM Cloud. (Gennette Zimmer, Chapter 1, Defining Terms, in Detwiler, D. (ed) 2020, *Building the Future of Food Safety Technology: Blockchain and Beyond*, Amsterdam Academic Press)
CTE	**Critical tracking event**	Any occurrence involving an item at a specific location and time associated with collection and storage of data useful for associating the item (or related items) to the specific occurrence at a later time and is determined to be necessary for identifying the actual path of an item through the supply chain. The concept of Critical Tracking Events in an agrifood supply chain allows unique traceability data to remain separate from proprietary commercial data. For each node, aggregation, de-aggregation, transfer and transformation of the product it will cover: – A unique location – the "where" – Unique identification of the parties involved - the "who" – A unique item identification – the "what" – A time and date stamp – the "when"
DLT	**Distributed Ledger Technology/ Blockchain**	A blockchain is a digital ledger or database where encrypted blocks of digital asset data are stored and chained together, forming a chronological single-source-of-truth for the data. Digital assets are distributed, not copied or transferred. Digital assets are decentralized, allowing for real-time accessibility, transparency and governance amongst more than one party. Blockchain ledgers are transparent; any changes made are documented, preserving integrity and trust. Blockchain ledgers are public or private and constructed with inherent security measures. (Builtin.com)
HACCP	**Hazard Analysis Critical Control Points**	'HACCP' is a food safety and risk assessment plan that was initially developed in the 1960s by NASA and a group of food safety specialists.
IoT	**Internet of Things**	IoT is a network of connected devices that collect and share data with other devices and systems.

Acronym	Acronym meaning	Definition
KDE	**Key data element**	A data input required to successfully trace a product and/or its ingredients through all relevant CTEs. In terms of data content, these can be categorised into three distinct areas: – Master data relates to locations, businesses, products (input materials, outputs) and their associated attribute data such as addresses, functions, descriptions, packaging configurations etc. These details will be stored in product master data files and retrieved each time a traceable item is scanned or looked up for ordering etc. or a location referenced. – Transaction data that consist of trade transactions, triggering or confirming the execution of a function within a business process. Transaction data is usually captured and stored in internal systems. – Visibility event data that captures the movement of a product through the supply chain detailing when and where a specific event occurred. Visibility data is usually made accessible across the whole supply chain. It makes it possible to track and trace goods with live data along the process.
NFT	**non-fungible token**	A unique digital identifier that is recorded on a blockchain and is used to certify ownership and authenticity. It cannot be copied, substituted, or subdivided.
NGO	**Non-government organisation**	A non-governmental organization (NGO) is a non-profit organization that furthers some social or humanitarian mission around the globe e.g. United Nations
NVD	**National Vendor Declaration**	The Livestock Production Assurance NVD communicates the food safety and treatment status of every animal every time it moves between properties, to saleyards or processors. NVDs are a legal document that are key to Australian red meat traceability and market access, and act as movement documentation throughout the value chain. (Integrity Systems Company)
PDA	**Personal Digital Assistant**	A portable terminal of small dimensions that combines both the functionalities of a computer and those of a smartphone. It helps automate processes in an agile and productive way, saving time when carrying out the daily tasks of a company. A PDA is used in any process that affects the traceability, control and tracking of merchandise, from the warehouse to its sale, including returns. It is an indispensable tool for the area of administration and logistics, especially today, many PDAs are used as POS systems, as they also help manage data outside the company. (LogisCenter)
PIC	**Property Identification Code**	A Property Identification Code (PIC) is an eight-character code allocated by the Department of Primary Industries (DPI) or an equivalent authority in each state or territory to identify a livestock-producing property. Producers must have a PIC to move livestock on and off a property – it forms the basis of Australia's food safety and traceability programs. (Integrity Systems Company)
QR code	**Quick reference code**	A machine-readable code consisting of an array of black and white squares, typically used for storing URLs or other information for reading by the camera on a smartphone. A QR code is a type of two-dimensional matrix barcode, invented in 1994, by Japanese company Denso Wave for labelling automobile parts.
RFID	**Radio Frequency Identification**	Radio Frequency Identification (RFID) technology uses radio waves to identify people or objects. There is a device that reads information contained in a wireless device or "tag" from a distance without making any physical contact or requiring a line of sight.
RPA	**Robotic Process Automation**	Automation of repetitive business processes without human intervention using bots. It may involve a combination of automation, computer vision and machine learning.
	Smart Contracts	Smart contracts are self-executing contracts, they can automate and authenticate processes where it is important for the participants in a process to be able to rely on and trust steps or conditions in a supply chain or exchange. (International Standards Organisation)

4

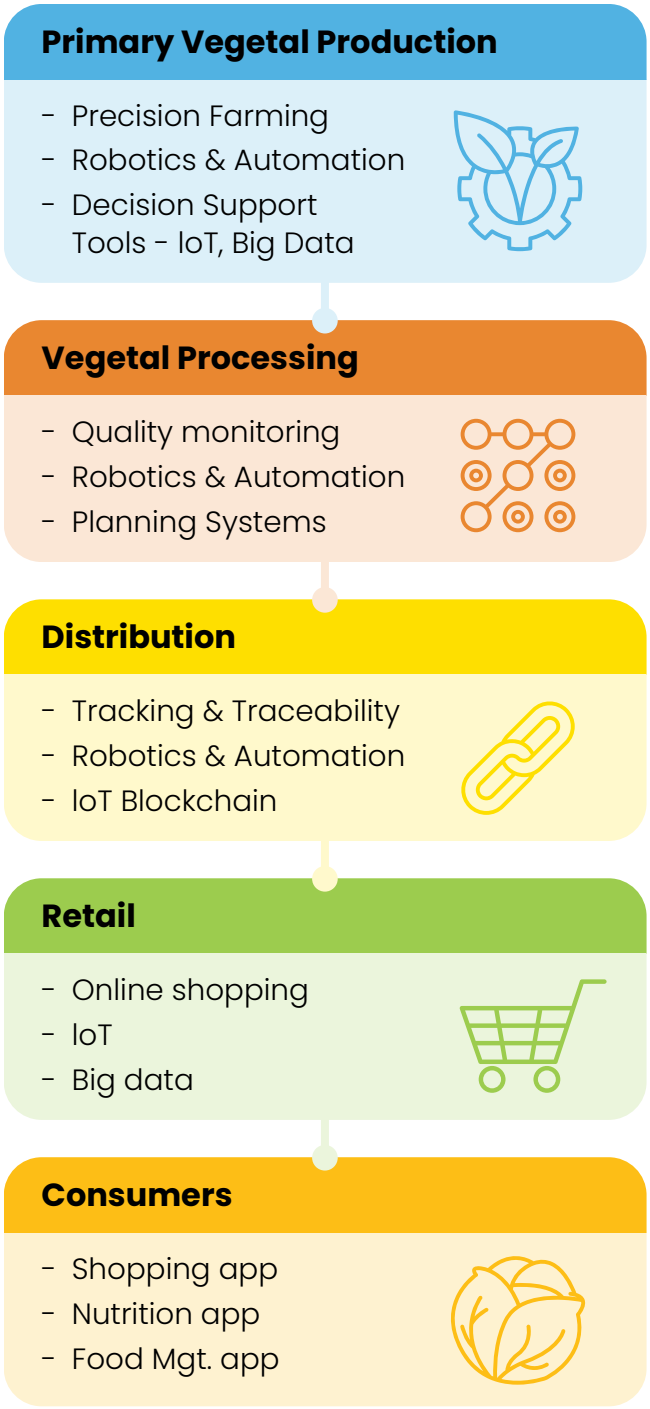
Traceability and compliance in Agrifood Supply Chains

Use of technology in agrifood supply chains cover a wide suite of applications, focused on productivity, certification of production, market specifications, and efficiency in the product supply chain. An example from a whole-of-supply-chain assessment in horticulture demonstrates this wider focus, with traceability becoming a prominent focus post-farm gate.

Compliance in Agrifood supply chains typically revolves around the following aspects related to traceability –

- Food safety
- Biosecurity
- Ethical labour
- Animal welfare
- Trade requirements and cross-border clearances
- Product claims and labelling
- Weights and measures.

Whole-of-supply-chain assessment in horticulture



Source: Hassoun et al 2022

4.1 Food Safety

The standards in the **Australia New Zealand Food Standards Code** are legislative instruments under the *Legislation Act 2003*. Food Safety Australia and New Zealand (FSANZ) administers these standards. **Safe Food Australia** provides industry guidance on compliance with these standards. The food safety regulatory system is described on the Australian government website **https://www.foodregulation.gov.au/about-the-system**.

Primary production and processing (PPP) standards aim to strengthen food safety and traceability throughout the food supply chain, from paddock to plate. They were developed by FSANZ with assistance from other Australian government agencies, industry stakeholders and consumer groups.

Each state and territory has an **authorised agency** which undertakes the required licensing and approvals, guidance and enforcement activities related to food safety. **Local governments** are also engaged as delegates within each state to undertake premises licensing and inspection activities relating to food safety.

In relation to **traceability**, requirements are listed under

- Standard 1.2.2 - Food Identification Requirements, for labelling food
- Standard 3.2.2 - Food Safety Practices and General Requirements, for food receipt and food recall
- Primary production and processing Standards 4.2.1 to 4.2.6.

Many businesses in the Agrifood supply chain are HACCP certified. HACCP 2023 certification explicitly requires traceability as a pre-requisite -

"Programmes including good hygiene practices, good agricultural practices and good manufacturing practices, as well as other practices and procedures such as training and traceability, that establish the basic environmental and operating conditions that set the foundation for implementation of a HACCP system." [3]

Lot identification and traceability

Lot identification or other identification strategies are essential in product recall and also help effective stock rotation. Each container of food should be permanently marked to identify the producer and the lot. The *General Standard for the Labelling of Pre-packaged Foods* (CXS 1-1985) applies.

A traceability/product tracing system should be designed and implemented according to the *Principles for Traceability/Product Tracing as a Tool within a Food Inspection and Certification System* (CXG 60-2006), specifically to enable the recall of the products, where necessary.

3 FAO and WHO. 2023. *General Principles of Food Hygiene*. Codex Alimentarius Code of Practice, No.CXC 1-1969. Codex Alimentarius Commission. Rome. **https://doi.org/10.4060/cc6125en**

4.2 Biosecurity

Australia's National Biosecurity Strategy 2022-2032 states a shared purpose to "develop a risk-based system underpinned by science that protects Australia's people, our environment, economy and lifestyle from the biosecurity threats of today and tomorrow."

One of the stated priorities of this Strategy is **Integration supported by technology, research and data** –

"We will create a more **connected, efficient and science-based** system to facilitate more timely, informed and risk-based decisions."

Actions to support this priority include (Italicised items relate particularly to traceability) -

- *Continue to invest in and roll out transformative technologies to digitise and automate processes*
- Increase stakeholder coordination to prioritise, drive and deliver national research outcomes
- Actively share data and research widely
- Enhance the accessibility and use of surveillance and interception data
- Further support innovations to build science and research capacity
- *Encourage the uptake of existing and emerging technologies, systems and processes*
- Increase the use of citizen science, Indigenous knowledge and on the ground insights
- *Encourage greater private sector investment in the development and delivery of biosecurity innovations.*

Biosecurity Australia has produced a useful guidance for businesses with a role in biosecurity. The **Intergovernmental Agreement on Biosecurity** (2019) coordinates between national and state policies, plans, laws and regulations.

As an example, biosecurity regulations in Queensland include requirements related to –

- Registering as a biosecurity entity
- Notifying authorities of livestock pests and diseases
- Moving and selling livestock
- Biosecurity planning, including managing farm access. See **Biosecurity QLD**.

States, territories and industries have also developed Biosecurity strategies and plans with specific traceability elements. The **National Biosecurity Implementation Plan** lists these as follows:

Figure 1: State, Territory, Regional and Sectoral Biosecurity Strategies and Plans

Industry and joint strategies/plans	Jurisdictional strategies/ policies	Regional strategies	Sectoral and other strategies/plans
Animal Health Australia Strategic Plan 2020-2025	ACT Biosecurity Strategy 2016-2026	Biosecurity Strategy for Kangaroo Island 2017-2027	Animal Plan 2022 to 2027
Biosecurity Plan for the Avocado Industry 2020	Commonwealth Biosecurity 2030	Lord Howe Island Biosecurity Strategy 2022-2024	Aqua Plan 2022-2027
Biosecurity Plan for the Banana Industry 2019	Northem Territory Biosecurity Strategy 2016-2026	Northern Australia Biosecurity Strategy 2020-2030	Australian Pest Animal Strategy 2017-2027
Biosecurity Plan for the Vegetable Industry 2018	NSW Biosecurity and Food Safety Strategy 2022-2030	Pacific Biosecurity Strategy 2022 to 2027	Australian Weeds Strategy 2017-2027
Biosecurity Plan for the Viticulture Industry 2019	Queensland Blosecurity Strategy 2018-2023	Tasmanian Wilderness World Heritage Area Biosecurity Strategy 2021-2031	CSIRO Australia's Biosecurity Future 2020-2030
Industry Biosecurity Plan for the Grains Industry	Queensland Invasive Plants and Animals Strategy 2019-2024	Torres Strait and Northern Peninsula Area Biosecurity Strategy	Decade of Biosecurity 2021-2030
National Citrus Biosecurity Surveillance Strategy	South Australia's Biosecurity Policy 2020-2023	Torres Strait Regional Biosecurity Plan 2018- 2023	Marine Pest Plan 2018-2023
National Forest Biosecurity Surveillance Strategy 2018-2023	Tasmanian Biosecurity Strategy 2022-2027	–	National Environment and Community Blosecurity Research, Development and Extension Strategy 2021-2026
National Fruit Fly Strategy 2020-2025	Victoria's Biosecurity Statement 2022	–	National Marine Pest Surveillance Strategy 2019
National Grain Biosecurity Surveillance Strategy 2019-2029	Western Australian Biosecurity Strategy 2016-2025	–	National Plant Biosecurity Diagnostic Strategy 2021-2031
National Lumpy Skin Disease Action Plan	–	–	National Plant Biosecurity Preparedness Strategy 2021-2031
National Potato Industry - Biosecurity Surveillance Strategy 2020-2025	–	–	National Plant Biosecurity Strategy 2021-2031
National Sheep Industry Biosecurity Strategy 2019-2024	–	–	National Plant Biosecurity Surveillance Strategy 2021-2031
South Australian Livestock Biosecurity Blueprint 2030	–	–	Plant Biosecurity Research Initiative Strategy 2018-2023
Tropical Plant Industries Biosecurity Surveillance Strategy 2020-2025	–	–	–

Source: Department of Agriculture, Fisheries and Forestry, 2024

ACT Biosecurity Strategy **https://www.environment.act.gov.au/parks-conservation/plants-and-animals/Biosecurity/act-biosecurity-strategy**

NSW Biosecurity Strategy **https://www.dpi.nsw.gov.au/biosecurity/managing-biosecurity/nsw-bfs-strategy-2022-2030**; Your Role in Biosecurity **https://www.dpi.nsw.gov.au/biosecurity/your-role-in-biosecurity**

NT **https://nt.gov.au/industry/agriculture**

QLD **https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/laws/biosecurity**

SA **https://pir.sa.gov.au/biosecurity**

TAS **https://nre.tas.gov.au/biosecurity-tasmania**

VIC **https://agriculture.vic.gov.au/biosecurity**; **https://agriculture.vic.gov.au/biosecurity/food-safety**

WA **https://www.agric.wa.gov.au/biosecurity-quarantine/biosecurity**

4.3 Trade and Cross-border clearance

4.3.1 Prescribed goods export

International trade in Agrifood is controlled by a range of requirements outlined in Commonwealth legislation and rules. Additionally, international regulators in market jurisdictions have requirements related to imported foods, including traceability. Australian food exporters are, in effect, subject to these regulations.

Agricultural exports have specific requirements outlined in the *Export Control Act 2020* and *Export Rules 2020*. The objective of the legislation is to enable trade by ensuring that export commodities meet importing country requirements and are fit for purpose. If the commodity is a food, it must be:

- fit for human consumption,
- accurately described and labelled, and
- fully traceable, if necessary.

Goods that are "prescribed" in the legislation include:

- milk and milk products
- eggs and egg products
- fish and fish products
- live animals
- meat and meat products
- poultry meat and poultry meat products
- rabbit and ratite meat and rabbit and ratite meat products
- wild game meat and wild game meat products
- organic products
- plants and plant products
- wood and woodchips.

Requirements for specific export products are detailed in the DAFF Export and Trade website **https://www.agriculture.gov.au/biosecurity-trade/export**. As an example of prescribed goods control, the following regulations apply to red meat and livestock exports.

Live animal export

The *Export Control (Animals) Rules 2021* and *Export Controls (Animals) Amendment Northern Hemisphere Summer Prohibition Rules 2022* are key legislation and regulation settings for live animal export. Additionally, the **Australian Standards for the Export of Livestock** (ASEL) and requirements of importing countries (**Micor**) apply. Under Australian Government livestock export legislation, the Department of Agriculture, Fisheries and Forestry regulates licensed livestock exporters, operators of registered establishments and accredited veterinarians. As an example of market regulatory requirements, the EU has specific traceability requirements outlined in the EUCAS program. The **European Union Cattle Accreditation Scheme (EUCAS)** is a national animal production scheme that guarantees full traceability of all animals through the National Livestock Identification System (NLIS), linking individual animal identification to a central database. EUCAS allows Australia to meet the European Union (EU) market requirements for beef by segregating cattle that have never been treated with hormonal growth promotants (HGPs) at any time.

For animals to be exported to foreign feedlots or abattoirs (feeder and slaughter animals), the **Exporter Supply Chain Assurance System** (ESCAS) and **Exporter Supply Chain Assurance Operations** (ESCAO) requirements must be met, requiring traceability from unloading in the market country until the animal is slaughtered at an approved abattoir.

An example of efforts to improve export services for live animals is the work being undertaken to improve the functionality of the **Tracking Animal Certification for Export** (TRACE). This platform manages Notice of Intention and Export Licence processes for livestock and animal productive material exports. Improvements are being made to -

- streamline core document management
- identify changes made in NOI variation applications
- centralise and display approved exporter documents
- increase data capture and validations of livestock exporter's licences and their approved export markets
- reduce manual processing by transitioning animal reproductive material exporters to use TRACE.

Meat and meat products export

Export of red meat is regulated through the Export Control (Meat and Meat Products) Rules 2021. As co-regulator, AUSMEAT supports the Export Meat Program, which provides inspection, verification and certification services to the export meat industry in Australia. Services provided include -

- The provision of export certification acceptable to Australia's trading partners
- a scientifically based inspection system that underpins the production of wholesome meat and meat products
- a capacity for ongoing scientific review of the inspection system
- the supply of inspection services and veterinary oversight as required to all establishments registered for export with the Department of Agriculture, Fisheries and Forestry
- audit activities that verify industry compliance with the Export Control Act 2020 and subordinate rules, including overseas market access requirements and establishments' Approved Arrangements.

The **Electronic Legislation, Manuals and Essential References** (ELMER 3) is a repository of compliance guidance information for meat exporters.

Of interest is the **Meat Export Modernisation Program**, which aims to (italicised item relates particularly to traceability) –

- Modernise Australia's regulatory approach by embedding our systems and processes as best practice and undertaking assurance more efficiently.
- Reduce regulatory cost and administrative burden for processors and exporters of meat and meat products, creating opportunities for Australian exporters to be more competitive internationally.
- *Make better use of innovative technologies for robust, real-time and risk-based regulation.*
- Maintain and strengthen Australia's already strong global reputation for a robust and verifiable regulatory meat export system.
- Embed and demonstrate a culture of innovation, transparency and mutual respect between the department and the export meat sector.

4.3.2 Simplified Trade System

As a participant in the World Customs Organization's SAFE Framework of Standards to Secure and Facilitate Global Trade, and the World Trade Organization's Trade Facilitation Agreement (TFA), Australia is committed to the development of a trade single window. (TSW). The TFA has a specific requirement that contracting parties have a TSW.

"Implementing a simplified trading system is a complex undertaking. It must be simple to use, providing one point of entry for all approvals so data only has to be entered once, and one source of truth in the information about requirements. The complexity lies in coordinating the agencies to share information, adopt Regtech solutions, where the requirements are embedded in software and easily updated, ensure system interoperability as well as the ability for simultaneous processing of approvals across agencies, and have that all the data protected so that it can only be used as intended."

Lowy Institute, 2023

Australia's Customs Integrated Cargo System was an important step towards a TSW. Investment and work by the Single Trade System Taskforce has progressed as follows –

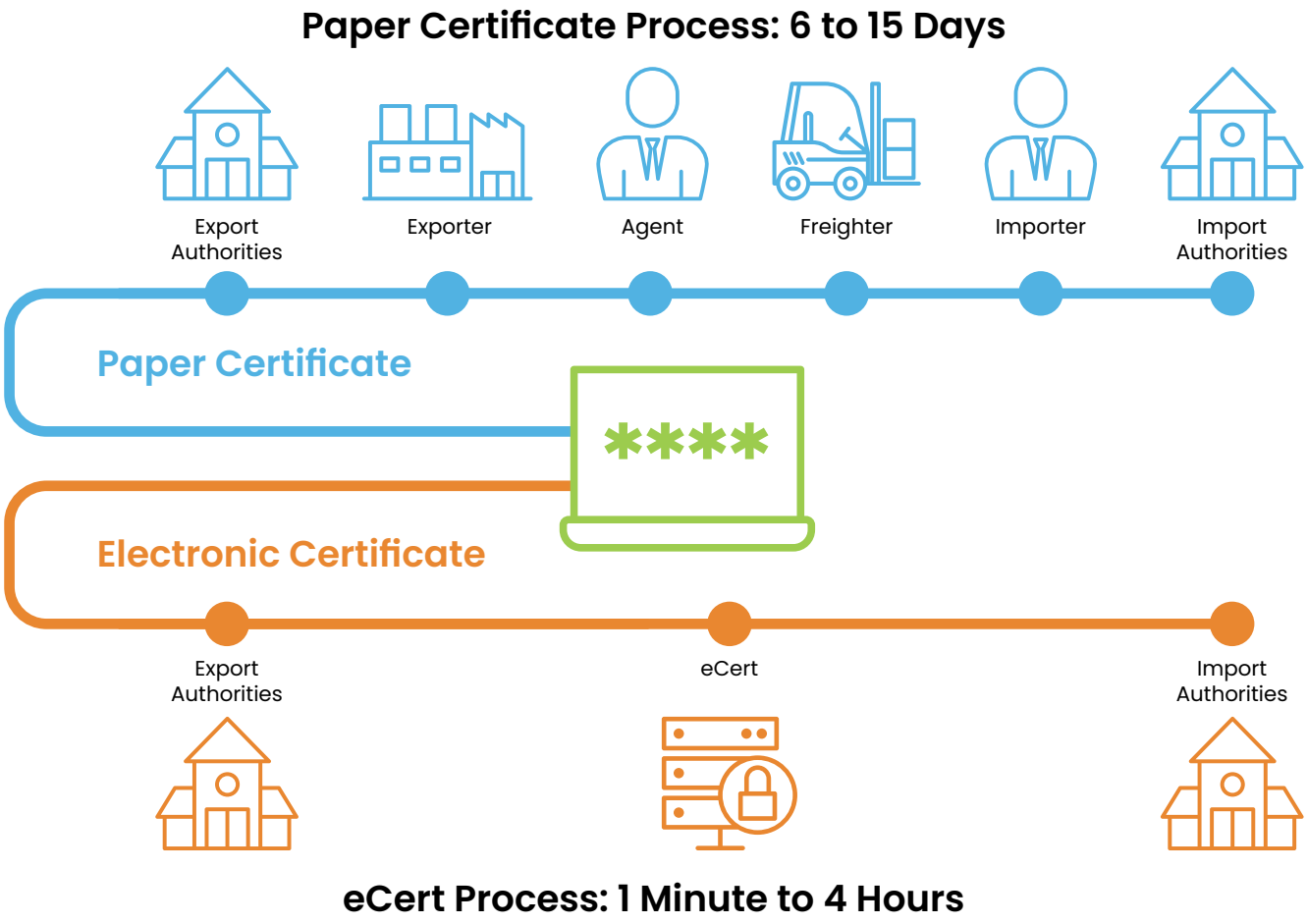
- provided advice to the government to inform effective investment for cross-border trade reforms, including a maritime single window, a biosecurity self-service portal and modernising agriculture and import systems
- identified common business pain points, such as problems accessing information, duplicative processes, complex regulation, inflexible technology and border delays
- calculated that the manual input of trade data adds approximately $450 per sea container and that information duplication costs businesses $431 million annually and $300 million in government charges, and
- recommended foundational projects such as "cross-border alignment" of information to be provided to the government with an initial focus on aligning the 14 "fit and proper person" tests in various regulations of different agencies.

The Taskforce has found that there are 29 agencies with a role at the border, more than 200 pieces of cross-border trade regulations and 145 federal ICT systems supporting cross-border trade.[4]

4 **https://www.rigbycooke.com.au/where-to-for-australia-on-the-trade-single-window/**

4.3.3 E-Certs

A recent regulatory streamlining initiative from the Department of Agriculture, Fisheries and Forestry for animal and plant export and import is e-certs. **E-certificates** replace paper-based phytosanitary and sanitary certificates with electronic certificates acceptable to both Australian regulators and trading partners.



Source: DAFF 2023

4.3.4 Imported goods

Imports of Agrifood products into Australia must be legal to import and meet biosecurity import conditions. These may be a permit or treatments to manage biosecurity risk. Biosecurity conditions are detailed in **BICON**. Import restrictions apply to food such as eggs and egg products, dairy products, meat and meat products, seeds and nuts, and fresh fruit and vegetables. Food imported for sale must be safe and comply with the **Country of Origin food Labelling Information Standard** and the **Australia New Zealand Food Standards Code**.

As an example, specific requirements related to import of meat products (considered high risk) are detailed as follows –

- **Beef and beef products (including food that contains beef or beef products as an ingredient)**
- **Cooked meat – manufactured or processed that is ready-to-eat**
- **Meat and edible offal – fresh, chilled or frozen**
- **Poultry meat that is cooked**
- **Poultry pâté, poultry paste and poultry liver that is cooked**
- **Raw beef and beef products**
- **Uncooked meat – manufactured or processed that is ready-to-eat**
- **Uncooked slow dry cured ready-to-eat ham**.

Importing food into Australia requires the food to be declared through a **Full Import Declaration** (FID). Importers must keep records defined in the Imported Food Control (Recordkeeping) Determination 2019 including contact details of suppliers or customers, descriptions of the food and batch or lot identification, transaction dates and quantities received or supplied.

Once a food has been cleared at the border, duties paid, and inspected, it is subject to all domestic food requirements such as consumer labelling prior to distribution.

4.4 Ethical labour

The International Labour Organisation (ILO) and global non-government organisations (NGOs) have identified workforce issues related to seafood supply chains that underly the risk of unethical labour practices globally, including:

- A lack of visibility in isolated and remote fishing operations
- A high proportion of migrant, undocumented workers
- Lack of training, inadequate language skills, and lack of enforcement of safety and labour standards
- Poor health conditions on vessels for workers (food, water, medicines)
- Long working hours while at sea
- A link with trans-national organised crime
- Outsourcing labour hire to third party suppliers making tracing labour opaque
- Long supply chains involving multiple players, jurisdictions, and legal frameworks.

In 2018, the Australian Parliament passed the Modern Slavery Bill. In 2022, the first review of the Act was initiated. This Act requires companies to produce a Statement on their efforts to eliminate slavery in all its forms from their operations and supply chains. A **public registry of these statements** includes several Agrifood supply chain companies that have this requirement (turnover of $100 million) and those that have voluntarily registered.

Laws and regulations cover workplace health and safety, visas and the right to work (see **VEVO**), pay rates and conditions (see **Fair Work Ombudsman**) and labour hire licensing.

4.5 Animal welfare

Animal welfare standards have been developed for land animals through a coordinated effort between Commonwealth and state and territory governments. **Animal Health Australia** and DAFF share oversight. The **Australian Animal Welfare Standards and Guidelines** provide practical guidance in compliance with state and territory legislation.

"The Australian Animal Welfare Standards and Guidelines cover producers' responsibilities and set out animals' needs in relation to feed and water; risk management in extreme weather, natural disasters, disease, injury and predation; facilities and equipment; handling and management/ husbandry; breeding management; and humane killing. For cattle, the Standards and Guidelines also cover castration, dehorning, and spaying; calf rearing systems; dairy management; and beef feedlots. For sheep, additional chapters address tail docking and castration; mulesing; and intensive sheep production systems. The Standards and Guidelines for goats cover both dairy management and intensive goat production systems. The Standards and Guidelines were developed to harmonise and streamline livestock welfare legislation in Australia, resulting in improved welfare in a way that is practical."

Livestock Production Assurance, 2023

Australian Capital Territory

ACT Government City Services; **Animal welfare legislation for the Australian Capital Territory**; *Animal Welfare Act 1982*; Animal Welfare Regulations 2001

New South Wales

NSW Government Department of Primary Industries; **Animal welfare legislation for New South Wales**; *Prevention of Cruelty to Animals Act 1979*; Prevention of Cruelty to Animals Regulation 2012; *Exhibited Animals Protection Act 1986*; Exhibited Animals Protection Regulation 2010; *Animal Research Act 1985*; Animal Research Regulation 2010

Northern Territory

NT Government Department of Industry, Tourism and Trade (formerly NT Department of Primary Industry and Resources); **Animal welfare legislation for the Northern Territory**; *Animal Welfare Act 1999*; Animal Welfare Regulations 2000

Queensland

QLD Department of Agriculture and Fisheries; **Animal welfare legislation for Queensland**; *Animal Care and Protection Act 2001*; Animal Care and Protection Regulation 2012

South Australia

SA Government Department of Primary Industries and Regions; **Animal welfare legislation for South Australia**; *Animal Welfare Act 1985*; Animal Welfare Regulations 2012

Tasmania

TAS Government Department of Primary Industries, Parks, Water and Environment; **Animal welfare legislation for Tasmania**; *Animal Welfare Act 1993*; Animal Welfare (Dogs) Regulations 2016; Animal Welfare (Domestic Poultry) Regulations 2013; Animal Welfare (General) Regulations 2013; Animal Welfare (Land Transport of Livestock) Regulations 2013; Animal Welfare (Pigs) Regulations 2013

Victoria

VIC Government Department of Jobs, Precincts and Regions (Agriculture Victoria); **Animal welfare legislation for Victoria**; *Prevention of Cruelty to Animals Act 1986*; Prevention of Cruelty to Animals Regulations 2019; Prevention of Cruelty to Animals (Domestic Fowl) Regulations 2016

Western Australia

WA Government Department of Primary Industries and Regional Development (Agriculture and Food Division); **Animal welfare legislation for Western Australia**; *Animal Welfare Act 2002*; Animal Welfare (General) Regulations 2003; Animal Welfare (Scientific Purposes) Regulations 2003; Animal Welfare (Commercial Poultry) Regulations 2008; Animal Welfare (Pig Industry) Regulations 2010

4.5.1 National Livestock Identification System and Livestock Production Assurance

Animal welfare is monitored mainly through a third-party compliance system operated through the **Integrity Systems Company**. The National Livestock Identification System is predicated on three fundamental traceability elements –

1. All livestock are identified by a visual or electronic eartag/device
2. All physical locations are identified by means of a Property Identification Code (PIC)
3. All livestock location data and movements are recorded in a central database.

The introduction of electronic National Vendor Declarations (eNVDs) is an example of the work to enable RegTech interfaces for livestock health monitoring and traceability in transit.

Meat & Livestock Australia has developed specific animal welfare advice for movement of livestock in its publication **Is the animal Fit to Load?**

Animal welfare is also a pillar of the **Livestock Production Assurance** program managed through the Integrity Systems Company.

4.5.2 Welfare of export livestock

For livestock exporters, the **Exporter Supply Chain Assurance System** (ESCAS) means that livestock exporters must ensure livestock control and traceability throughout the entire supply chain. This ensures that livestock remains within an approved supply chain and provides assurance that the subsequent handling and slaughter is conducted in accordance with international animal welfare recommendations.

Australia Exporters are also required to comply with the **Australian Standards for the Export of Livestock** (ASEL), which applies to the preparation of livestock for the voyage from farm through to on-board care, as well as State and Federal Government animal welfare regulations to assure the welfare of exported livestock.

4.6 Product claims and labelling

Food labelling is the means for end consumers to understand more about the nutritional qualities, contents, and quantity of product they purchase. In relation to traceability, there are requirements for food **Country of Origin** labelling under the *Country of Origin Food Labelling Information Standard 2016*.

Information required on nutritional panels compliant with the **ANZ Food Standards Code labelling** are supplied by states and territories. An example of labelling guidance **https://www.qld.gov.au/health/staying-healthy/food-pantry/food-labelling/about-food-labels**.

4.7 Weights and measures

The National Measurement Institute (NMI) is the peak body responsible for maintaining Australia's measurement system. The legal units of measurement are prescribed in terms of the **International System of Units** (SI).

NMI maintains Australia's primary measurement standards to realise the legal units of measurement, and provides traceability to the SI for all Australian made measurements. Traceability in measurement involves ensuring an unbroken chain of calibrations to primary measurement standards. Traceability helps ensure that measurements are comparable to each other and gives industry, researchers, regulators, and consumers' confidence in the accuracy of measurement results.

NMI fulfils these important trade roles by -

- developing and maintaining standards of measurement for physical quantities
- developing **chemical and biological reference materials**
- delivering **proficiency testing services**
- delivering measurement services.[5]

5 **https://www.industry.gov.au/national-measurement-institute/australias-measurement-system**

5

International RegTech applications

This section highlights international regtech developments and industry applications related to traceability. It is not a comprehensive listing of regulatory settings or all available solutions.

5.1 China

Blockchain Service Network (BSN) China and BSN International

BSN is China's blockchain-based domestic and cross-border traceability and logistics platform, developed to support e-commerce activity.

> "The Blockchain-based Service Network (hereinafter "Service Network" or "BSN") is a cross-cloud, cross-portal, cross-framework, global infrastructure network used to deploy and operate all types of blockchain applications. BSN aims to change the existing problem of the high cost of developing and deploying blockchain applications by providing public blockchain resource environments to developers, just like the internet, thus greatly reducing costs associated with the development, deployment, operations, maintenance, and regulation of blockchain applications and, thereby, accelerating the development and universal adaptation of blockchain technology."

BSN White Paper 2020

This platform was trialled in Hangzhou and Zhejiang provinces in 2019 and reduced border clearance times from 191 hours to 27 hours and to 12 minutes for Chinese exports. Nanning Customs, with 26 border crossing with VietNam along an 800 km border, is using **Powerbridge Blockchain Cross-Border Compliance** to manage cross-border goods clearances.

Foodgates

Foodgates is a food safety regtech application has been developed using a BSN-compliant France-China food platform. The platform uses blockchain to supply data from producer in France through to retail in China. A component of this platform is a private blockchain to enable Chinese regulators to access required data on shipments. It anticipates that China Customs will eventually adopt this form of regulatory data exchange. The Chinese Government has a strategy to further develop the use of blockchain as part of its e-government policy (Vigeure & Davidson 2023).

5.2 United States

FSIS Food Recall API

The U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS) launched a new feature on its website that enables software developers to access data on recalls and public health alerts through an application programming interface (API). This is FSIS' first public API and the organization says it will transform the way the public can benefit from this critical and timely public health information.

National Uniform Eartagging System

Today, a National Uniform Eartag¬ging System (NUES) is in effect in the United States. It is a numbering system for the official identification of individual animals that provides a nationally unique identification number for each animal and enables the tracing of livestock move¬ment interstate (USDA 2020).

AgGateway

AgGateway is a global non-profit organisation with a mission to develop the resources and relationships that drive digital connectivity in global agriculture and related industries.

The Traceability Initiative in North America is working in the areas of Seeding and Provenance (which includes grain traceability). In Europe, AgGateway is standing up a special interest group on Farm and Crop field identification, with the goal to enable the linkage of crop-related data from different industry sources through standard identifiers. Benefits of these efforts include better product management and customer service, as well as contributing to food safety and regulatory compliance.

USDA's Partnerships for Climate Smart Commodities

"This federal program from the U.S. Department of Agriculture represents the first significant step-up of funding for sustainable agriculture in the United States. The program provides $3.1 billion in public investment and incentives for developing commodity supply chains that can verify that the crops are produced using a suite of climate-smart agricultural practices."

Olsen 2023.

5.3 Canada

Sustainable Canadian Agricultural Partnership

A federal, provincial, and territorial initiative, this partnership funds traceability and value chain programs to whole-of-supply-chain digitisation.

In British Columbia, for example, the **Traceability Value Chain** (TVC) program provides cost-shared funding up to $75,000 (USD) towards the adoption of information sharing systems that will enhance agrifood and seafood traceability among supply chain partners.

The TVC program is intended for agriculture, food and seafood sector organizations, commercial food hubs and value chain partners.

Quebec Centre for Inter-university Research and Analysis on Organisations (CIRANO)

In a paper produced in 2021 by CIRANO, titled Traceability and Succession of the Quebec Agri-Food Sector Depends on an Acceleration of Digitization, this grouping of major Canadian companies and universities pointed to the regtech challenges and futures in digitised Agrifood.

"In a digital world, access to and exchange of information and data between the economic agents of a factory, a company and even an industry are therefore radically modified. Indeed, members of a board of directors as well as the regulators of an industry are now able to request and obtain a much higher level of information granularity with respect to data, information, and audit trails. This new context of transparency makes it easier to identify and measure the positive and negative externalities generated by economic activity.

The supply chains of a digitized industry become transparent, as the traceability of the ecological footprint of each stage of the production process is implemented by the data generated by digitization. This is where the link between the digital transition and the ecological transition is made (Poore et al., 2018; Brady et al., 2019; Kaan et al., 2017).

Even if this information is private, regulators and governments in general may, through legislation or other means, require access to it. This means that the concerns of the public (who will also push for this data) and governments about the impact of industrial, agricultural and commercial activities on the environment, climate, public health, noise and scenic beauty will be better addressed in a digital world as this information will exist and will be available.

This increased degree of transparency may induce a defensive attitude on the part of the company, but, on the other hand, it may also incite it to seek a win-win solution for the private and the public and thus find its own interest. Indeed, in a world of information sharing, the regulatory approach to be favored will rather be the

adoption of a joint risk management and prevention program to reduce negative externalities and favor positive externalities. The aim is then to move towards the concept of smart regulation (see Eisen, 2013; Zetzsche et al., 2018; Saiz-Rubio et al., 2020)."

Rousseau & Mondin 2021

Companies promoting blockchain solutions for agricultural sector supply chains in Canada were listed (Demestichus 2020) in Figure 3 as follows.

Company of Commercial Product	Website
AgriChain	https://agrichain.com
AgriDigital	httos://www.agridigital.io
AgriLedger	http://www.agriledger.io/about/
ATQ et Bœuf Québec	https://www.atq.oc.ca/fr/accueil/l-actualite-en-revue/513-la-chaine-de-blocs-sera-testee-dans-l-agroalimentaire-d-ici
arc-net	https://arc-net.io
Bühler Smart Supply Chain	https://digital.bruhlergroup.com/smartsupplvchain/
Connecting Food	https://connecting-food.com/
Demeter	https://demeter.life
DOWNSTREAM	https://www.down-stream.io
Etherisc	https://etherisc.com/
Fishcoin	https://fishcoin.co
Honeysuckle White	https://www.honevsucklewhite.com
IBM Food Trust	https://www.ibm.com/blockchain/solutions/food-trust
Provenance from Shore to Plate	httos://www.provenance.org/tracking-tuna-on-the-blockchain
Ripe.io	https://www.ripe.io
TE-FOOD	https://tefoodint.com
Worldcovr	https://www.worldcovr.com/

ThisFish

Developed by a Canadian company in 2017, **ThisFish** uses AI, IoT sensors, computer vision and a consumer-facing app to enable transparency of seafood supply chains from harvest to retail. In the compliance space, it collates, and uploads, catch certificates and compliance documents, is interoperable with government and third-party platforms for reporting, complies with GDST, traceability and other data standards.

Agrian and Telus

In November 2020, with an eye toward industry digitisation, Canadian telecom company Telus launched Telus Agriculture after it acquired seven ag companies. Among those seven acquisitions was Agrian and its management platform for precision, agronomy, sustainability, analytics and compliance. The Agrian database is free to use, and it features more than 12,000 manufacturer-checked and indemnified labels.[6]

6 The Daily Scoop https://www.thedailyscoop.com/news/retail-industry/trio-compliance-acquisitions-may-boost-traceability

5.4 European Union

Digital Product Passports

Digital Product Passports are part of an EU strategy to advance the sustainability and circularity of products through the **Ecodesign for Sustainable Products Regulation (ESPR)**.

A Digital Product Passport (DPP) will be mandatory for some products shipped to and within the European Union (EU) as early as 2026 as part of the EU's European Green Deal (EGD) and Circular Economy Action Plan (CEAP). Eventually, nearly all products entering EU nations will require a DPP, affecting local and international businesses in numerous industries. A DPP will forever transform how physical goods are tracked through the supply chain, providing sustainability-related information via data carriers like QR codes.

As the European continent pushes for net-zero emissions by 2050, the role of DPPs is paramount. They measure a product's environmental and safety impact, providing a clear path for businesses to align with their green goals. This level of supply chain transparency not only supports a business' sustainability efforts, but also has the potential to win over the hearts and minds of eco-conscious consumers by preventing greenwashing.[7]

For textiles, DPP is the combination of an identifier, the granularity of which can vary throughout the lifecycle (from a batch to a single product), and data characterising the product, processes and stakeholders, collected and used by all the stakeholders involved in the circularity process.

Currently the DPP regulation applies to target products including –

- Batteries & vehicles
- Chemicals
- Construction & buildings
- Electronics & Information and Communications Technology (ICT)
- Furniture
- Plastics
- Textiles.

It is notable that the EU is supporting the implementation requirements for the DPP (CIRPASS), funded by the European Commission under the Digital Europe Programme (DIGITAL) and DIGITALEUROPE is leading the work strand on communication, dissemination, and stakeholder engagement.[8]

Tasks underway include –

- Present an unambiguous cross-sectoral definition and description of the DPP
- Define a cross-sectoral product data model for the DPP with demonstrated usefulness for the Circular Economy
- Propose an open DPP data exchange protocol adapted to the needs of CE stakeholders and propose such a protocol based on up-to-date digital technologies
- Build stakeholder consensus on key data for circularity and related open European and global vocabulary standards to be included in the DPP for the batteries, electronics, and textiles value chains.
- Develop use cases and roadmaps for piloting, deployment, and circular business value generation of cross-sectoral DPPs.

7 ABI Research **https://www.abiresearch.com/blogs/2024/04/23/digital-product-passports-explained/#:~:text=Eventually%2C%20nearly%20all%20products%20entering,data%20carriers%20like%20QR%20codes**

8 Digital Europe **https://www.digitaleurope.org/projects/digital-product-passport/**

EU Titan Project

TITAN has the following objectives:

- To develop and demonstrate co-created food transparency solutions that improve the safety and authenticity of our food.
- To provide a range of co-created demonstrated transparency initiatives and solutions that will facilitate consumers making improved food choices.
- To provide food stakeholders with fit-for-purpose, state-of-the-art solutions for increasing and monitoring transparency in the food system.
- To ensure all solutions are co-created, demand-driven, and applicable to small and large business.
- To develop a fertile and vibrant network of transparency technology businesses that will form the basis of a European incubator of next-generation food transparency solution providers for realizing the EU FTF strategy within the EGD.
- To engage, communicate and disseminate innovative solutions to inform stakeholders and maximize upscaling, transferability, exploitation, and take-up.

This four-year project will deliver transparency solutions in the areas of food safety and authenticity, traceability, health and sustainability, and improving information to the consumer. TITAN will develop 15 innovative solutions including exploiting DNA-based Rapid Detection Methods, Blockchain, AI, and IoT to

- enhance transparency in agri-food businesses with a focus on SMEs,
- improve food choices by providing more transparent information to the consumer,
- enhance food safety and authenticity of products, and
- provide improved information on the health and sustainability of food products.

The **EU Titan Project** in collaboration with industry and organisations such as the **Milan Polytechnic Digital Innovation Observatory**, are working to develop tools to support traceability and compliance in the Agrifood sector.

Relevant projects include –

- **Ploutos_H2020**
- **QuantiFarm**
- **Farmtopia**

Proagrica and chemical traceability

Proagrica has bought several companies holding compliance labelling data for crop chemicals, to consolidate efforts to ensure sustainable usage. In purchasing companies such as CDMS and integrating with Proagrica's Sirrus data, agronomists can check the supplier. The company points out that compliance activities cover not only government requirements, but consumers seeking more information and assurance on what has been sprayed on food.

Serialized Datamatrix encodings according to international standards (e.g. GS1) on sales packages and logistics units will in future help to reliably cover the traceability of the product, batch and sales unit across all logistics levels in (agricultural) chemicals. Proagrica is part of the European Crop Protection Association, developer of the **CRISTAL** common practices for bar coding and labelling of agro products guidance in 2017.

"Following consultation, Proagrica implemented a solution which combines EDI (electronic data interchange) and portals, fitting seamlessly within each business' ERP system, allowing connection between partners and a complete overview of each products' history.

All transactions are recorded electronically for both the distributor and manufacturer, with all orders being traceable by their point of origin and manufacture date – completely eliminating the need to order a recall of an entire range.

Portals have granted advanced functionality for both manufacturers and distributors. Manufacturers can open orders, reply, and see delivery notes and invoice data. For distributors, an ecommerce-style portal makes purchasing simpler and more convenient.

Dashboards that visualize product histories and credit partners in real-time, facilitating simpler product recalls and greater understanding of transaction history.

Agro CloSer – the new legal entity founded by Agrodis and Nefyto to lead this drive towards connectivity, is now piloting data integration for the Dutch crop protection market."

Proagrica

European Institute for Technology Food

EIT Food is one of the EU's 8 Innovation and Technology institutes created in 2008 to drive innovation and entrepreneurship across Europe.

EIT Food invests in projects, organisations and individuals contributing to a healthy and sustainable food system. The Institute funds startups and has established the EIT Food Acceleration Network to mentor outstanding food and agriculture startups.

In relation to regtech and traceability, **EIT Food** has invested in several digital traceability startups and projects, such as **Tracifier** and **Pig Tracker**.

CATCH – EU Fisheries Control and Digization

The EU has announced that the **CATCH technology** will be made mandatory in 2026. This is a digital tool to trace all imported seafood into the EU.

"The control of fishing activities will be **entirely digitalised** – from the net to the plate - by gradually expanding the geo-localisation and electronic reporting to all fishing vessels, irrespective of their size, and mandating catch recording and reporting in certain recreational fisheries. All fishing vessels will be tracked via a **vessel tracking systems (VMS)** and all catches will need to be recorded via electronic means. User-friendly tools such as apps on mobile devices will be used to remove the burden for fishers. For the first time, **full digital traceability will be mandatory** along the supply chain, enabling the authorities to more effectively **tackle illegal fishing**. The system will be mandatory for fresh and frozen fishery and aquaculture products. It will gradually be expanded to processed fishery and aquaculture products, such as canned products, giving consumers more information on the origin. These rules will apply to all fishery and aquaculture products, including imports."

EU 2024

EveryFish EU is using a range of technologies, including AI, to monitor catches and ensure compliance.

Regulators' sticks and carrots

Olsen (2023) makes the point that European Union and the United States have taken different tacks to encourage companies to get serious about traceability. The EU has relied more on policy regulation (the stick) while the U.S. has focused on payments and subsidies (carrots). The critical ones from each adding urgency to companies' attempts to trace supply chains:

EU Corporate Sustainability Reporting Directive (CSRD)

"About **3,000**-plus American companies that operate in Europe must be prepared to deliver CSRD reports to the EU between 2025 and 2029 (depending on their size). In the Biodiversity and Ecosystem Services Standard, **ESRS E4**, one disclosure requirement explicitly requires traceability to a company's raw materials due to a business's local impacts and dependencies on nature."

EU Deforestation Free Regulation (EUDR)

"The **EUDR** represents an expansion of laws that focus on timber products from deforestation caused by illegal logging. It will require any company importing or exporting seven specific commodities (cocoa, coffee, soy, palm oil, wood, rubber and cattle) and their derivatives to and from the bloc to be able to prove that these products did not come from land deforested after 2020."

Olsen, 2023

5.5 United Kingdom

Trase

Trase is a supply chain mapping solution developed to assess risk in global supply chains and provide a level of traceability related to deforestation.

5.6 India

Cropin Trace

Cropin has developed a range of AgriTech solutions, including a cloud-based traceability solution which has ease of use for SME farmers.

5.7 New Zealand

A summary of the status of traceability technologies in New Zealand describes the following -

Digital agriculture (e.g. artificial intelligence, traceability technologies)

CRI's, universities, industry bodies (e.g. DairyNZ), farmer cooperatives (e.g. Livestock Improvement Corporation, Ballance AgriNutrients) and private research institutes (e.g. PlantTech Research Institute) researching, developing and commercialising digital technologies, agriculture practices, and barriers to adoption. Digital innovation led by individual and groups of farmers. Existing (e.g. Gallagher), growing (e.g. Rezare Systems) and startup (e.g. Halter NZ) commercial companies developing digital technologies. Agrilech New Zealand - an association of organisations and individuals growing. New Zealand's capability to maximise opportunities from agritech. Projects on baselining adoption, agricultural data interoperability and sharing examples. Agrilech Industry Transformation Plan (ITP) provides a Government vision for the agritech sector, along with Government actions to realise this vision in partnership with industry. KPMG facilitated NZ Agrifood Data Exchange to develop examples of ecosystem-level sharing of data. Ministry for Primary Industry (MPI) initiatives on model and data interoperability. Maori Data Sovereignty in context of genomic data broadening to include all data.

Moving from experimentation to acceleration as digital technologies becoming established on more farms and more agritech companies establish. Emergence of an ecosystem of agritech providers, Government, industry and research is occurring through facilitation by cross organisation groups such as AgriTech NZ, AgriTechITP and KPMG. Very early phase of institutionalisation with questions regarding data governance, Māori data sovereignty beginning to be raised but not yet addressed in policy. Many actors in the ecosystem and now emerging attempts at coordination of activities (e.g. MPI and KPMG). Limited initiatives debating the direction of development and desired outcomes from digital agriculture. Currently described as ways to increase efficiency and productivity and meet environmental and animal welfare requirements of regulations and consumers.

https://www.agresearch.co.nz/nzbida/

https://www.planttechresearch.com/

https://am.gallagher.com/en-NZ

https://halterhq.com/

https://agritechnz.org.nz/

https://home.kpmg/au/en/home/media/press-releases/2021/09/ new-data-exchange-revolution-ise-australian-agrifood-sector-14-september-2021.html

https://www.mbie.govt.nz/dmsdocument/11572-growing-innovative-industries-in-new-zealand-agritech-industry-transformation-plan-july-2020-pdf

https://home.kpmg/au/en/home/media/press-releases/2021/09/ new-data-exchange-revolution-ise-australian-agrifood-sector-14-september-2021.html

https://www.temanararaunga.maori.nz/

Klerkx et al, 2023

Halliday (2022) lists a number of blockchain initiatives in the beef supply chain in his investigation of the use of blockchain technology in New Zealand.

- TE-FOOD describes itself as "The #1 end-to-end food traceability solution on blockchain" and claims to service over 6000 business customers worldwide (**https://te-food.com/**).It has recently embarked on a large traceability project for pork in Vietnam"
- The Botswana Ministry of Agriculture is developing a blockchain-enabled IoT system for tracking cattle (**https://chester-beard.medium.com/cattle-iot-and-blockchain-in-botswana-4b059e64deca**).
- Zimbabwe is currently seeing the rollout of the E-Livestock Global traceability system, which sists on the Provenance blockchain developed by Mastercard (**httos://www.engineeringnews.co.za/article/blockchain-based-e-livestock-supply-chain-traceability-system-launched-in-zimbabwe-2021-06-18/rep_id:4136**).
- Wyoming-based BeefChain (**https://beefchain.com/**) has been certified by the US Department of Agriculture as a Process Verified Programme, becoming the first blockchain company to do so.
- BeefLedger (**https://beefledger.io/**) is an Australian blockchain company offering end-to-end traceability solutions for beef production. Beefledger was placed in external administration in March 2022.
- TraceX Technologies (**https://tracextech.com/**) is a blockchain powered food traceability platform based in India.
- NSF (**https://www.nsf.org/testing/food**) is a global provider of testing, inspection, and certification services. In 2020 it formed a consortium with Fujitsu UK, the Institute of Global Food Security at Queen's University, B4B Telecoms Ltd and Samsung Electronics to build a blockchain-based agri-food supply chain system called NSF-Verify (**https://www.nsf.org/news/new-consortium-uses-blockchain-technology-to-protect-northern-ireland-agriculture-products-in-world-markets**).
- Neogen (**https://www.neogen.com/**), a US-based provider of genetic and diagnostic testing technologies, has partnered with blockchain provider Ripe Technology Inc **https://www.ripe.io/**) to automate and enhance food safety (**https://www.neogen.com/neocenter/press-releases/neogen-partners-with-ripe-io-to-bring-blockchain-to-food-safety-and-animal-genomics/**).

5.8 Vietnam

Vietnam has committed to national Agrifood traceability and is focused on delivering a national traceability portal and supporting uptake through standards harmonisation and regulation by 2025. This will enhance existing provincial initiatives in Quang Ninh, Hoa Binh, Hanoi City and Hun Yen, where industry data is being integrated with regulatory platforms.

Digital solutions for fresh produce have been examined for applicability to Vietnam (World Bank 2022) and some extant solutions are listed:

6

Australian RegTech developments and applications to support traceability

Australia's National Agricultural Traceability Strategy specifically articulates a pressing challenge of

"Alignment of government and commercial regulatory and compliance requirements to reduce regulatory burden, to support market access and promote consistent supply chain procedures."

6.1 Regulator initiatives

The regulator mindset is evolving in recent years. For regulators, there is recognition of –

- Market structures. An example is the economic regulation of seaport terminal and storage networks.
- Co-design and co-regulatory modes. An example is the DAFF-Grain Trade Australia Grain Supply Chain Code, the National Livestock Identifications System and Electronic National Vendor Declaration
- Industry responsibility for achieving regulatory outcomes.
- Use of industry and government datasets
- Automation and digitalisation of compliance interfaces to reduce the industry burden.

An example of the regulatory mindset evolution is detailed by Safe Food Queensland in its 2023 Annual Report in relation to its food safety regulatory role –

Designing a new regulatory approach for now and the future

"As outlined in Safe Food's Strategic Plan 2020-24, we are currently modernising our systems to better support a regulatory delivery model that aims to ensure a best practice approach to food regulation which acknowledges the challenges facing Queensland's dynamic food industry. During 2022–23 Safe Food commenced the design of its new regulatory approach, which will provide an opportunity for stakeholders to have input into the creation of a more collaborative, proactive, transparent, and responsive regulatory environment for both accredited food businesses and the agency. This work is being progressed in unison with the agency's digital transformation and a new business model. The new approach will be developed with reference to the regulatory delivery model, a conceptual framework used to steer improvements to regulatory delivery. The model is based on the understanding that successful regulation depends as much on successful implementation as it does on design. The model was developed as a mechanism to improve the impact of regulation, and to encourage the use of regulation to promote protection, prosperity, and efficiency. This runs contrary to traditional hierarchical models of regulation, which rely on compliance and enforcement methods and have been proven to be largely ineffective in demonstrating achievement of regulatory outcomes."

Some examples of effective industry compliance initiatives and applications related to traceability are detailed in the following section.

6.2 Horticulture

Hort Innovation Australia undertook a review of technologies being used for traceability in the apple and pear production and supply chain. It found that -

"To date there are no purpose specific whole of chain fruit product traceability system solutions and only a few pilots to address a point of origin trace. Consequently, traceability data and the variety of associated contextual information are fragmented across systems and there are many significant improvements in access and efficiencies that could be achieved for the industry with a purpose-built system."

Hort Innovation Technology Review Apple and Pear Production and Supply Chain (2021)

The industry has also integrated industry standards under **FreshCare** and the **Harmonised Australia Retailer Produce Scheme** (HARPS), to streamline compliance for fresh produce suppliers. Freshcare is now embarking on an exploration of where and how efficiencies can be created in compliance activities using RegTech applications. **Freshcare and Horticulture Innovation Australia** are presently undertaking a project to evaluate the multiple compliance layers of Australian horticultural export value chains to deliver a RegTech framework that verifies statements of claims and removes duplication.

Successful traceability pilots have been conducted for **citrus fruits**, **potatoes and cherries** in 2022. Horticulture Innovation Australia has funded and supported several traceability proof-of-concept projects, covering cherries, potatoes, melons, apple and pear, citrus and table grapes. See **https://agriculture.vic.gov.au/export/traceability/traceability-research-and-development**; **https://www.dpi.nsw.gov.au/agriculture/horticulture/stone-fruit/industry-documents/using-a-standards-based-traceability-system-to-improve-horticulture-supply-chains**; **https://www.agric.wa.gov.au/biosecurity/plant-and-plant-product-traceability-project**.

A range of technologies are evident, from RFID, QR code, data loggers, IoT sensors, isotopic authentication testing, APIs, are used to identify and track product attributes along supply chains.

Testing Traceability Systems Grant Program

The Western Australian Department of Primary Industries and Regional Development (DPIRD) has invested in this program to assist plant product growers and supply chain participants to test traceability systems to provide valuable insights into the key components, which systems work best, and the challenges and costs faced in implementing traceability. The program, administered by the Department of Primary Industries and Regional Development, offered eligible recipients up to $25 000 (exclusive of GST), with a total of $100 000 (exclusive of GST) available. Projects were conducted in 2022-23 financial year.

With new requirements for traceability of melons, leafy greens, and berries (see **FSANZ requirements**) it is expected that further technology uptake will support traceability in horticulture.

6.3 Dairy

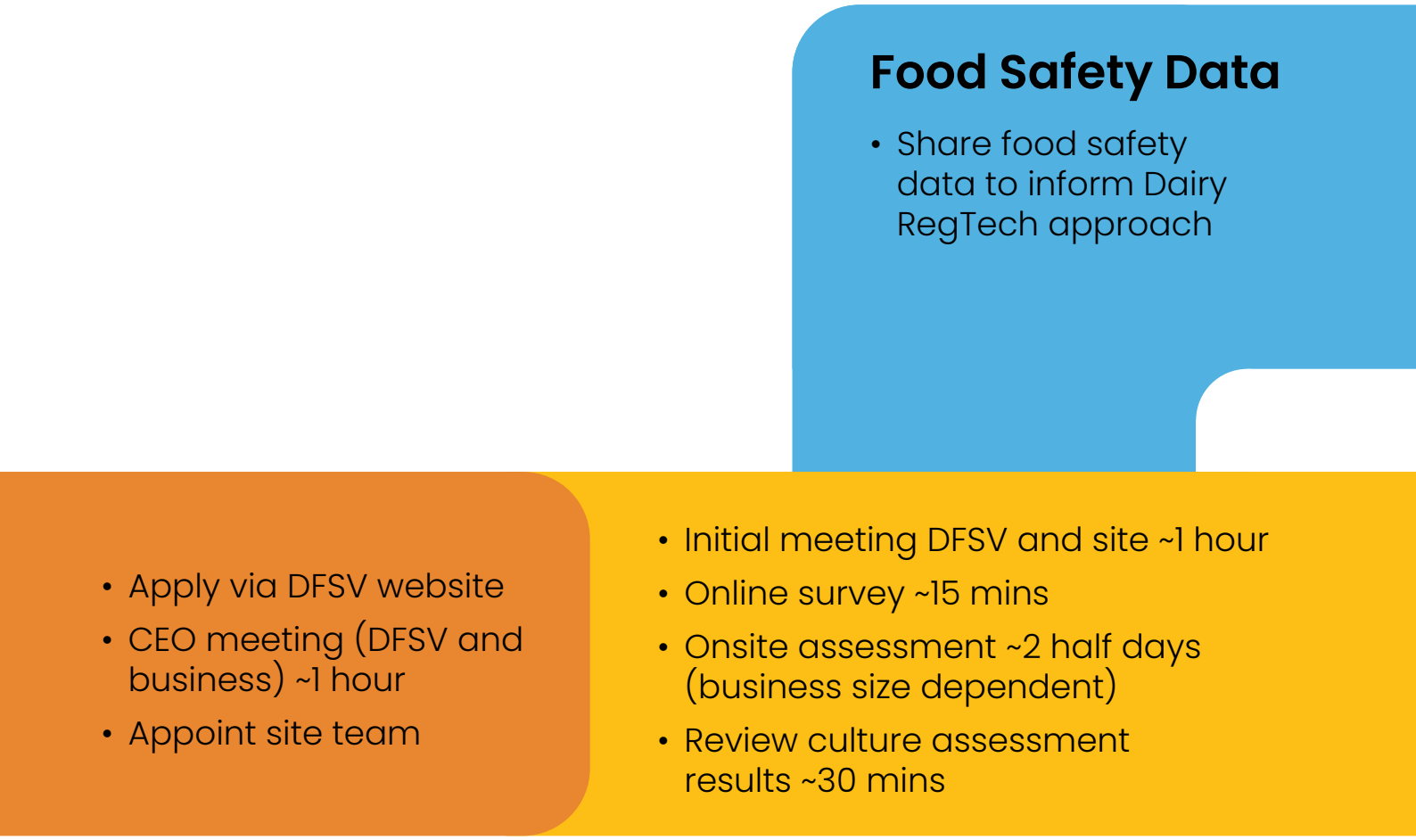
Dairy RegTech Program is a food safety culture program developed to support industry to comply with the requirements of Dairy Food Safety Victoria.

"Dairy RegTech supports DFSV's efforts to safeguard public health through a robust regulatory framework. This approach recognises that food safety systems depend on the people who implement them, and importantly the food safety culture of a business.

While sites who transition to Dairy RegTech will continue to undergo compliance audits, these audits will be targeted to focus on areas that support better food safety practices and incorporate the other information gathered through Dairy RegTech.

Transitioning to Dairy RegTech is voluntary for dairy manufacturers. It is not yet available for dairy farmers."

Source: Dairy Food Safety Victoria



South Australian Dairyfarmers Association (SADA) has taken leadership in testing a traceability solution based on distributed ledger technology through the **Datahash Dairy Alpha trial** and subsequent expansion through dairy supply chains.

"The Datahash Event Ledger has recorded immutable data, meaning the data are available indefinitely and cannot be tampered with. Data events are encrypted as a message on the Hedera Consensus Service Network (Hedera Hashgraph proofs). These two functions allow us to ensure data provenance so the complete history of a data event could be retrieved (if necessary) with Hedera Hashgraph proofs testifying to that history. The importance of this function is to allow accurate data synchronisation between systems as well as independent verification of events where necessary for compliance-based activities."

Strengthen

Food Safety Culture

- Implement action plan
- Ongoing review of action plan
- Re-assessment based
- on progress of action plan

Dairy RegTech Adoptor

- Tailored and targeted DFSV audits
- Ongoing food safety data analysis
- Ongoing support from DFSV
- Access to Food Safety Culture
- Community of Practice

- Attend workshop and develop action plan ~1 day

Plan

6.4 Red Meat and Livestock

AgLive integration with on-farm management systems such as **Gallagher Animal Management System** for on-farm and farm exit traceability of livestock. Pioneering the mobile e-NVD with Integrity Systems Company, AgLive is an integrator of on-farm data. This solution links directly with regulatory platforms, to automate upload of compliance data. A digital token for each animal can link chemical application to compliance requirements (growth promotants, withholding periods) and enable processors and exporters to assess animal health and risk prior to them leaving the property of origin.

AgLive can link farm data related to soil, water, environmental conditions and farming techniques to individual animals, to underpin sustainability claims and emerging regulatory requirements. Certifications attached via a digital token, and, eventually, a digital twin, will support compliance in export markets and enable verification related to organic or Halal status to attach to each animal.

If you operate in a global market you can't just use Australian standards. We've got to use the standards that are more acceptable in those markets, particularly in the European market and now the American market. We're all becoming very conscious of environment and animal welfare.

XIoT livestock tag

Xsights has developed a livestock traceability system which is currently deployed at Craig Mostyn Group in Western Australia.

"Specifically for Livestock, the capability exists to track, process and report using a combination of the XIoT tag, QR codes, and a secure web-accessible data system that multiple key stakeholders can interface with.

Using this approach, information about the health, origin, and movement of livestock can be recorded in a secure and highly scalable way, and linked to a unique QR code that is attached to each animal or its identification documents.

For example, a farmer could attach a QR code to an animal's XIoT tag, linking it to detailed information about the animal's unique identification number, breed, age, health status, vaccinations, and any other relevant information.

This information is recorded on a secure cloud-based platform, enabling intermediaries, such as feedlot operators, processors, and retailers, to scan the QR code and access the information in real-time, ensuring ready access to key information with which to inform traceability and provide transparency."

Farm biosecurity

One Biosecurity (1B) is South Australia's voluntary, free on-farm biosecurity management program for livestock producers. Developed in collaboration with key industry groups, including Livestock SA, the on line 1B portal helps to protect animal health. It supports producers to adopt good on-farm biosecurity practices and promotes risk management. In addition to creating a Biosecurity Plan for the individual enterprise, the One Biosecurity Portal enables completion and download of Health Declarations, Enhanced Abattoir Results, prefilled Saleyard Placards.

Exoflare, in collaboration with Meat & Livestock Australia, developed a farm access application, to manage biosecurity risk from people accessing the farm and in livestock transport operations.

6.5 Grains, Pulses and Oilseeds

Pulses Australia has divested activities related to licencing and operational guidance to Grains Australia (part of Grains Research & Development Corporation), Grain Producers Australia and Grain Traders Australia. Specific compliance support to pulse producers and processors is available through these organisations.

Grain Traders Australia (GTA) is working with DAFF to deliver a voluntary standard for both domestic and international grain supply chains, the **Grain Storage Assets and Management Standard**.

"Both GTA and the department are pursuing a shared goal to deliver efficiencies to Australian grain industry participants through recognition of the Standard to meet the department's regulatory requirements. We both believe this will deliver efficiencies to Australian grain industry participants. The Standard will set out how industry will meet the department's regulatory goals. The department must be able to assess the Standard against the Commonwealth's legislative export requirements for entities involved in the grain export supply chain. This will provide increased clarity, simplicity and confidence in the export grain supply chain, from both a commercial and a regulatory perspective. While the Standard will be voluntary, through defining the requirements for compliance via different levels of operation, the Standard will also be able to be adopted by the domestic industry. In those instances, the requirements of the department will not be applicable. Additionally, as part of other government initiatives, **the project to develop the Standard has highlighted opportunities for industry to adopt new technology to sample and test grain for quality and phytosanitary purposes**. This will help make assessment more accurate, improve confidence in the inspection process and could also reduce costs to industry and the department. **This Standard will include elements of that technology adoption that may be realised during the project timeline by industry and the Department, or alternatively after the project**. Longer term the Standard will be the basis for an alternative assurance arrangement, in which the department recognises the GTA Standard and the proposed auditing and assurance framework in meeting the regulatory requirements. The department will consider intervening less as the level of assurance increases. Industry will show higher levels of assurance through meeting the standards; using nationally recognised technology; the compliance history of establishments; industry quality management systems."[9]

DAFF April 2023

9 https://www.agriculture.gov.au/biosecurity-trade/export/controlled-goods/plants-plant-products/busting-congestion-for-plant-exports#industry-systems-recognition-for-grain-project

6.6 Seafood

Western Rock Lobster Traceability Compliance Proof-of-Concept

In 2022, as a proof-of-concept under the auspices of the Australian Ag Data Exchange, the WA DPIRD, Western Rock Lobster Council and Fisheries RDC, using the IBM Food Trust platform, brought together a range of technologies and data sources to create a traceable, data sharing capability to trace rock lobster and supply data for regulatory compliance.

Laser labelling of shellfish

The Tasmanian Oyster Company has developed a prototype hardware system for the automated processing and laser etching of individual oysters through three elements; a vision system for the identification of the unique and variable shape of the oysters, a soft-grip automated robot to correctly orientate and align the oysters for accurate delivery to the laser, and a CO2 laser for etching of symbols on the underside of the oyster to identify the provenance of the oysters.

IUU Seafood import regulation

Additional measures to monitor seafood imports are anticipated and traceability will likely feature as a means to identify the flow of vulnerable seafood products such as squid, sharks, sardines and surimi products.[10]

Sydney Fish Market Traceability Project

University of Technology Sydney partnered with **Sydney Fish Market** in a four year project to address the challenge of consumer requirements for information on the source, quality and freshness of seafood, offering a transdisciplinary solution to achieve real-time tracking from catch to transport and sale.

Starting at the source, the UTS research team will produce an app for fishers to track catch location, method and species. The app will also use image processing technology to verify the species. Smart sensors will track the fish to its destination, monitoring temperature, packaging and freshness.

This app will provide traders and customers with catch to market information, including the freshness quality index, allowing customers to build trust in the catch and transport process and confidence in their final purchase.

The quality tracking system (BeFAQT) combines expertise in IoT, image processing, e-nose, blockchain system and mobile apps in an original and innovative way to address issues in the fish supply chain.

This is a Food Agility project led by Sydney Fish Market, UTS and UDT. It also involves NSW Department of Primary Industries and the Fisheries Research and Development Corporation.

Tech Lab, UTS

10 DAFF **https://storage.googleapis.com/files-au-ag/agriculture-au/p/prj9633a8366441e8d71e9dd/page/IUU_Fishing_Import_Measures_Draft_Report.pdf**

6.8 Wine

Wine Australia has invested in systems as a co-regulator to support provenance and traceability. Examples of this include –

- **Label Integrity Program**, which enables customers to verify geographic indicators and wine labelling claims
- **Wine Australia Licensing and Approval System**
- **Export Label Image Search System**

The concept of a national vineyard registry is under consideration to support biosecurity and sustainability objectives and to provide more accurate supply base data.

eBottli

eBottli has developed a whole-of-supply-chain traceability system which can support compliance activities, using blockchain data technologies, geolocation services for bottles and containers, and unique identifier labels. The aim is to tackle counterfeiting in wine production, distribution and export and trace the full provenance and authenticity of the wine. It covers on-farm activities such as spray diaries, harvesting, as well as off-farm processing, storage and distribution.

7

Challenges and Opportunities

The Productivity Commission in its White Paper on RegTech (2020) came to the following findings, which are relevant to exploring the opportunities and challenges in uptake of RegTech -

Regulatory technology ('regtech') is the use of technology to better achieve regulatory objectives. Used well, it can support the improved targeting of regulation and reduce the costs of administration and compliance.

While regtech can improve regulatory outcomes and reduce costs, it is not a substitute for regulatory reform. Indeed, as regtech is intended to make the task of regulating easier, advances in technology heighten the onus on policy makers to ensure the need for, and design of, regulation are soundly based.

Australia is viewed as being comparatively well placed internationally for widespread adoption of regtech. Yet, with the exception of financial system applications, extensive use of regtech remains relatively uncommon.

There is potential scope in Australia to extend existing low tech solutions — including digitised data, forms, registers and transactions. These could reduce compliance costs for individuals and businesses, improve the efficiency of regulator practices, and generate flow on benefits for the community.

Leading edge regtech involves the use of data for predictive analytics and real time monitoring, enabling better regulatory outcomes and potentially fewer compliance burdens for businesses. But advanced regtech requires specialised resources and long development times.

Even in low tech applications, widespread implementation of regtech can take some years. It can require substantial investment by regulators and businesses in capacity and cultural change while (as with technology solutions generally) enumeration of the scale and timing of the benefits can be difficult.

Regtech solutions may be particularly beneficial where:

- regulatory environments are particularly complex to navigate and monitor
- there is scope to improve risk based regulatory approaches, thereby targeting the compliance burden and regulator efforts
- technology can enable better monitoring, including by overcoming constraints related to physical presence
- technology can safely unlock more uses of data for regulatory compliance.

Creating and maintaining a regulatory environment that supports the realisation of regtech benefits would mean:

- improving the consistency and structure of data and the interoperability of, and standards for, technology — these are precursors to wider regtech adoption
- investing in the technical skills and capabilities of regulators to enable measured steps in regtech adoption
- determining accountability for outcomes associated with regtech solutions, including with regard to privacy, data security, and responsibility for resolving disputed outcomes
- reviewing regulation to remove technology specific requirements that could prevent the take up of beneficial regtech solutions
- creating familiarity with the possibilities of regtech (for example, through liaison forums and trials), facilitating collaboration between regulators, regulated entities and regtech developers, and establishing safe environments to develop and test regtech solutions.

7.1 Regulatory agencies

The OECD identifies four broad challenges that digital transformation poses for continued regulatory efficiency and effectiveness. These are -

1. The pacing challenge — the sheer pace of technological change itself fundamentally challenges contemporary regulation. Digital technologies develop faster than regulations and the governing structures that create and administer them.

2. The design challenge — 'fit for purpose' regulatory frameworks are more difficult to design because digital innovations are blurring traditional market distinctions. For example, households are now both producers and consumers in energy markets because of solar technology. Additionally, the digital economy has tested the boundaries of existing regulatory regimes, sometimes resulting in 'new tech' participants playing by different rules compared to their non-digital counterparts. Information asymmetries in digital markets may also require new and different forms of regulation.

3. The enforcement challenge — more complex and globally integrated supply chains make it difficult for regulators to identify and enforce obligations onto regulated entities. Some typical examples include intellectual property rights and taxation, but in practice this issue can arise in any aspect of regulation where market structures are complex.

4. Institutional and transboundary challenges — traditional ministerial, institutional and jurisdictional boundaries are no longer adequate to address issues in tech disrupted markets. New digital technologies can span multiple regulatory regimes, creating potential confusion and different risks. Also, ad hoc and fragmented responses across jurisdictions can undermine the effectiveness of regulatory action, or alternatively, create barriers to the spread of beneficial digital innovations. Governments and regulators face substantial political and special interest pressures when markets are disrupted. Market incumbents may seek to maintain barriers to entry that might otherwise be challenged by digital innovations, and to the detriment of the consumer. Also, the benefits and risks associated with new market activities are not always known at the outset and governments and regulators need to balance the need for responsible consumer, environmental and social protection against a 'wait and see' approach that supports innovative market developments and market-based solutions to potential competition problems.

"As the Australian Productivity Commission has observed: "many regulators and businesses remain unfamiliar with the possibilities of regtech, creating barriers for application and procurement. Low awareness can dampen both demand and supply responses... Uptake of regtech solutions also requires regulators with the capacity and motivation to incorporate regtech, and regulated businesses and individuals that are able to incorporate new approaches in the way they operate. Or are simply more open to it — new ways of operating can be facilitated by trusted third parties or intermediaries (such as for audit functions and the processing of approvals and payments)."

Inquiry into reform of South Australia's regulatory framework, 2021

DAFF in its National Agricultural Traceability Alliance commentary adds –

"By streamlining traceability regulations, we have the potential to deliver an industry-wide economic projected benefit of $108 million to $197 million a year. This can be achieved through greater alignment, reduced duplication, and more efficient compliance mechanisms. In agricultural production trade, we must navigate and meet multiple regulatory and compliance obligations whether they are retail, consumers, importing markets or government regulation.

Time and costs could be saved through better alignment of needs and improved information sharing, as well as flexible documentation and audit requirements. We know having a set of consistent and easy to comply with traceability obligations between commercial operators will give producers the confidence to invest in their own systems.

By helping producers to generate, capture and transmit robust and easily transferable traceability information, exporters and regulators can meet a broader range of importing countries requirements and pivot quickly in response to trade restrictions."

An example of the opportunity presented by RegTech application is in food safety. Donaghy et al (2021) describe how big data could be used to predict the presence of pathogens and contaminants, by linking pathogen growth with environmental factors and hazards. The future prospect is that big data can be used to predict the presence of pathogens or contaminants, by linking environmental information with pathogen growth and/or hazard occurrence on-farm.

"Data gathered from digital information systems on farm, including field scanning drones, can precisely identify areas within a field, which are subject to aflatoxin contamination because of crop conditions. In turn, this real-time data, facilitated by smart technologies including AI, directs mitigation measures, in the form of dynamic harvesting, to prevent food quality issues downstream (Grieve et al., 2019).

Drones, which are now regularly used in large-scale agriculture, will be increasingly used to harness data related to food safety and quality, e.g., animal intrusion in crop fields or localized field flooding conditions (Cancela et al., 2019). Potential also exists for large farm owners to use wireless IoT applications to collect data regarding the location, wellbeing, and health of their cattle (Busse et al., 2015; Köksal and Tekinerdogan, 2019). Biosensors and wearable technologies may be used to identify unhealthy animals (Neethirajan, 2017; Vidic et al., 2017).

Availability of such real-time data enables livestock managers to separate unhealthy animals from the herd. In some circumstances, such herd/flock management could mitigate potential food safety issues in the human population e.g., if the carrier/shedder status of both healthy and unhealthy animals, was available for foodborne pathogens.

It is foreseeable that further data collecting devices and databases will be interconnected to provide voluminous structured and unstructured data at the farm level. This will be used to enhance source attribution analysis in foodborne outbreak scenarios and enable more precise farming for food safety and quality attributes. It is foreseeable that upstream food safety parameters, collated and logged in blockchain ledgers could be analyzed and used as part of a risk-based inspection system downstream in the supply chain."

The concept of "Rules as Code" (RaC) describes the conversion of regulatory requirements into readable code.

"RaC helps people to understand their obligations and entitlements by turning legislation, regulation, standards, and policies into machine readable code which can be understood and interpreted by computers. This code then powers user interfaces like web forms, enabling users to input information and receive instant answers. By leveraging this technology, people don't need to make phone calls or fill out forms that require manual processing before they receive an answer.

By leveraging this technology, people don't need to make phone calls or fill out forms that require manual processing before they receive an answer. RaC streamlines interaction with the Australian Government and enhances efficiency, providing immediate responses to enquiries using RaC driven user interfaces. The encoded legislation ("the rules") exist alongside the original version (it doesn't replace it) to facilitate digital service delivery.[11]

Currently the Australian Government is trialling Rules as Code (RaC) development, as part of its **Australian Digital Economy 2030** goals and the NSW Government is using RaC to assist in community gaming licensing. RaC represents an opportunity for regulators to reduce the compliance interface with businesses and to reduce time for regulatory determinations based on a repeatable, logical process.

11 **https://www.govcms.gov.au/rac**

7.2 Legal issues

"There are two broad categories of laws, which are often interwoven in practice. Public law, which is made and implemented by governments (often loosely termed "regulation"), includes international conventions and treaties, state and national statutes and the regulations for the implementation of these statutes, and administrative rules and arrangements. Government policies, plans, and programs, though generally not categorised as law, are rules that have a significant effect on rural innovation. R&D and agricultural policies are also relevant; trade and competition policy and taxation rules are among the many that can have an impact."

Martin, 2021

Legal concerns arise from the use of IoT technologies and in the supply of data from producers to regulators. Martin (2021) outlines emerging legal issues as follows –

- equipment (machines and devices) – liability and risks of physical impacts, the exposure of people, plants, or animals to chemicals, or contamination of the environment. Regulation around use of drones, autonomous vehicles and agricultural chemicals are relevant examples
- data (capture, storage, and communications) – digital infrastructure, ownership, sharing, codes of conduct, powers of government to access data, standardisation for integration
- machine decision making – ownership of IP created by machine from multiple data sources, social impacts displacement, IR, training implications, erroneous algorithms.

7.3 Digital infrastructures

In certain regions, especially rural areas, the lack of robust digital infrastructure and connectivity can hinder the seamless integration of digital solutions in the food supply chain (Jiang & Stylos, 2021).

The National Farmers Federation (NFF 2020) points to the lack of digital infrastructure as a significant barrier to uptake of AgTech.

"This remains an issue for many Australian farmers. The nature of the broadband connectivity options available (including coverage, speed, price, capacity, and latency) is an important factor in technology uptake, and the poor quality of services in areas of regional Australia is a major factor restricting uptake."

7.4 Data standards, common formats and language

A challenge repeatedly raised by solution providers developing RegTech applications is the lack of consistent data standards in the agricultural sector. For some years, manufacturers and retailers have adopted industry standards that facilitate a common language, which informs data fields in these compliance and traceability applications. These detail generic items e.g. PUC/SKU/GTIN/SSCC codes, practices e.g. mass balance, salvage, which become standardised over time. Compliance data from physical operations for industry standards and certifications can then be digitised.

The structure of commodity-based regulation in the Agricultural sector may hamper cross-cutting data standards and traceability formats such as the Critical Tracking Event (CTE) and Key Data Element (KDE) frameworks and utilisation of global data standards.

Solution providers using blockchain and IoT sensor data report the frustration and cost generated by the lack of industry-wide standards for traceability, particularly as they are required to integrate with international standards to achieve interoperability between systems.

This issue is prevalent in other jurisdictions and is being addressed via regulation or industry banding together to develop these standards. An example of industry initiative is the **Digital Container Shipping Association** (DCSA), a not-for-profit organisation of nine major container shipping lines, dedicated to digitalisation of container shipping technology standards, based on United Nations Trade Data Models UN/CEFACT (e.g UN/CEFACT International Semantic Standards for Global Supply Chain Data Exchange) and ISO standards (e.g. ISO 9897 container park location). DCSA convenes the **Future International Trade Alliance** (FIT Alliance), constituted by DCSA, the **Baltic and International Maritime Council** (BIMCO), **Fédération Internationale des Associations de Transitaires et Assimilés** (FIATA), the **International Chamber of Commerce** (ICC) and **Society of Worldwide Interbank Financial Telecommunication** (SWIFT), each committing to standardise digitalisation of international trade, with an initial focus on adoption of electronic Bills of Lading.

Track and Trace standards developed by the FIT Alliance support pre-shipment, pre-ocean, ocean, post-ocean and post-shipment transactions and operations. **https://dcsa.org/standards/track-trace/**

The recently published UNCEFACT-based work on **digital product conformity certificate exchange** and the formation of the ISO Technical Committee 347 on **Data Driven Agrifood Systems** represent efforts to standardise agrisemantics, sustainability models, metrics and data in agrifood systems, livestock activities data management, and greenhouse, controlled environment, and urban farming.

The **Australian Agricultural Traceability Protocol** developed through the Food Agility Cooperative Research Centre **AgTrace Australia** initiative aims to move beyond one Australian agricultural data exchange to an enabling protocol based on the UN Transparency Protocol. A pilot in red meat has been completed.

The GS1 developed **National Location Registry** is a means to standardise location data to facilitate transport and logistics services for farm inputs and outbound product. Utilising global location numbers, it allows producers and processors to identify specific locations, avoiding duplications and allowing suppliers more efficient digitised recording of consignors and consignee locations.

7.5 Cultural and social concerns

Ethical concerns arise with the use of emerging technologies like artificial intelligence and automation. Job displacement, algorithmic biases, and control over decision-making processes are ethical considerations that need attention (Bankins & Formosa, 2023). Moreover, over-reliance on technology may result in decreased human interaction and personalisation, impacting customer relationships and loyalty (Nugroho et al 2023).

7.6 Supply chain integration and shared insights

Australian producers have demonstrated a keen interest in on-farm applications that bear a direct impact on productivity and compliance. The challenge they face is integration of disparate applications and integration of their data beyond the farmgate to derive benefit.

ProAgrica (2023) points to the opportunity to drive efficiency through use of big data analytics applied to optimisation of the supply chain, as an example of an untapped potential that can benefit producers, held back by data being "trapped" and stagnating in individual organisations.

Technologies are available but not deployed due to this lack of integration and a lack of appreciation of the challenges faced by producers, such as complexity in the supply chain, seasonality and variability of production, uncertainty of critical input supplies, and the need for accurate yield forecasting.

For many producers, information asymmetry between supply chain parties holds back the uptake of integrative tools that would support regtech at the supply chain level. Commodity-based, Free-on-Board terms of trade dominate Australia's Agrifood export, so producers often have little incentive other than destination market compliance, to share traceability data, as it is unlikely to impact their return on a commodity trade.

7.7 Lack of trust and cybersecurity threats

The NFF points to concerns about data privacy and ownership, and how farm data is used by solution providers, can undermine trust and limit uptake. The NFF is actively working to address these concerns, through the development of the **Farm Data Code**, which aims to support the custodians of production data, to protect and safely share their own data. This lack of trust can be somewhat remedied if enterprise data is abstracted or aggregated into meaningful indicators, retaining raw data with the custodian.

Solution providers consulted have confidence in the security protocols they have adopted, such as encryption techniques and cloud-based storage, which manage the risks associated with data sharing in an arguably safer environment than emailed PDFs or industry platforms. They point to the need for producer education to demonstrate the traceability data is restricted to supply chain events and shipment identity, not IP or commercial transaction data. Notifications to supply chain partners are likewise focused. The business enablement afforded through data sharing can be clearly shown in an educational program.

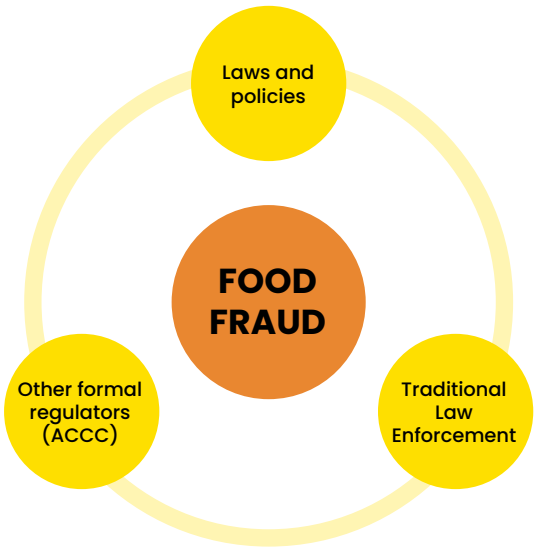
Agrifood has been a target for cyber attack in recent years, creating disruption to food security and trade. BDO Australia researchers (Agrifutures 2021) found that a variety of industry-specific technology has been adopted, with limited understanding or comprehension of the risks associated with adopting these new technologies. This increases the likelihood the organisation will experience a cyber security attack.

Technology is being rapidly adopted in the sectors without proper process, understanding of the business reliance on that technology, or consideration of the cyber security risks and vulnerabilities being introduced into the business.

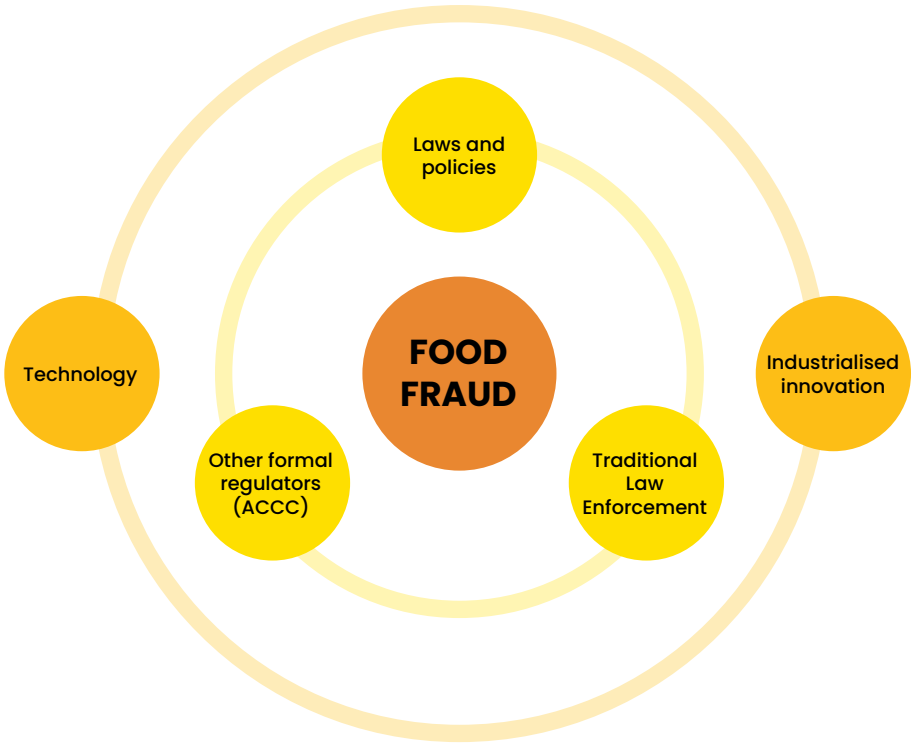
7.8 Food Fraud

A gap in the food regulatory landscape where regtech applications can contribute to prevent fraudulent activities that damage brands is identified by Lindsay (2022) and Smith et al (2021). Lindsay posits the layer of technology combined with innovation in industry as providing a means to address this issue.

Traditional regulatory organisation



Innovative regulatory organisation



Source: Lindsay 2022

AgriFutures Food fraud report (2021) found that -

The rise in reported fraud incidents has highlighted the need to reinforce companies' ability to combat fraud within their own organisation and across the entire product supply chain. Methods and tools have been specifically developed to assist companies assess, prevent and mitigate product fraud. **A number of regulatory and certification organisations now require a vulnerability assessment and compliance testing. It is now widely accepted that vulnerability assessment is an important first step in addressing product fraud. Traceability is another major tool to combat product fraud**. Traceability is the ability to track any product through all stages of production, processing and distribution (including importation and retail). Current traceability solutions vary widely in their scope and sophistication, but end-to-end traceability systems are challenging and expensive to implement. Blockchain tends to be oversold as a 'guarantee' of product authenticity and anticounterfeiting in general, but it is not the ultimate solution to the problem of product fraud because there is no guarantee as to the integrity of the data that a blockchain contains. There is also potential for QR codes and smart packaging to play roles in combatting product fraud.

Smith et al, 2021

The FAO, in its recent report on early warning systems and tools for food safety, outlines the capabilities of the SGS DIGICOMPLY open-source platform.

SGS DIGICOMPLY is a horizon-scanning platform that monitors and aggregates relevant food safety, food security and trading information from more than 3 000 qualified sources distributed across 160 markets. The sources include reports from food safety authorities, scientific publications, standards, legislation and social media. To date, more than 5 million documents have been collected, extracted and enriched to allow users accessing the platform to support food security and food safety across the world. SGS DIGICOMPLY can provide preventive and proactive solutions for managing food safety risks by aggregating information on regulations, supply chains, testing, media, trading and the environment. The basic version of SGS DIGICOMPLY is license/access-free. Users start by customizing SGS DIGICOMPLY based on their role and needs. Users can choose from two role-based options: regulatory specialist and quality assurance. If a user selects "regulatory specialist", the dashboard offers three further options based on the user's daily tasks: 1. Learn about a specific country's regulatory framework to help with exports. 2. Search for specific regulations, provisions, or requirements within regulation texts in English. 3. Monitor regulatory changes.

UN FAO 2023.

Tools for food safety early warning and identification of emerging risks that are multi-jurisdictional are detailed in Annex 3 of this report, which is titled **Early warning tools and systems for emerging issues in food safety**.

7.9 Maturity of RegTech solutions in Agrifood traceability

A common criticism of Agrifood technology solution provider startups is that they often come from non-agricultural sectors and aim to disrupt without a clear understanding and knowledge of the conditions and constraints experienced by the industry (Fairbairn et al 2022).

Startups are attracting international venture capital (Klerkx and Villalobos 2024; Sippel and Dolinga 2023), are encouraged to expand on an international scale, and to promote themselves as proprietary offerings, as opposed to part of a national mission or industry-wide solution. This militates adoption of open-source standardised features such as data formats and common reference nomenclature.

While some of Australia's RegTech and Ag 4.0 solutions are mature, many offerings to agrifood businesses are startups (defined as being in business for less than 3 years, employing <50 employees). We found that a significant number of startups are engaged in an innovation ecosystem, sponsored by government, research institutions and agribusiness. A number of Agrifood accelerators and incubators are listed in the figure below.

Figure 2: Examples of Agrifood incubators and accelerators

Some examples of AgriFoodTech start-up innovation ecosystem support actors

Incubator and accelerator programmes and ecosystem builders
Connected to large private (international) agrifood companies: Bayer Leaps, Lely Feed The Future, John Deere Startup Collaborator, BASF Startup Science, Shoots by Syngenta, Deloitte FoodTech Accelerator, Pascual Mylkcubator 2.0, Danone Manifesto Ventures, The Unilever Foundry, Nutreco Feed and Food Challenge, Mondelez Co-Lab Tech.

National or regional public or public-private incubator programs and ecosystem builders: Thrive Canada Accelerator (Canada), Zone AgTech (Canada), British Columbia Centre for AgriTech innovation (Canada), Nature Growth (Israel), The Kitchen Hub (Israel), Fresh Start (Israel), Wageningen University and Research Start Hub (The Netherlands), Robocrops (The Netherlands), AgFrontier (Australia), SproutX (Australia), Beanstalk AgTech (Australia), Acre Agtech Incubator (United States), AgLaunch (United States), Farm 491 (United Kingdom), AgriTech-e (United Kingdom), Italian National Agritech Centre (Italy), FoodTech HUB Latam (Brazil), India Agritech Incubation Network (India), Dao Foods (China), The Yield Lab Europe (Europe), The Yield Lab Latin America (Latin America), The Yield Lab Asia (Asia) RootCamp (Germany), Foodtech.ac (Poland), EIT Food (Europe), IICA Semana de la Agricultura Digital (Latin America), FAO Innovation Fund Incubator (global), UNDP CULTIV@TE (global), CGIAR Accelerate for Impact Platform (global), Endeavor (global).

Networking and matchmaking events
EvokeAg (Australia), World Agri-Tech Innovation Summit (global, in multiple countries), F&A Next (Netherlands), Agrifood Tech Expo Asia (Singapore), AgTech Connect (United States), AgTech Nexus (United States), Farm & Food 4.0 (Germany), CFIAgrotech (Chile).

Investment brokers/venture capital and private equity firms
AgFunder (global), Tenacious Ventures (Australia), S2G ventures (United States), Bread and Butter Ventures (United States), Syngenta Ventures (global), Rockstart Ventures (Netherlands), Global AgInvesting (United States), AgLaunch (United States), Rabobank FoodBytes (The Netherlands), WWF Impact Investing (global).

Specialized research and innovation institutes and programmes
Delft AgTech Institute (Netherlands), Digital AgriHubs (Europe), CARE-AI (Canada), Agriculture Technology Campus (United States), Agritech Institute for Small Farms (United States), Cornell AgriTech (United States), Global Institute for AgriTech economics (United Kingdom), NUS Agritech Centre (Singapore), Good Food Institute (United States).

AgriFood tech media, advisors and influencers
AgFunder (Global), AgThentic (Australia), Agtech So What (Australia), Green Queen Media (Singapore), Good Food Institute (United States), Agritecture (United States), Future of Agriculture (United States).

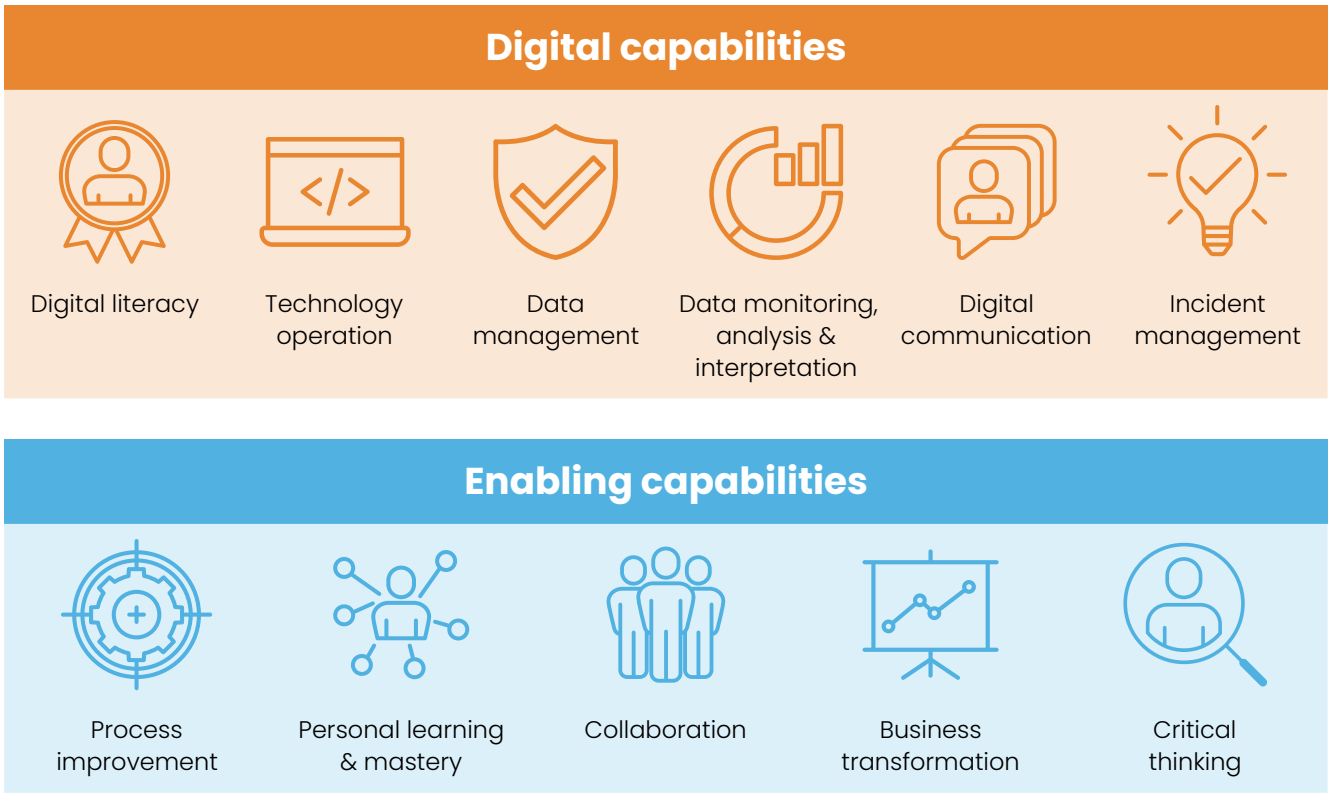
Source: Klerkx, Villalobos 2024

This ecosystem support enables "scope for transdisciplinary work, in which researchers work together with AgriFoodTech start-ups seeking to tailor their technologies to farming practice and other food system activities and processes through co-design, enhancing the bundling of innovations to better support food system transformation pathways."

The connection of these incubators and accelerators with national policy objectives in relation to food system resilience, security, sustainability goals and market access indicates a motivation for public as well as private sector investment to grow these startups.

7.10 Digital capability in agriculture

Five years ago, the rural research and development corporations (RDCs) and KPMG undertook a capability assessment of digital capability in Agriculture. The following graphic indicates the skills and application needs identified.[12]



In this study, agriculture-specific role categories were found to have low levels of digital maturity. More specifically, while the maturity of digital adoption varies between role categories across the supply chain, the study found that there is currently a consistent lack of proficiency in operating technologies and digital devices applicable to business activities and processes.

Whilst the full range of digital and enabling capabilities will be required in the future of the agricultural industry, the greatest level of expectation is set on data collection and analysis as well as data management.

The analysis demonstrated that the workforce are aware of the value of data collection and the habit of data collection is increasing. However, significant barriers seem to remain in understanding what data is required and collecting data digitally to allow for analysis and decision making processes. Among the most influenced role categories within the agricultural industry, the study found that livestock farming and crop farming, currently representing the top employer sectors, hold the greatest potential for workers' capabilities to be augmented by leveraging technologies.

12 https://www.crdc.com.au/sites/default/files/Agricultural%20workforce%20digital%20capability%20framework_Report_Final%20deliverable.pdf

8

Cross-agricultural applicability of RegTech solutions

Initiatives to develop RegTech applications and improve the efficiency of regulation are often driven by challenges in a specific commodity trade.

Traceability is not currently mandated for domestic food distribution beyond the one-back-one-forward requirement for food safety. Recent food safety standards for traceability have been extended for leafy greens, melons and berries, and will come into force in February 2025.

For international trade, Australia will respond to foreign market regulation that will impact traceability (e.g. US Section 204(d) of the FDA Food Safety Modernization Act (FSMA); EU Regulation (EC) No. 178/2002; Fisheries Control Regulation (EU) 2023/2842).

Traceability is therefore being driven less from a compliance mode than from a customer and consumer demand, as the customer strives to meet their own commitments and consumers seek information on the origin and conditions of production.

Understanding that domestic traceability compliance is currently not the prime driver, and trade is dominated by commodity FOB terms, which distance producers from consumers, industry adoption across the agriculture sector is largely an industry-driven activity.

For industry to perceive value in adoption of traceability, it must deliver to customer and consumer needs that represent compelling return on investment, and a willingness to pay for product assurance. Cross-cutting Agricultural RegTech applications are often part of a wider solution to offer that additional value beyond simply meeting regulatory requirements. For example, the ability to monitor red meat throughout the export supply chain, tested through **MLA** using the **Escavox** tracker device and platform, enabling a level of food integrity assurance and traceability to international markets in support of Australian Government trade efforts. The saving of $3.82/kg in switching from air to sea freight was also a discovered benefit. Similarly, **OBE Organics**, using **TIVE trackers**, were able to verify the movement of an international shipment which had missing paperwork to enable cross-border clearance, saving $35,000 per container and meeting international regulatory requirements.

The following are examples of potential wider cross-cutting impact for agriculture that may support compliance activities and create shared value for the public and the regulated.

8.1 Integrators and data exchanges

There are few fully integrated solutions able to aggregate event and compliance data for traceability of the product and for domestic and international regulatory purposes. An integrator can utilise multiple technologies and existing systems adopted by farmers to support compliance requirements. The aim is to link isolated systems into meaningful data formats along the product supply chain. One integrator described their task in livestock traceability as "verifying animal and environment".

We have found the valuable service of data integrators for traceability. They can ingest data in a variety of formats and populate regulatory systems as defined by the producer/owner of the data. They perform an invaluable service in advancing industry compliance for complex supply chains, for SMEs with limited capacity, and for supplying verified data to the expanding mandates from domestic and foreign regulators and customers.

The integrators can work with solution providers, a mix of technologies and multiple regulators to relieve the producer of the compliance burden. Being technology agnostic and standards-based, the integrators can supply APIs and create decision loops from the whole supply chain, providing the producer with insights and managing privacy settings, data sharing agreements and data access and permissions, as well as data security protocols.

Important value capture for the producer through the integrator includes support for on-farm management and strategic as well as operational decision-making.

As the traceability demands of customers and consumers is unlikely to abate, integrators as service providers become an essential part of the ecosystem.

Cloud-based integration by subscription averts high up-front costs and "lock in" to proprietary solutions that may not be scalable and rely on the producer to maintain cybersecurity protocols and hygiene.

The **Australian Agrifood Data Exchange** (AADX) is a concept that is under development to address the data-sharing concerns and duplication identified in farmers supplying data for compliance and customer requirements.

In a compliance trial involving red meat producers, it was found that-

"In many sectors, industry-level producer compliance programmes operate alongside specific compliance and audit programmes for customers, brand owners, or markets, and in some cases environmental stewardship or carbon programmes are also likely to apply. All of these programmes would be candidates for similar processes and technologies to those demonstrated for sheep.

The following recommendations should be considered for future work:

- Compliance and audit bodies should collaborate to **align common requirements** that appear in more than one programme, so that it is easier for producers to re-use evidence that demonstrates compliance with those requirements. Programmes can still retain their own audit integrity and differentiation above the common requirements.
- Effective operation of a data exchange, and integration with a range of applications, data sources and data consumers, relies on the development of consistent **common data specifications** and **shared governance expectations**. These components lower integration cost and risk. The work of developing data specifications should be prioritised and should leverage existing international data specifications where appropriate.
- A data exchange is just one part of creating efficient, effective compliance and certification schemes and is not a silver bullet. Building producer trust in the governance, security, use and value of a data exchange is a long-term endeavour and will not be achieved without consideration to long term **adoption and change management**."

MLA, 2022

Research undertaken with solution providers to understand the impact of the AADX found-

"Lack of trust, and the perception that the AADX is a top-down imposition were also clearly identified as barriers among AgTechs in this study. The barriers identified are also interrelated with the risk of a data monopolisation by the AADX, which could create a considerable data power imbalance.

This is to be mitigated by stringent and transparent governance structures. Other risks identified are technical in nature and relate to data quality, system reliability, system security, interoperability and user interface. If not mitigated these risks can affect the trust, confidence and usefulness of the AADX. Data governance such as regulations, standards and policies are imperative to mitigate these risks."

Bewong et al 2023

8.2 Rapid on-site product testing

The ability to quickly verify the origin of food will be a useful advance of the lab-dependent testing regime. It is a key part of international research and RegTech development. As CSIRO is prosecuting a digital infrastructure of reference samples, rapid testing on-site will provide a further layer of assurance for customers and consumers. In EU, **SwissDeCode** helps food producers to grow and supply food that is safe to eat by delivering real time certification of authenticity, safety and quality of products, processes and premises. SwissDeCode's DNAFoil® technology allows farmers, food manufacturers and other agents in the food value chain to quickly detect soil, animal and plant diseases, as well as food contamination or adulteration, on the spot and without long lab delays. This form of rapid, on-site testing means that processes can be streamlined, and risks can be reduced.

Once this data is digitally secured and the food product enters into the supply chain, stakeholders further down the line, including consumers, have access to the information, giving them confidence that the products are safe, authentic and traceable. SwissDeCode recently closed its first venture round led by VisVires New Protein (Singapore) and EIT Food to accelerate the development of its technology.

Extending rapid testing to encompass product origin/provenance will be dependent on available reference samples and this is an infrastructure which can be supported by government and industry peak bodies.

In the past five years, the Australian Nuclear Science and Technology Organisation (ANSTO) has extended its laboratory testing regime for food provenance to include on-site testing, with high accuracy, now being applied to tracing and verifying the origin of **seafood and indigenous bushfoods**.

The **GS1 Digitallink 2D barcode** as a carrier for provenance certification and credentials, will enable regulators to respond to product origin requirements in an agile manner, which is particularly relevant for perishable products.

"Our solution will deliver a user experience equivalent to making an espresso coffee, and a certificate equivalent to those issued by laboratories," said the CEO and Co-founder, Brij Sahi. The automated system aims to provide ISO certified **results in just 30 minutes compared to current processes which can take up to seven days.**"

EIT, 2024

8.3 Adoption of a common Agricultural CTE/ KDE framework for voluntary traceability

An important foundation for standardisation of basic traceability (product identity, supply chain events and processes, data sharing) is agreed data standards, syntax and understanding of the "language" of traceable critical tracking events (CTEs) and their key data elements (KDEs).

It is likely that a significant proportion of meanings are common across commodity groups in Australian agriculture.

These shared meanings and formats and standards that are consistent with international understandings, will establish a basis for system interoperability and allow solution providers to develop solutions that harmonise.

Industry leadership will be essential to bringing consensus on the CTEs and KDEs that will facilitate this "language". It is perhaps the most critical development to accelerate industry adoption of traceability and avert proprietary versions.

8.4 Improved clarity around regulatory challenges

A useful example of a regulatory challenge is the remote inspection and loading of livestock for export regulatory requirements. The deployment of veterinary inspectors to remote ports is a clear challenge which the regulator has experienced.

This was articulated in a challenge put to RegTech solution providers through the Austrade Business Research & Innovation Initiative **BRII regulatory challenge**. Such specific challenges that may be overcome using RegTech applications are useful calls on industry, like the DAFF RegTech Traceability Round.

8.5 On-farm and in-transit biosecurity management

The National Biosecurity Implementation Plan which informs state and industry level plans recognises the importance of existing and emerging technologies, systems and processes and the innovation the industry can drive in this space. Examples of technologies to manage farm-level digital biosecurity management plans e.g. **Exoflare** platform, can potentially be extended across production sites throughout Agriculture.

Applications to support in-transit monitoring and documentation of animals and plants e.g. **Aglive**, **Escavox**, Direct Livestock's **Truck Tracker**, are being adopted across multiple commodities and offer high granularity of traceable product, and assets such as vehicles and containers.

We note that biosecurity could be enhanced through greater data sharing between national and state regulators. The lack of data sharing agreements between levels of government restricts data sharing, such as the location of export depots, LPA audit data, which can support state regulators monitoring the health and movement of livestock, were cited as examples.

8.6 Animal welfare and health status

Solutions that are capable of monitoring animal welfare and health status parameters are emerging. These solutions can extend to create a digital twin on an animal, recording data on a wide range of parameters indicative of health and welfare status. Active IoT devices, NFT tokens, underpin recording on production conditions, location, animal weight, and inputs. Affordability for all species is a consideration, however, for animals on large grazing holdings, or in remote locations, this promises a valuable option for traceability and compliance, including specific credential requirements. Virtual Herding Technologies raise their own animal welfare questions (Reichelt and Nettle 2023) and these will need to be worked through with solution providers and producers.

8.7 Linked geospatial and entity identifiers

Limitations related to Property Identification Codes (PICs) have been well documented when determining the location of production areas. The lack of consistency in recording specific agricultural operational locations can be somewhat overcome through the allocation of a unique Global Location Number (GLN). While GLNs can be allocated to specific sites/ blocks, operational area geospatial data enables specific areas for application of water, soil treatments and methods, fertiliser, pesticides, crop identification etc to be clearly identified for compliance purposes. **The USDA Crop Sequence Boundaries** provide an open-source mapping through a block grid system, enabling datasets to be overlayed to land at a granular level. Similarly, Queensland's **Long Paddock Silo** grid climate data initiative provides reference geospatial identification.

8.8 Batch scanning of farm chemicals

Chemicals are typically sourced from international manufacturers for formulation into farm products in Australia. Traceability is achievable through records maintained by suppliers and distributors under chemical control and distribution legislation. However, batch control at retail and on-farm is a gap that could be covered by a digitally scannable format such as a 2D data matrix barcode, enabling digital traceability on-farm in application. **Trust Provenance** is one solution provider supporting the traceability of farm chemicals. **Proagrica** has created reference data for chemicals and labels in the EU through the **AgroCloser** initiative, providing solution designers with access to consistent names and label data for farm chemicals. An Australian version of this resource will be valuable to support RegTech develop tools for industry and regulators

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