DIGITALISATION OF PRODUCT CERTIFICATES, CLAIMS AND CREDENTIALS

A future state analysis and framework for discussion

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DISCLAIMER

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EXECUTIVE SUMMARY

The challenge

Conformity systems are under new and increasing pressure. One reason for this is the rapid transition of global supply chains to data-driven digital systems, which has created a growing gap between the traceability of products as they flow along the supply chain and the traceability of their associated conformity and credentialing information. Increasing problems with falsified and sub-standard goods in international markets, as well as concerns over technical barriers to trade, are also highlighting weaknesses in global conformity systems.

To address this pressure, it is necessary to modernise conformity systems by reducing their traditional dependence on physical and PDF certificates, while facilitating the modernisation of public and private sector processes relating to product assurance. It is time for the conformity and accreditation community to embrace a digital future and to move towards digital data exchanges, distributed trust and verifiable credentials.

In this future, digital tools will give users of product conformity and credentials easy and ready access to the conformity and accreditation data they need to have confidence in their products. Before those tools can be developed, it is necessary to establish a standards-based framework for the digital exchange of national product conformity and credential data.

The proposal

The purpose of this paper is to propose a framework for product conformity and credentialing data exchange. An important characteristic of this proposed Framework is that it applies ISO/IEC standards to achieve traceability of product conformity certificates, business entities, products, test samples and more, using GS1 identifiers and data carriers.

The application of ISO/IEC ratified global standards brings benefits beyond those that can be achieved using local or proprietary systems that do not include any common data structures. It also means that the Framework can accommodate existing industry-specific approaches and schemes, and is compatible with existing and emerging ISO/IEC-based supply chain frameworks. Processes involving multiple streams of evidence or optional pathways for approval of goods can also be accommodated.

The Framework does not call for the use of specific technologies. Rather than a specific technological implementation, the proposed Framework represents a general structure aligned with global data standards that can accommodate different supporting technologies, for example, blockchain, non-fungible tokens or verifiable credentials.

While GS1 is the only standards organisation that supports all the ISO/IEC identifiers identified in the Framework in an integrated manner, other recognised identifiers do exist for some elements. Existing and potentially emerging identifiers that are recognised as a global standard under ISO/IEC will not be excluded from the Framework.

A voluntary, rather than a mandatory approach is proposed such that individual organisations can implement the Framework based on the value that it may be perceived to add in any given context. No new data would be captured or exchanged through the adoption of the Framework, and information disclosures would be subject to existing industry norms.

Importantly, the proposed Framework is not intended as a replacement or alternative for any well-established existing national certification and conformity or approval schemes. These can be accommodated by the Framework, as it simply strengthens and simplifies the referential integrity of existing programs. The Framework is internationally scalable, reflecting the global systems governance systems under which the international accreditation community responsible for overseeing certification and conformity schemes already operate.

The provision of strategic direction by national governments, working in coordination with national quality institutions, would greatly facilitate the achievement of the benefits described within this report.

Appendices

- A next step, to move from Framework to prototype, is discussed in Appendix A.
- An analysis of cost and benefit considerations is provided in Appendix B.
- A glossary of terms is given in Appendix C.

1. INTRODUCTION

A growing gap between product traceability and conformity data

The rapid transition of global supply chains to data-driven digital systems is placing new and increasing pressures on product conformity systems, their relevance, and the ability to deliver benefits through international trade income growth and the economic wellbeing of people. Specifically, there is a growing gap between digital product traceability and the traceability of associated product conformity and credentialing information.

Data exchange standardisation for all conformance and accreditation processes can assist in closing that gap, to support government and industry modernisation and help align them with global supply chain and traceability developments. To achieve this, it will be necessary to:

- Develop and apply a standards-based framework for national product conformity and credentialing data exchange
- Establish a common/shared credentialing capability to provide confidence in product conformity data; and
- Support the product conformity ecosystem in embracing a digital future involving document-less data flow, distributed trust, and the exchange of verifiable credentials

The world is changing, and product conformity infrastructure must evolve

International markets have increasingly opened through free trade agreements; however, technical barriers to trade and other non-tariff obstacles have increased, along with the trafficking of falsified or sub-standard goods.

Traditionally, product conformity systems have been heavily reliant on trust and the exchange of manual documents and electronic (mostly PDF) certificates. While such documents can be fraudulently altered, even legitimate documents can be misused.

A test certificate, for example, pertains either to the sample as received or to a batch/shipment; however, it can often be in the interests of suppliers to spuriously infer that the test certificate applies to the ongoing supply of the product (or even to a related, but different product).

Similarly, a product certificate in current circulation may have ceased to be valid because associated credentials, authority, or standing of the certificate holder have changed.

The need for digitalisation of national product conformity systems

Defining a robust traceability system, addressing both physical products and product conformity information, represents an essential measure to ensure market access and support global trade.

Such a system must enable highly systematised data exchange between manufacturers, exporters, importers, distributors, retailers, consumers, and regulators, as required. It must be underpinned by global data standards and exhibit interoperability across equivalent systems used by trading partners.

Linking conformance with traceability using common elements (product, place, and party identifiers) has merit for economic and data efficiency. It supports efforts to reduce complexity and so-called “tell us once” initiatives geared towards reducing the number of times the same data is requested.

Applying ISO/ IEC ratified standards and industry-adopted business vocabulary is attractive, as the ready-made system is already in place.

The objective

The common factor among these challenges is the absence of a standardised framework for the digitalisation of conformance and accreditation processes – including the necessary information architecture and common language to identify, capture and share data of relevance to national product conformance.

This paper puts forward a broad framework ('The Framework'), a general structure aligned with global data standards that can accommodate different supporting technologies (for example, blockchain, non-fungible tokens or verifiable credentials).

The objective of the proposed Framework is simply to move to an approach based on global data standards to deliver international alignment, harmonisation, and interoperability, that leverages the existing data standards used by industry for product traceability.

The Framework provides an industry pathway to potential future states, including open attestation systems that are less reliant on central registries. In doing so, credential holders could have greater control over information disclosures than is currently possible.

Data exchange standardisation for conformance and accreditation processes will assist in closing the gap between physical product and product conformity data flow. It will help align conformity infrastructures everywhere with evolving supply chain traceability systems.

An effective digital architecture will minimise the impact on existing business processes whilst providing Accreditation Bodies (ABs), Conformity Assessment Bodies (CABs) and others with the means to deliver value through innovation without compromising the integrity of product conformity systems.

2. CONFORMITY ASSESSMENTS AND TRACEABILITY

Conformity assessment

Conformity assessment gives us confidence in the products that are supplied to us. Conformity assessment processes touch every product that we encounter in our lives, from the food we eat to the houses we live in, the cars we drive and the appliances we use.

The global conformity assessment ecosystem comprises a vast pool of specialist providers, undertaking a wide range of expert assessments, to ensure the functionality of supply chains in delivering suitable and safe products.

This network of providers of conformity assessment includes testing laboratories, inspection bodies and certification bodies. By 2020, almost 82,000 laboratories, 12,200 inspection bodies, over 550 proficiency testing providers and almost 200 reference material producers were accredited by the over a hundred signatories of Mutual Recognition Arrangements (MRAs) of the International Laboratory Accreditation Cooperation (ILAC)[1].

Traceability

Traceability, as defined in ISO 9001:2015, is the ability to trace the history, application, or location of an 'object' (e.g., product). When considering a product or a service, traceability can relate to:

- the origin of materials and parts
- processing history
- distribution and location of the product or service after delivery.

Traceability is primarily concerned with tracking a product as it moves through the supply chain, while certification and conformity assessment occurs at points along the supply chain. While there is a single traceability chain, there are multiple points at which conformity assessment is provided, verifying the compliance and the authenticity of the product at each stage.

For example, milk can be physically traced along the supply chain. At various points, milk from the farm is tested and certified. The milk may be processed at the dairy or manufactured into strawberry yoghurt, for example. The yoghurt, strawberries, and other ingredients are also subject to testing and certification, as well as the final packaged product.

[1] https://ilac.org/about-ilac/facts-and-figures/

While one might choose to view the product conformity and credentialing information (which attests to the product's suitability) as a natural part of the traceability of a product, the conformance and credentialing also require distinct traceability.

Conformity certificates and test reports are traceable items. An issued product certificate, for example, also requires tracking and tracing, adding an additional layer to the overall traceability. Questions typically asked about certificates include: "Is it valid?", "Does it apply to the product in question?", "Was it issued by an accredited body?", etc. Conformity certificates are inextricably linked to products, manufacturers, manufacturing locations or other related entities. However, the certificates are also physically separate traceable items and are often only 'loosely coupled' with the physical subject of the test or certification.

Conformity assessment data – a critical component of traceability

When conformity assessment does not work as intended, there are inevitable product failures, recalls, or other disruptions to supply chains and trade. These problems can be attributed to inadequate safeguards over the integrity and traceability of conformity assessment data.

Traditionally, product conformity data has been heavily reliant on trust and the exchange of manual documents and electronic (mostly PDF) certificates. However, such arrangements are cumbersome and open to misuse and abuse by bad actors.

i. **Is it valid?**
   Paper-based certificates (or their electronic equivalent) can be altered or falsified. It can be challenging to detect such activity in a timely manner. Detection after consumption, or following incorporation into finished products (buildings, for example), can be expensive or impossible to remedy. Another issue is that formal product certifications cease to be valid when related credentials, authority, or standing of the certificate holder change (i.e., the certificate holder has become subject to a restriction of activities or has ceased trading).

ii. **Does it apply to the product in question?**
   A test certificate, for example, pertains either to the sample as received or to a batch/shipment; however, it can be in the interests of a supplier to spuriously infer that the test certificate applies to the ongoing supply of the product (or even to a different, but related product). Similarly, a certified product could be made in a factory with several related production lines; so, does the certification cover all production or only specific production lines?

iii. **Was it issued by an accredited body?**
   Conformity assessments undertaken by unqualified parties cannot be relied upon. Indeed, this may be worse than no assessment at all since it can provide a misplaced sense of confidence. The global accreditation framework exists to provide assurance over the competence of bodies that undertake conformity assessment. Accreditation and credentialing constitute critical foundations for supply chain systems integrity.

3. CURRENT STATE CHALLENGES

Changes in the Global Trading Landscape

International markets have progressively opened through free trade agreements; however, technical trade barriers have increased along with the trafficking of falsified or sub-standard goods. Over the past 20 years, whilst applied tariffs in the Asia-Pacific region have halved, non-tariff trade barriers, including sanitary and phytosanitary controls, have risen significantly[2]. At the same time, the OECD and World Bank have also reported a significant increase in counterfeit and pirated goods; these now represent between 3.3% and 5% of the value of world trade[3].

> The growing complexity of international supply networks, driven by increased globalisation and the use of digital technology, is outstripping the capacity of traditional controls that ensure compliance of traded goods and services.

A fundamental shift has begun in the handling of the information that supports product supply, partly in response to these issues, with considerable interest shown in achieving a more robust connection between physical goods and the underlying assurance processes. This shift has intensified during the COVID-19 pandemic, with global supply chain vulnerabilities exposed.

To illustrate, global healthcare industries and the World Health Organization have regulated the use of ISO/IEC standards to ensure patient safety and provide unique device identification for implants. Food industries have called for end-to-end supply chain traceability with the United States (US) Food and Drug Administration developing a policy[4] to identify and recall contaminated food in a matter of minutes, rather than days or weeks. Some nation-states have moved to require the identification of building materials using standardised semantics and labelling.

A problem of standardisation

Global standards and systems to support digital product traceability through supply chains are now well established in the form of global trade identification numbers and global location identification numbers.

In contrast, the systems for managing product conformity and credentialing information[5] have not kept pace with digital transformation. This gap between digital product traceability versus traceability of product conformity and credentialing information is now a problem. This gap is less apparent in Government to Government (G2G) ePhyto, Patents and IP and some Business to Consumer interactions (for product marketing claims e.g., organic certification). However, it is becoming quite stark for Business to Government (B2G) and Business to Business (B2B) exchange of product conformity data.

Aligning standards and capabilities to connect physical product flow with product conformance information is critical, as the current misalignment is a cost/efficiency burden impacting all industries. It is often overlooked that the need to address certain credentialing requirements ("Is the buyer a legal entity?", "Is the product prohibited or does it meet local specifications?", "Is the purchase order legitimate?") comes well before any physical product flow.

Governments have a critical role to play in simplifying and harmonising international trade procedures, supported by key trade facilitation agencies, including the World Trade Organization (WTO), World Customs Organization (WCO), United Nations (UN) agencies, and the World Economic Forum (WEF).

[2] https://www.unescap.org/sites/default/d8files/APTIR2019_Introduction.pdf

[3] https://www.oecd.org/corruption-integrity/reports/trends-in-trade-incounterfeit-and-pirated-goods-g2g9f533-en.html

[4] https://www.fda.gov/food/guidance-regulation-food-and dietarysupplements/

[5] https://casco.iso.org/key-considerations.html

For example, the WTO and the WEF have recently recommended that governments interested in harnessing trade digitalisation[6] leverage trade agreements by "promoting the use of open, global standards for product identification and data sharing across global value chains" and by "creating a linkage between product identification and classification systems". They also state that "the GS1 Digital Link standard offers a method for achieving this linkage".

Additionally, the WTO's Technical Barriers to Trade (TBT) Agreement strongly encourages the use of international standards, and it emphasises the need to avoid unnecessary barriers to trade. In Article 5.4, the TBT Agreement states that "In cases where a positive assurance is required that products conform with technical regulations or standards, and relevant guides or recommendations issued by international standardising bodies exist or their completion is imminent, Members shall ensure that central governments bodies use them, or the relevant parts of them, as a basis for their conformity assessment procedures."

The rationale for this is explained as follows: "International standards can help countries overcome these problems. By ensuring compatibility across countries and conveying information to consumers about goods that have been produced abroad or processes that took place in another country, international standards can generate economies of scale and production efficiencies, reduce transaction costs, and facilitate international trade."[7]

It is worth noting that several countries (including China, New Zealand, Vietnam, Russia, and Canada) have adopted the Global Trade Identification Number as a standardised form of strong entity identification for traded goods. However, until emerging international trading platforms begin specifying the use of global data standards as a key deliverable, then it is likely that national/proprietary interests or other stakeholder concerns will limit progress. For now, it remains the case that disjointed efforts, by various stakeholders involved in supply chain development, are compounding the challenge of achieving national and international harmonisation.

International Response

United Nations Industrial Development Organisation

The United Nations Industrial Development Organisation publication, Standards & Digital Transformation - Good Governance in a Digital Age – October 2021 notes that there are limits to the effectiveness of national policy-setting approaches and that global standardisation has an important part to play:

"Progress in the innovation and development of digital technologies and digital transformation is creating a fast-moving environment and is unstoppable. The evolving regulatory and policy frameworks develop appropriate governance rules for technology; however, this evolving Framework has limitations such as being primarily nation bound and time-consuming. Standards have a significant role in this Framework, being transnational, multi-stakeholder driven, speedy to develop and responsive to user needs."

"Standards are a voluntary complement to regulation, which have the effect of enhancing efficiency and productivity. These standards inform effective regulations, which can create an enabling environment for innovation and minimise risk for disruptors and investors. Standards developed by international organisations can provide an effective response to market barriers. In the context of digital transformation, the timely and harmonised adoption of standards is likely to play a key role towards this end, both as a means of promoting interoperability, productivity and innovation, and of ensuring the scale-up of solutions to be implemented globally."

6 The promise of TradeTech: Policy approaches to harness trade digitalization. World Trade Organization and World Economic Forum. April 2022.

7 Technical Barriers to Trade (The WTO Agreements Series). World Trade Organisation. Revised in 2014. https://www.wto.org/english/res_e/publications_e/tbttotrade_e.pdf

APEC Business Advisory Council

Within the Asia Pacific region, ABAC's Report to Ministers[8] also highlights the impetus from industry to move to greater adoption of global data standards to support digitalisation:

"ABAC has welcomed the recognition by APEC Leaders and Ministers that wider use of GDS [global data standards] can improve supply chain performance and visibility, enabling greater interoperability and supply chain integrity across the region. This has only become more important with the increasing digitalisation of trade and greater use of e-commerce, but many economies lag in the uptake of this technology, and approaches are often bilateral rather than regional. APEC should encourage a regional implementation approach."

World Economic Forum

A 2016 report by the World Economic Forum[9] identified the need for agreement on common standards and greater adoption of technology, including digital technology, along the value chain. In particular, the report noted the development and deployment of digital technologies and processes as being central to the required transformation of the construction industry.

On 28 October 2021, the Asia-Pacific Economic Cooperation (APEC) Business Advisory Council (ABAC) published their annual Report[10] to APEC Leaders, noting: "ABAC has welcomed the recognition by APEC Leaders and Ministers that wider use of global data standards can improve supply chain performance and visibility, enabling greater interoperability and supply chain integrity across the region. This has only become more important with the increasing digitalisation of trade and greater use of e-commerce, but many economies lag in the uptake of this technology, and approaches are often bilateral rather than regional. APEC should encourage a regional implementation approach."

World Trade Organisation and International Chamber of Commerce

To help companies and government agencies adopt available standards to accelerate the digitalisation of trade processes, the World Trade Organization (WTO) and the International Chamber of Commerce (ICC) jointly published in 2022 the Standards Toolkit for Cross-border Paperless Trade[11].

The document identifies almost 100 trade-related standards, frameworks and initiatives that can enable global supply chain parties to speak a common language, independent of what technology is used in the implementation. ISO/IEC standard keys are recognised within the toolkit as fundamental global identification standards.

The purpose of WTO and ICC in publishing this toolkit is to provide the international trade community with the first-ever complete survey of available digital trade standards that may facilitate trust, collaboration, and data exchange in supply chains in real time.

National Entities

Some countries are quickly advancing with digitalisation agendas. Notably, General Administration Customs in China has adopted GS1 standards for product identification to support customs clearance[12]. The Green New Deal is set to redefine requirements for trade with the European Union with emphasis on greater transparency of product and production systems credentials. The United States (US) Food and Drug Administration has proposed wide-ranging traceability requirements for imported products[13] and US Customs has commenced trialling GS1 entity identifiers to credential economic operators. New Zealand uses ISO/IEC standard keys to identify all local companies[14] and has regulated the use of GS1 product identifiers on import declarations where available[15].

8 http://www2.abaconline.org/assets/2021/ABAC_Report_2021.pdf

9 Shaping the Future of Construction. World Economic Forum. May 2016. http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Construction_full_report__.pdf

10 https://www.apec.org/Publications/2021/10/ABAC-Report-to-APECEconomic-Leaders

11 https://iccwbo.org/media-wall/news-speeches/icc-and-wto-launch-first-ever-standards-toolkit-for-paperless-trade/

12 http://static.gds.org.cn/b2b/Content/Index/GDSN_call_to_action.html

13 https://www.fda.gov/food/food-safety-modernization-act-fsma/foodtraceability-List

14 https://www.nzbn.govt.nz/whats-an-nzbn/about/

15 https://www.customs.govt.nz/globalassets/documents/tsw/import-declaration-requirements.pdf

Meeting the challenge

Global data standards bodies, in cooperation with trade facilitation bodies, are making significant progress towards the interoperability of trade systems. However, the global landscape for product supply is complex and any universal standardisation is likely to remain a challenge well into the future. While international bodies are moving broadly in the same direction, there is not yet complete harmonisation in some areas. For example, the use of global identifiers in trade is one area where overlapping global systems do exist. Product conformity data exchange is an area that has historically been under-explored as a basis for reconciliation of alternative approaches and it is hoped that this report may contribute to the international dialogue around supply chain traceability and interoperability.

Furthermore, as described in the future state analysis in Section 8, the future may well involve less reliance on physical forms and certificate exchange, as systems for the paperless exchange of credentials gain prominence.

Finally, it may be worthy of note that international Free Trade Agreements sometimes oblige signatory nations to cooperate in the advancement of systems for electronic document exchange. Challenges around the interoperability of product conformity data exchange may represent an opportunity for nations to contribute to global standardisation of supply chain data exchange, while addressing existing obligations under trade agreements.

4. BUILDING BLOCKS FOR EFFECTIVE DIGITAL TRADING SYSTEMS

There is a growing realisation that technology on its own is not the complete solution to enabling industry transformation. Agreed frameworks and standards provide the necessary foundation upon which interoperable technological solutions, suitable for global data exchange, can be built.

Global conformance framework

The general term used for an organisation carrying out conformity assessment (including testing, inspection, and certification) is conformity assessment body (CAB).

There are three main forms of conformity assessment that can be used individually, or more often, in combination:

- Testing[16] – the determination of one or more characteristics of a sample or product, usually performed in a laboratory
- Inspection - evaluation of a product or process against defined specifications using experience and professional judgement
- Certification – written assurance by an independent body that a product, service, or system meets specific requirements

Accreditation bodies are established in most economies for the purpose of accrediting CABs to the relevant standards. Accreditation is the independent evaluation of CABs to recognised standards for competence in carrying out specific activities.

At a global level, the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperation (ILAC) are the international organisations for accreditation bodies involved in conformity assessment activities undertaken in accordance with ISO/CASCO standards.

[16] Although beyond the scope of this paper, this definition also encompasses calibration

A key function of these organisations is to maintain a single worldwide program of conformity assessment, which reduces the risk for businesses and their customers by assuring them that accredited certificates and other attestations may be relied upon. IAF deals primarily with certification and related activities, while ILAC deals primarily with testing and related activities.

The activities of the global bodies IAF and ILAC are supported through a network of regional bodies. Individual accreditation bodies that have been peer-evaluated as competent are able to sign regional and international arrangements to demonstrate their competence in their accreditation of CABs.

Digital traceability standards – supporting simplified global trade systems

Global data standards for traceability are critical for efficient and resilient global supply chains and trade. Digital traceability systems are dependent on quality data, including the exchange of product conformity information. Signatory countries to APEC are committed to best practices for the adoption of global data standards[17] to ensure simplified, harmonised, and standardised trade.

[17] https://www.apec.org/Publications/2020/03/APEC-Guidelines-and-Best-Practices-for-the-Adoption-of-Global-Data-Standards

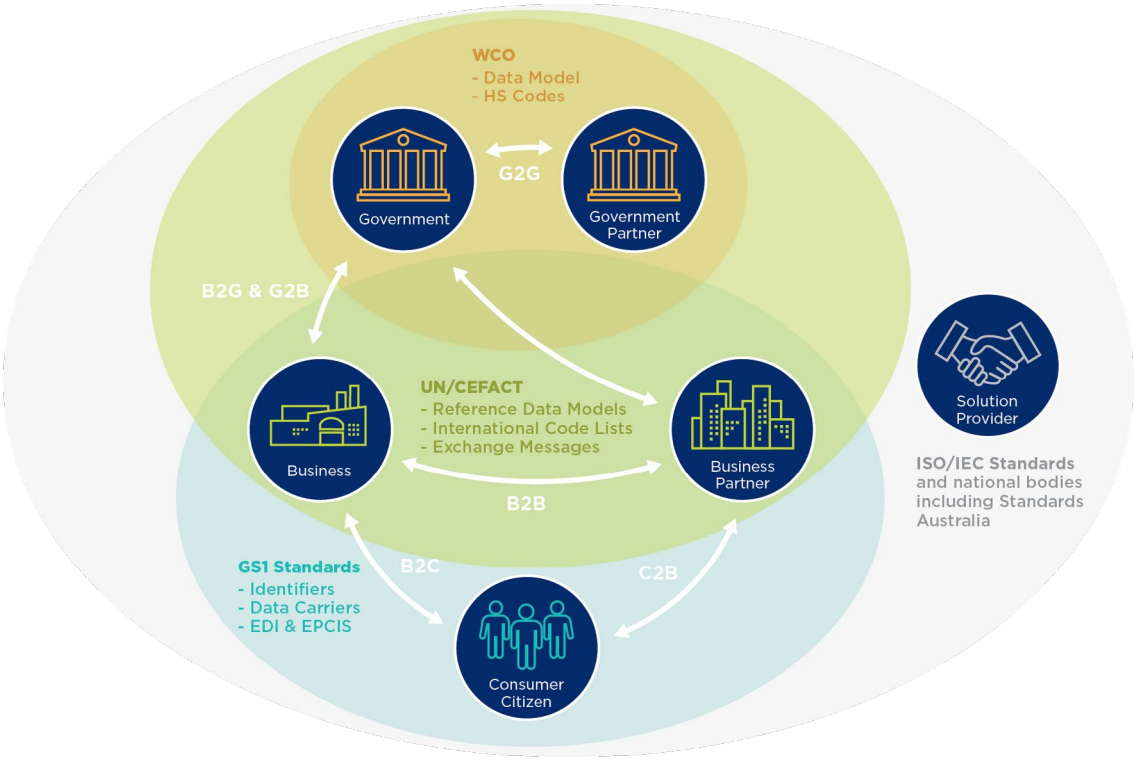

Figure 1: The relationship between key trade facilitation standards agencies

Product conformity systems are tightly integrated with global trade systems. Key United Nations (UN) agencies and the World Customs Organization (WCO) work together alongside global standards bodies to enable efficient and effective data exchange between governments. The relationship between key agencies that are focused on global trade and supply chain data exchange, is shown in Figure 1.

Overlapping circles within the diagram should not be interpreted as duplication. Agencies focus on different layers of information management. ISO/IEC typically focuses on the 'what should be done' whereas UNCEFACT and GS1 focus on the 'how' – with GS1 concentrating on the operational pre-requisites, including globally unique and unambiguous identification of products and locations, to enable businesses to transact.

ISO/IEC and national standards bodies, including Standards Australia, are responsible for global data standards. At the international level, publishing and maintaining standards that relate to the exchange of trade information falls within the responsibility of the ISO/IEC Joint Technical Committee, JTC1.

GS1 is an international standards-writing organisation that supports government and industry by developing supply chain standards encompassing traceability, chain of custody and related needs. GS1's standards-writing activities contain several standards that have been adopted as ISO/IEC standards. GS1 standards focus on the unique identification of products, locations, shipments, consignments, documents and many other 'items' involved in supply chains and trade. GS1 standards support the automatic capture of data as these 'items' physically move between trading partners, via technologies such as barcodes, RFID and IoT. Finally, GS1 standards enable data sharing between all stakeholders in the supply chain (both public and private) to automate master data sharing, Order to Cash and Procure to Pay processes, traceability, freight management, product recalls and a range of other business processes.

The **United Nations Centre for the Facilitation of Procedures and Practices for Administration, Commerce and Transport (UN/CEFACT)** supports trade facilitation through recommendations and electronic business standards, such as electronic messaging, eCertificates, Core Component Libraries, UN Code lists and UN Recommendations.

There are numerous completed UN CEFACT projects, as well as several that are underway at the time of writing, having direct relevance for the standardisation of supply chain data exchange systems. Among the projects underway at the time of writing, UN CEFACT Project P1073 *Supply Chain Cross-Industry Track and Trace* and Project P1114 Digital *Product Conformity Certificate Exchange* are of particular interest.

The **World Customs Organization (WCO)** supports the effectiveness and efficiency of customs administration through the development of international conventions and instruments. WCO maintains the international Harmonized System goods nomenclature and the WCO Data Model that addresses the procedural and legal needs of cross-border regulatory agencies[18].

Simplification, harmonisation, and standardisation of trade processes require the global alignment of multiple parties. UN/CEFACT and WCO's work on intergovernmental data exchange is enhanced and supported by the adoption of global data standards across most industries. This reflects the far-reaching application of such standards for global and domestic trade. UN/CEFACT Core Component Libraries[19], WCO Data Models[20] and the GS1 Standard and Core Business Vocabulary[21] are well aligned – and in some cases, the same. However, the way this alignment operates and how businesses use GS1 standards through supply chains is not well understood by many government agencies.

There is a growing awareness that traceability solutions that are not based on global data standards create inefficiency that is contributing to market failures and supply chain vulnerability[22]. The costs and benefits for government and industry of applying global data standards have been well defined[23].

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18 http://www.wcoomd.org/DataModel

19 https://unece.org/trade/uncefact/unccl

20 http://www.wcoomd.org/DataModel

21 https://www.gs1.org/standards/epcis/epcis-cbv/1-0

22 https://www.pc.gov.au/inquiries/completed/supply-chains/submissions

23 https://www.apec.org/Publications/2017/11/Study-on-the-Applicationof-GDS-for-Supply-Chain-Connectivity-Phase-2

5. APPLYING STANDARDS TO PRODUCT CONFORMANCE INFRASTRUCTURE

The challenge

A fully digitalised supply chain should accommodate all the following types of information and processes:

1. Commercial transaction data
2. Regulatory and cross-frontier processes
3. Conformity information
4. Real-time monitoring data (where applicable)
5. Document authentication
6. Tracking of physical goods, including repackaging and 'bulk breaking' processes
7. Uniquely linking data with individual shipments of physical goods ('digital twin')

Linking conformity information (Item 3) with individual shipments (Item 7) carries the potential to solve certain intractable supply chain weaknesses – in a way that is not possible, even in principle, with legacy (paper-based) trade systems.

However, no standard or common convention is currently available for the capture and exchange of product conformity information along a supply chain. There is also an absence of a standardised framework for connecting disparate processes which may share a common link with a product. One of the challenges is that the information of interest is generated by a large and diverse group of entities, which are not directly part of the supply chain. This situation has compounded the difficulties with incorporating such information into digital data flows.

Conformity information itself is a complex mix of data types and may include any, or all, of the following:

- Product and system certifications
- Sampling and test results
- Source/origin attestations
- Inspection reports
- Sign-off/clearances
- Credentialing of conformity assessment bodies

Existing treatment of product conformity and credentialing information

ABs maintain publicly accessible registers of accredited CABs and, in some cases, the certificates that have been issued by their accredited CABs. These registers typically enable searching using an accredited organisation number or a certificate reference number. However, it is more challenging to authenticate or validate that the test results, certification, or inspection results in use at any given time are genuine, current and pertain to the supplied product(s).

The following weaknesses are inherent to most supply chains:

1. It is easy for nefarious agents to fraudulently alter a test/inspection report or product certificate, as well as take a genuine report for one product and imply that it relates to another product
2. It can be difficult to establish whether specific items 'as-supplied' are conforming or not, since traditional documentation is often not unequivocally linked with a delivery shipment
3. Establishing or confirming the authority upon which issuing bodies make conformity claims can be problematic where a sole product relies on multiple testing and other conformity data points that require checking across multiple information sources
4. There is no straightforward way to share or query information about entities, locations, products, or events that may have occurred, as each party is capturing information using different methods

These weaknesses create challenges for product conformity stakeholders and add cost and complexity for industry and governments to interact with product conformity data.

Common entities and data elements

The traceability of products and of related conformity processes involve many of the same entities and data elements:

- Legal entities that are Accreditation Bodies (ABs)
- Legal entities that are Conformity Assessment Bodies (CABs) and are approved by ABs to undertake specified testing, certification, or inspections
- Organisations (legal entities) that produce, or supply, products that are tested, certified or inspected
- Physical locations/sites where the above legal entities operate, carry out activities or are subject to testing, certification, or inspections
- Products that are subjected to testing, certification, or inspection
- Samples of products that are tested, certified, or inspected; and
- Test results, certificates, or inspection reports (product conformity process outcomes).

Additional entities of potential relevance to product conformity systems include:

- Assets – including configurable items such as weighing, measuring, or dispensing machines
- Service relationships – defined as an approved scope of service offered by a CAB; and
- Events – that may include calibration, testing, certification, or inspection

Applying digital identities within the accreditation ecosystem

So, how do ISO/IEC-based identification keys, used extensively in physical supply chains, map to elements of the product conformity systems components? An illustration of the accreditation ecosystem is depicted in Figure 2, with references to applicable GS1 Identification keys.

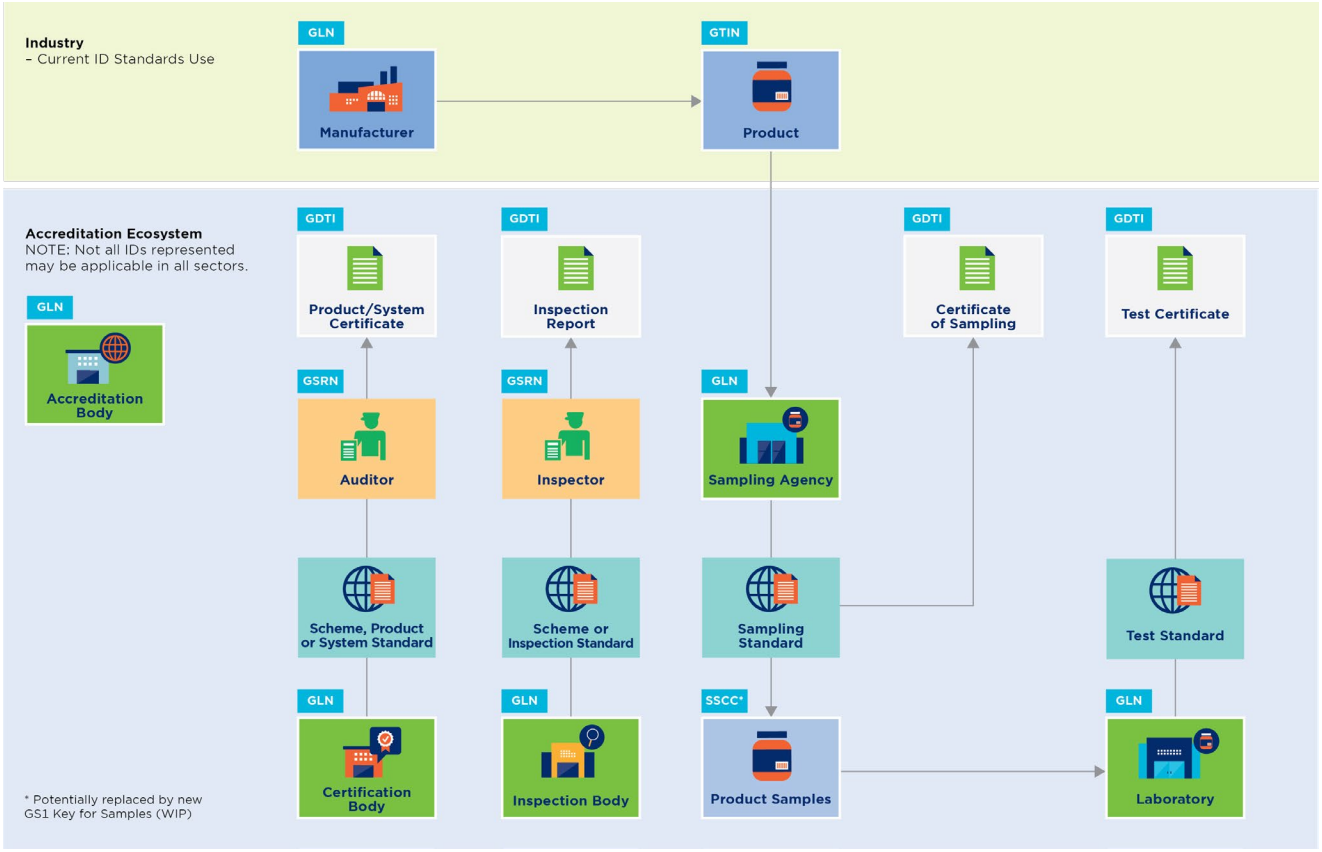

Figure 2: ISO/IEC Identification keys mapped to product conformity entities

GLN (Global Location Number)

GLNs are used to identify entities, organisational business units and physical or virtual locations. In the case of the accreditation ecosystem, they are used to identify the ABs, CABs and the organisations that are subject to testing, locations where tests occur (or sites that are certified) and the location where process conformity data may be stored (a server or address). This identifier is compliant with ISO/IEC 6523. GLN semantics and rules are defined at https://www.gs1.org/standards/id-keys/gln

Application example: A CAB issues a certificate to an organisation's business unit, located at a defined site. Each entity, including the CAB, its client (the organisation), the client's business unit and the relevant locations are all identified using GLNs

GTIN (Global Trade Item Number)

GTINs are used to identify products. The GTIN is composed of a Company Prefix and a unique item reference (typically represented as a barcode number). GTIN is compliant with ISO/IEC 15459- 6. Further details are available at https://www.gs1.org/standards/id-keys/gtin

GTIN specificity may be enhanced via batch/lot referencing or serialisation to identify specific lots or items[24].

A product that is subject to testing is assigned a unique product identifier. The same identifier that is used for supply chain purposes is used for test and certificate referencing.

SSCC (Serial Shipment Container Codes)

SSCCs are used to uniquely identify shipments, containers, or logistics units. A test sample provided for a product may be defined as a logistical unit. SSCC is compliant with ISO/IEC 15459-1 and described at https://www.gs1.org/standards/id-keys/sscc

Unique identification for samples is being addressed by GS1 as part of the Global Standards Management Process. Note that laboratories often create their own sample identification codes that often have weak links, or no links, to the product/ shipment that the sample relates to

GDTI (Global Document Type Identifier)

A GDTI identifies documents such as Purchase Orders, Invoices or any other type of document used in supply chains and trade. A GDTI can be used to identify certificates, test or inspection reports or declarations. GDTI is compliant with ISO/IEC 15418. Further information is available at https://www.gs1.org/standards/id-keys/gdti

A GDTI has an option to include serialisation, allowing it to uniquely identify a particular document. A specific test certificate, for example, can be uniquely identified by means of a GDTI with serialisation.

The appropriate symbology can be included on the document (e.g., a QR or DataMatrix), to encode – besides the GDTI – a link to additional information about the certificate, including its authenticity via validation mechanisms.

GSRN (Global Service Relationship Number)

GSRNs are used to identify relationships, for example, between individual service providers such as an accredited service provider (defined scope) and an inspector or auditor. GSRN is compliant with ISO/IEC 15418. Further information is available at https://www.gs1.org/standards/id-keys/gsrn

Leveraging global standardsrecognised for digital trade applications

Keys including the GLN, GTIN, SSCC and GDTI are recognised as fundamental global identification standards within the Standards Toolkit for Cross-border Paperless Trade published by the ICC and the WTO.These keys form part of the wider GS1 system of compatible standards.

GS1 emerged as the de facto international global data standard for retail products via a cooperation agreement between the Uniform Code Council in the United States (established 1974) and the European Article Numbering Association (established 1977).

[24] A particular lot or batch of a product can be uniquely identified by means of a compound key that includes both the GTIN and a batch or lot number. A specific instance of the product can be uniquely identified by means of a compound key that includes both the GTIN and a serialisation number.

As previously noted, ISO/IEC standards now explicitly recognise the GS1 system of standards for a wide variety of supply chain elements. The GS1 system of ISO/IEC compliant standards are recognised by the United Nations and related bodies applying legislated standards.

At a national level, the GS1 system of ISO/ IEC compliant standards are increasingly adopted by governments to simplify regulatory systems. To illustrate, in New Zealand the local business identifier, or NZBN, is based on a GS1 identifier (the Global Location Number). An increasing number of economies are introducing GS1 standards in single window and trade processes, including the USA, Canada, Vietnam, New Zealand, and China. China now uses GS1 keys to enhance the harmonised system (HS) of tariff codes to classify traded products[25]. GS1 and WCO trade code nomenclature is well aligned and increasingly integrated.

Alternative Identifiers

Although there is no single standards organisation, other than GS1, that supports all the ISO/ IEC identifiers identified in the Framework in an integrated manner (e.g., Products, Entities, Locations, Shipments and Documents), other recognised identifiers do exist in the case of Products and Entities, for example. The vision is to ensure that these identifiers and other potentially emerging identifiers, which satisfy the need to be recognised as a global standard under ISO/ IEC, are not excluded from the Framework.

[25] https://www.gs1hk.org/about-us/news/China-Introduces-GS1-GTIN-for-Customs-Clearance

6. RECOMMENDED PRIORITY USE CASES

As described in the previous section, GS1 standards that are widely used across industry for supply chain management and trade can be directly applied to the conformity ecosystem. In other words, there is a single global standards framework that is applicable to all sectors. This section provides an overview of the priority areas for adopting ISO/IEC data standards in the conformity process. The recommended priority use cases include:

1. AccreditationCredentialing
2. Product Conformity Assessment Data
3. Supply Chain Conformity Events
4. End-to-end digitalisation of product attestations

Each of these cases is discussed next.

Accreditation credentialing - Use case

The first recommended priority use case would be in the identification of the formal recognition awarded by accreditation bodies (ABs) around the world to the individual organisations (CABs) involved in making conformity attestations. In this way, the authority upon which such attestations rest can be verified. This use case enables the 'accreditation status' of these attestations to be digitally associated with all issued conformity certificates as well as with physical entities or product releases.

The identification keys of relevance are the GLN and the GDTI:

1. Use a GS1 Global Location Number (GLN) (ISO/IEC 6523) to identify
   - Each Accreditation Body (AB)
   - Each Conformity Assessment Body (CAB)
2. Use a GS1 Global Document Identifier (GDTI) (ISO/IEC 15418) to identify:
   - AB-issued credentialing information for each accredited CAB (including accreditation standard, accreditation number and accreditation scope/licence)

Product conformity assessment data - Use case

The second recommended priority use case involves the unique identification of certificates issued by CABs as part of their testing, auditing, or inspection processes and, to the greatest extent possible, the unique identification of parties, locations, and products relevant to all certificates issued by CABs.

A range of identification keys are in scope for this use case:

1. Use a GS1 Global Location Number (GLN) (ISO/IEC 6523) to identify:
    - Unique business entities – e.g., manufacturers, importers
    - The CA provider (e.g., laboratory, certification body, inspection body) issuing a product conformity certificate
    - The business entities (e.g., manufacturers/ locations relevant to the certificate)
2. Use a GS1 Global Document Identifier (GDTI) (ISO/IEC 15418) with serialisation, to identify the certificate itself
3. Use a GS1 Global Trade Item Number (GTIN) (ISO/IEC 6523), plus the batch/ lot number and/or the serial number as needed, to uniquely identify each product being tested. And
4. Use a GS1 Serial Shipping Container Code (SSCC) (ISO/IEC 6523) to identify:
    - Each unique shipment of a product sample sent for testing. (The SSCC of that shipment can be associated with the respective GTIN plus the batch/lot number and/or the serial number of the sample as needed.)

The following real-life example of a bundle of reinforcing steel manufactured and supplied by InfraBuild Steel, marked with a product tag carrying GS1 standards-compliant data, demonstrates how this can work in practice. Encoded on the GS1 DataMatrix 2-dimensional barcode in the example is a series of digits that contain all the information shown in the first and third columns of the table in Figure 3.

AI Code	AI Type	Data	Comments
01	Global Trade Item Number (GTIN)	99316266014168	This is the InfraBuild issued GTIN for Deformed Bar 24x15000mm
21	Serial Number	1613802680	Unique Serial Number for this bundle
10	Batch/Lot Number	1600231688	Identification for the heat number for this bundle
30	Variable Item Count	54	Indicating there are 54 Deformed Bars 24x15000mm in the bundle
31	Logistic Measure (Weight)	3002	Indicating the weight of the bundle

Figure 3: Example of encoded data on the product tag of a bundle of InfraBuild steel

Shown in Figure 4 is an actual Test Certificate issued by InfraBuild Steel Mill for the delivery that includes the bundle shown in Figure 3. Notice that:

- the test certificate has been assigned a GDTI (with serialisation) as a unique certificate identifier, and
- the test certificate includes the unique product identifiers (GTIN, batch and serial numbers) of the bundles in that delivery.

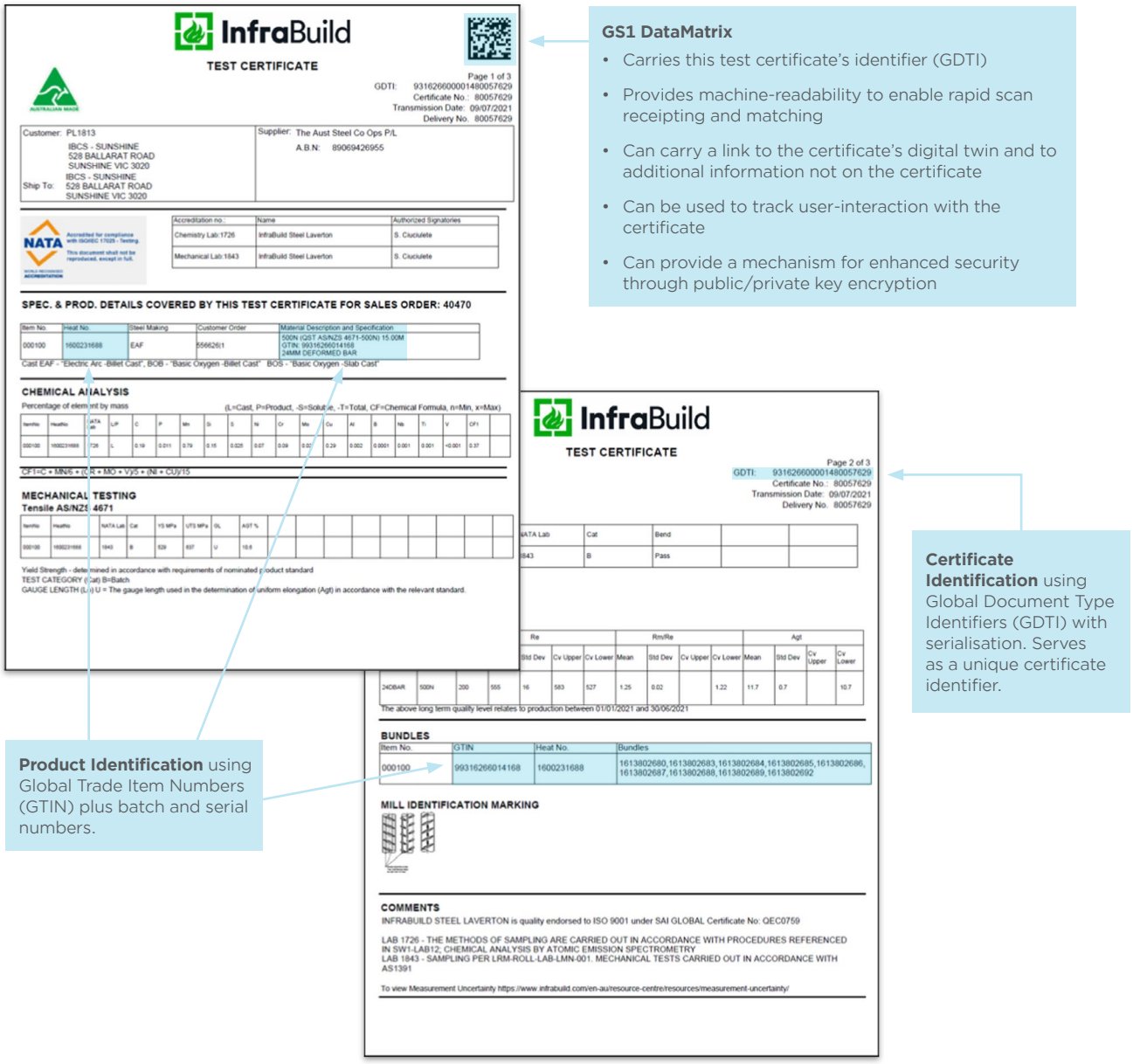

Figure 4: First two pages of InfraBuild's Test Certificate for the bundle of Figure 3

Supply chain conformity events – Use case

The third recommended priority use case involves supply chain traceability. Tracking of supply chain events using the Electronic Product Code Information Services (EPCIS - ISO/IEC 19987), combined with a Common Business Vocabulary (CBV - ISO/IEC 19988) represent mechanisms for improving supply chain transparency and enhancing overall product conformance system integrity.

EPCIS is a GS1 standard that enables trading partners to share information about the physical movement and status of products as they travel throughout the supply chain – from business to business and ultimately to consumers. It helps answer the "what, where when and why" questions, to meet consumer and regulatory demands for accurate and detailed product traceability information.

EPCIS is providing the foundation for traceability systems across the world in sectors including agriculture, packaged foods, and healthcare, among others. As the adoption of EPCIS standards continues to grow globally, the opportunity for 'digital certificates' to travel along with products' digital twins is increasing.

Current and potential future states are illustrated in Figure 5.

The future will involve product conformity data being exchanged in real-time to automate government and industry traceability and decision support systems.

Event-based information about testing, inspection and certification processes and the exchange of such data has dramatic implications for regulatory automation and the value of product conformity processes. Additional information about EPCIS is available online[26].

End-to-end digitalisation of product attestations - Use case

The fourth recommended priority use case involves supply chain attestations. Certain supply chain functions can only become possible as a result of connecting sequential discrete supply chain stages.

Consider the tracking of sustainability measures, or ethical manufacturing practices, which could reflect the sum of all stages of a supply chain. Each precursor stage in supply might be subject to its own type of local certification, oversight, and conformity outcomes.

Linking separate stages of supply chains to generate a complete picture of supply has remained elusive, largely due to the complexity of modern supply chains, but also due to the absence of a standardised framework for connecting disparate processes. While end-to-end digitalisation is a sophisticated use case, the potential payoff is large.

A recognised framework, in which product flows could be tracked and then linked with associated attestations under valid protocols would provide a powerful basis for managing complex layers of attestations. For this use case, cross-border interoperability would be important for success.

To illustrate what might be possible, consider the examples in Figure 6 of existing industry schemes and the ways in which current outcomes might be augmented through the power of global standardisation.

[26] https://www.gs1.org/standards/epcis

Current State	Future State – leveraging a common event language
Accreditation events, product conformity tests and certificate issuance and use are static. A focus on 'current state' with few systematic controls over prior states or event history to ensure currency and change	Critical Tracking Events (activities defined by CAs), as well as key data elements required to enable traceability, are systematically captured.

Figure 5: Current and Future State Analysis Table

7. MANAGING CREDENTIALING INFORMATION

Checking the credentials of CABs and others in the product conformity community is not a new process. Accreditation bodies around the world publish information on their respective websites to enable users of product conformity data to verify that CABs are accredited and that the certificates they issue are authentic.

Some CABs are already applying data carriers (i.e., a QR codes or a DataMatrix) on certificates to direct users to CAB websites and related services. In this case, the certificate holder is required to trust that the CAB website and verification services are trustworthy.

Figure 7 illustrates how credentialing is currently managed by CABs and the opportunity for accreditation bodies to standardise processes and reduce the potential complexity for industry of having many different processes (possibly hundreds) and methods to verify the authenticity of certificates issued.

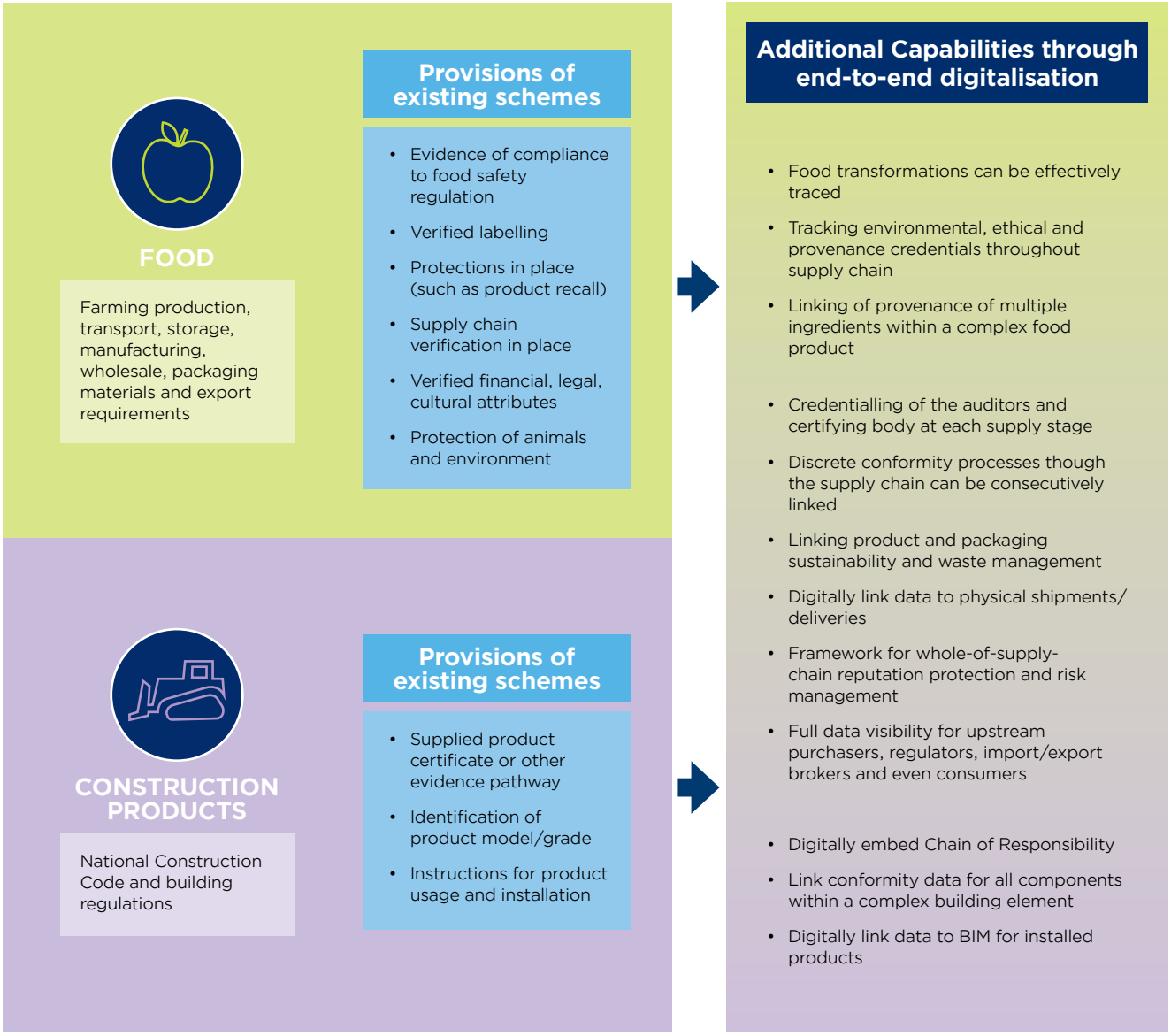

Figure 6: Illustration of Framework Benefits for Existing Food and Construction Schemes

As Is

The 'as is' state shows CABs applying data carriers or contact information (an email address or phone number) for users to check that the certificate is as printed (or as stored in soft copy).

That is, a user wanting to check credentials is invited to visit a website to ensure that the details on the certificate are correct. Applying a QR code or a DataMatrix, and directing users to a URL address, results in hundreds and perhaps thousands of pathways with no independent checking of the authority/credentials held by the CAB.

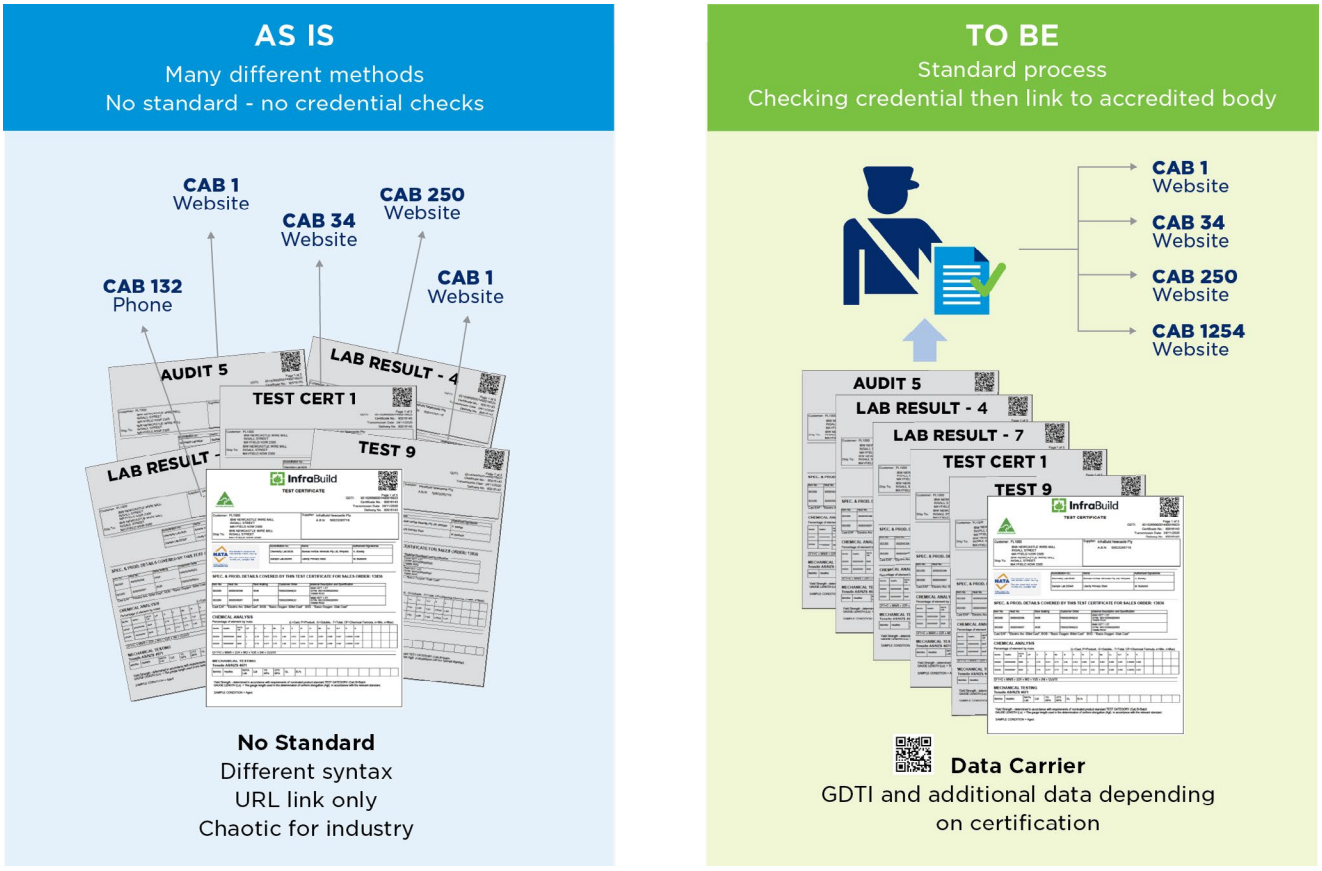

Figure 7: Product Certification Credentialing – 'as is and to be' illustration

To Be

In the 'to be' case, CABs apply to each certificate a unique standardised certificate identifier, the Global Document Type Identifier (GDTI). Each certificate also carries a QR code or a DataMatrix that can be scanned – via mobile phone or other means – to reveal a unique web address that includes the certificate's GDTI, which can link to the CAB's own site and can also be translated by a central 'resolver' (a pointer service) that:

- checks the certificate issuer credentials are correct and current; and
- directs the certificate users to the CAB (certificate issuer) services, i.e., a business website or online checking systems

This web address may follow the GS1 Digital Link standard[27], built upon established standards from the Internet Engineering Task Force (IETF) and the World Wide Web Consortium (W3C). An example of what a Digital Link may look like for the Certificate from InfraBuild shown before is given in the figure below.

[27] Further information about the GS1 Digital Link Standards is available online at https://www.gs1.org/standards/gs1-digital-link

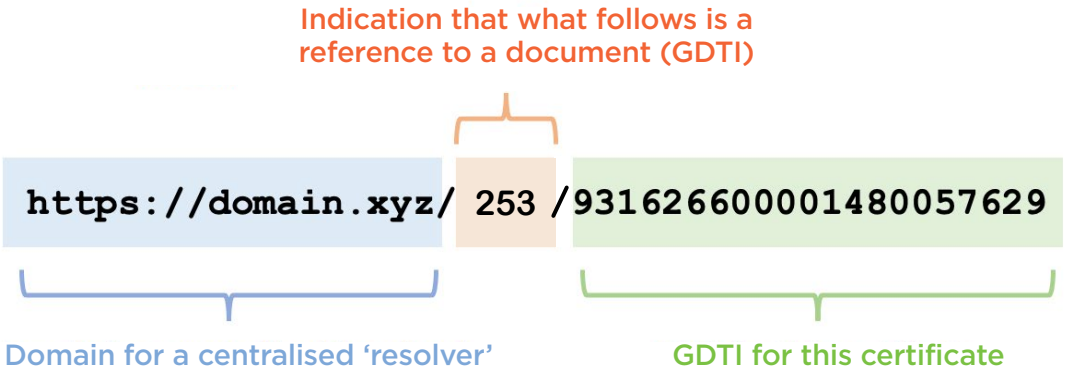

Figure 8: Example of a Digital Link for a certificate, using domain.xyz as the resolver's domain

The 'to be' case depicted above does not involve the centralisation of CAB data. This is a preferred (lowest impact) approach and is one of several credentialing information management options. More advanced processes, including the use of cryptography (public and private key exchange as used in online banking), are also possible but not discussed here.

The key focus is supporting existing product conformity business processes and laying the foundations for a future transition to data-driven - rather than paper-driven systems - over the next ten years.

Shared infrastructure options

Accreditation bodies (ABs) around the globe manage accreditation information for CABs via central registries. Determining the currency of CAB credentials does not necessitate that all certificate issuance or product conformity activity records are maintained in a central register (which would be costly and complex to administer). Three models are possible and are illustrated in Figure 8.

The 'register with links to CABs' is recommended for product and test certificates for the following reasons:

- It avoids a major cost of managing data and minimises the impact on CABs, by leveraging data platforms that are currently operated by ABs in the national interest
- It has the lowest operational impact on existing processes and systems
- It involves the least amount of effort from CABs. The credentialing mechanism and 'resolver service' is managed for and on behalf of CABs who simply provide a web address (or in the case of no online presence, an 'information page' with a phone number to call)
- It provides a pathway to more sophisticated credential exchange processes; and
- It effectively addresses the risks described earlier in the discussion (many disparate processes and complexity for industry and individual users of certificates)

The future will likely involve less emphasis on central registries (more distribution of trust across multiple organisations) and less reliance on paper and PDF certificates (more direct data exchange). The suggested approach is:

- ABs focus on governance and managing CAB credentialing information; and
- ABs provide support to their members via a digital credentialing service that verifies the currency of the CAB accreditation and points to their data (to support certificate authentication and perhaps 'future' data exchange).

This can be achieved with relative ease via the use of existing ISO/IEC standards.

Large Central Registry *Suits some certificate types*	**Register with links to CABs** *Preferred for product/ test certificates*	**Distributed Registers**
• ABs maintain information about CABs and their certificates in one central database. • CAB activity and certificate issuance information are centralised • Large single/few central registries for lookups • Central administration for members	• Only CAB credentials are maintained in central registers. • CABs maintain their transactional data (activity and certificate issuance) • ABs provide a service to point users to CAB data sources (resolver service based on global standards) • CABs manage their own data	• All CAB data is distributed and maintained without a central register • Minimal data is maintained by ABs • CAB provides a data exchange service based on verified credentials • Less reliance on document exchange

Figure 9: Table defining shared infrastructure options

8. FUTURE VISION FOR CONFORMITY AND CREDENTIALING

The move between the current state and a future vision must be evolutionary rather than revolutionary. A radical and immediate change to the present conformity and credentialing processes is not recommended, but rather the progressive application of ISO/IEC standards and enabling technologies over time to allow the community to adapt and manage change.

Having said this, a clear future vision is required to ensure all stakeholder activities are aligned to a common goal, and different stakeholder groups can map their glide path to this future state, perhaps with different priorities and actions but all leading to the same destination.

To define this future vision, we refer to the UN/CEFACT principles of interoperability for customs and single windows (Recommendation No. 36)[28], which defines interoperability as "the ability of two or more systems or components to exchange and use information across borders without additional effort on the part of the user." The UN/CEFACT Recommendation provides the foundation to illustrate the future vision for conformity and credentialing as detailed in Figure 9.

[28] https://unece.org/DAM/trade/Publications/ECE-TRADE-431E_Rec36.pdf

System Property	Current State	Future State
Autonomy	Industry and region-specific protocols requiring interpretation for data exchange	Standard system functions do not require specific details to seamlessly exchange digital information
Agreement and consensus	A mixed mosaic of G2G and B2G agreements to enable exchange of information	Widespread agreement and a common understanding of data exchange protocols
Responsiveness and connectivity	'Acting on demand' and issue-specific responses using digital automation	'Always on' interconnected systems across transnational boundaries with security
Data flow, security, privacy, and confidentiality	Trust-based with centralised risk management and governance to manage interoperability functions	Trustworthy systems with distributed control and management of information for privacy, security, and risk management
Data harmonisation and open standards	Focused on advances in technology and the modernisation efforts of governments	Emphasis is placed on data and open architecture to leverage international standards and protocols

Figure 10. Table defining systems properties – current and future state analysis

Applying principles to product conformity agents and processes

The perspectives described in Figure 10 provide one of many possible views on the future state of conformity assessment and associated credentialing processes based on the above UN/CEFACT principles. The scenarios draw on insights from online content verification and developments moving industries away from a traditional reliance on trust-based systems and exchange of paper or PDF certificates – including but not limited to third-party laboratory testing results, site audits, declarations, or passports.

Technology will be a key enabler, once Global Data Standards are in place

Key technologies that will support the journey to this future vision include:

1. Distributed trust systems – for product conformance information management and credential exchange
2. Verifiable credentials – to enable digital authentication of organisations involved in product conformance – and the conformity activities they manage; and
3. Blockchain and distributed ledger technology – for maintaining and sharing data

Distributed trust systems

Many-Party Attestation Models are already in place and have major implications for the future of product conformity data management systems:

- Less or no paper exchange options
- Certificate authentication through verifiable credentials - code exchange
- Avoiding the need for centralisation of many/large registers; and
- Allowing accreditation and certification agencies to provide business as usual services

This is a popular model for government, as it avoids the requirement for larger central registers, and the costs and complexity of managing proprietary data.

Dimension	Current State	Future State
Accreditation Bodies	ABs maintain product conformance systems that are heavily dependent on trust and manual exchange of data between many parties	ABs enable their members to transition to digital product conformity – delivering value by managing risk, ensuring relevance, and supporting systems that focus on integrity and credentialing of claims
Conformity Assessment Bodies	Focus is on data issuance, not data exchange systems	Conformity data is available via a distributed trust involving many accredited bodies with ABs involved to provide trustworthy data exchange mechanisms to strengthen overall product conformity system integrity. Certificate issuance and credential mechanisms become standardised to enable interoperability
Certificates	Document heavy – with paper and PDF-based information exchange in a range of formats as determined relevant by certifiers – few data standards	Certificates are issued in digital format (as data exchange) with supporting physical twins (continued paper or PDF) for business continuity (and compliance with legacy laws) until paper forms are no longer needed (use case dependent)
Certificate Credentialing	Reliance on trust and reputation of certified agents – weak and difficult mechanism to prove the authenticity of a certificate – with widespread abuse	Digital certificates authenticated using a distributed trust model (by credentialed certifiers) and without reliance on a central registry. Verifiable credentials enable industry and government to deliver efficiency and safety through real-time data exchange i.e. regulatory automation
Certified Products	No common process across all certifiers for identifying products or samples used for testing and certifying conformity	The link between product and certification (layered certificates) is simple and universal – via a standard global system of product, location/ entity (the certifier) and related entities. Each certificate is unique
Certification Events	Testing, certification, and certificate use processes are dependent on the certifiers – making auditing challenging	A structured language is used (based on EPCIS) to manage certification events for products. This language is aligned with regulatory events to enable better government with industry rules and legislation that leverages digital credentialing (via verifiable credentials exchange) that NATA and JAS/ANZ make possible
Certificate Use	Few mechanisms exist for certificate users to capture information about certificate use	Every time a certificate is interrogated (by industry or government users) there is an audit trail that facilitates greater insight into the value and effectiveness of product conformity processes
Certificate Data	Certification master data is held by certifiers and challenging to access – certifiers derive little value from the information other than knowing their customer	Certifiers become more relevant and valuable to industry and government, ensuring that certification processes are applied for public and industry benefit (via enabling transaction data to drive industry and regulatory process efficiency)

Figure 11: Table summarising current and future state product conformity system impacts

Verifiable credentials – what are they?

Verifiable credentials have been used extensively for online content verification and will become increasingly important for the exchange of trusted information between parties involved in product conformity systems.

In the physical world, a credential might consist of information related to the subject of the credential, the issuing authority, the type of credential, the attributes or properties being asserted, constraints and evidence related to how the credential was derived.

A verifiable credential can represent all the same information that a physical credential represents. The addition of technologies, such as digital signatures, makes verifiable credentials more tamper-evident and more trustworthy than their physical counterparts.

Holders of verifiable credentials can generate verifiable presentations and then share these verifiable presentations with verifiers to prove they possess verifiable credentials with certain characteristics. Both verifiable credentials and verifiable presentations can be transmitted rapidly, making them more convenient than their physical counterparts when trying to establish trust at a distance.

Examples of how to use this data model using privacy-enhancing technologies, such as zero-knowledge proofs, are widely available.

Blockchain and distributed ledger technology

Is blockchain relevant? Possibly, but not on its own or without strong governance, data validation and standards. Blockchain and related technology (and there are many forms) which enable distribution or sharing of data between and across businesses also need a range of foundational building blocks, without which the technologies will not deliver their intended benefits.

A critical underlying assumption for blockchain and related technologies is that a unique digital representation of physical objects (sometimes called digital twins) is always possible. This requires unambiguous, globally unique, and persistent identification of the physical item, e.g., the hip implant, the bale of wool, the physical certificate of conformity, litre of diesel or grain of rice. We know that this is difficult for the latter two cases.

In addition, immutable registers have their own inherent issues, especially when incorrect information is included or when data redaction is required (as is often the case in law). Governance, security, and computational issues are also relevant and are subject to ongoing research, as the fitness-for-purpose of blockchain becomes better understood. In the context of product conformity and traceability, blockchain applications should be considered alongside other data management systems. However, it is important that global data standards remain prominent, to define the structure and meaning of all data that is shared.

A clear focus on data standards, instead of selecting specific platforms/solutions (based on blockchain or any other technology) will lead to greater flexibility. Companies can choose their own technology partners, leading to increases in competition and innovation and, ultimately, lower costs.

Cybersecurity

Any platform on which confidential information is held and exchanged, regardless of the technology implementation, must deliver adequate security of access and robust protections against penetration, denial of service and other attacks.

While addressing these issues is beyond the scope of this paper, it is recognised that there is a clear need to specify appropriate data security standards as a basic element in the development of any data exchange platform.

9. CONCLUSION

A coordinated approach is required to close the gap between digital product traceability versus traceability of product conformity and credentialing information. Defining a robust traceability system, addressing both physical products and product conformity information, represents an essential measure to support global markets.

Such a system must enable highly systematised data exchange among supply chain parties, and with regulators. It must be underpinned by global data standards and exhibit interoperability across equivalent systems used by trading partners.

The objective is to deliver international alignment, harmonisation and interoperability in a way that leverages the existing data standards which are used by industry for product traceability.

What is the alternative?

Solutions by individual industries to address context-specific concerns will result in a patchwork of incompatible systems. Efforts to coordinate information exchange among certifiers, testing and inspection authorities will become chaotic and potentially intractable.

> Without intervention, it is easily imaginable that the existing mosaic of systems and methods will proliferate (e.g., proprietary QR or other codes), each using different semantics and pointing users to different data sources such that conformity attestation becomes complex, costly, incompatible, or impossible.

For individual CABs, this may not be a concern, but for an entire industrial supply chain, the problem's rate of growth rapidly becomes exponential.

A global dialogue

What is being proposed is a technology-neutral data standards framework, rather than a specific implementation. The Framework is sufficiently flexible to accommodate and support:

- pre-existing certification schemes;
- refinement/formalisation of existing industry approaches;
- progressive development of capabilities based on need and specific use cases;
- conformity approaches that may be unique to a particular industry;
- different supporting technologies (such as blockchain and non-fungible tokens); and
- evolving regulatory and other external impacts.

The ideas presented within this report describe one possible pathway forwards, however, what is most needed is the commencement of a global dialogue to consider the future of conformity assessment data exchange.

Fruitful dialogue might occur within various different contexts, such as global fora (WTO and others), regional economic groupings, standardisation bodies (ISO, UN/CEFACT and others) and within the context of Free Trade Agreement discussions. Ultimately, such dialogue should involve international trade facilitation bodies, intergovernmental bodies, accreditation and CAB representative bodies, industry representative bodies and government participants from around the world, all of whom are critical stakeholders in the international conformity ecosystem.

APPENDIX A
– TOWARDS A PROTOTYPE

A broad framework for the digitalisation of conformance and accreditation processes, built upon international standards, has been described above. The emphasis has been on general principles, including the key role of global data standards, rather than the elaboration of specific technological implementations.

The next step is to translate this proposed broad framework into a prototype, i.e., a tangible working tool that can be tested and refined with the input of stakeholders from the conformance and accreditation ecosystem. Following validation of the prototype, the refined version could be used in an initial pilot with interested parties, based on a modest scope. Towards this goal, an Australian pilot initiative called conformity.ID is under development, which will represent the first experimental implementation of the ideas presented in this report; a distributed network of interoperable databases that allows stakeholders to validate and explore conformity and credentialing information about products, locations, businesses and processes.

The design of conformity.ID will avoid the centralisation of product conformity data. Instead, it will rely on multiple distributed data sources managed by separate entities, including accreditation bodies, certification bodies, auditors, laboratories, scheme owners and government bodies (see Figure 12).

This distributed network will be freely accessible via approved gateways, through which users will be able to validate credentials, certificates and conformity assessments for products, locations, businesses, assets, and processes via unique identifiers, such as GLNs, GTINs and GDTIs.

The prototype will be designed to reflect the structure of existing global accreditation ecosystems, with the intent of being scalable and interoperable with other similar national and international systems. While the initial concept model deployed in Australia would be operated by the local authorities in conformity and accreditation (NATA and JAS-ANZ) with the support of GS1 Australia, the governance for any emerging overseas models might be quite different, and yet still retain interoperability based on common underpinning identifiers.

Given the proposed use of open, global standards for identification and data sharing, the conformity.ID initiative is aligned with the policy approach to harness trade digitalisation published by the WTO and the WEF, published in April 2022.

The use of fundamental identifier standards such as GTIN, GDTI, SSCC, and others, conformity.ID is also aligned with the standards toolkit for cross-border paperless trade published by the WTO and the ICC in March 2022.

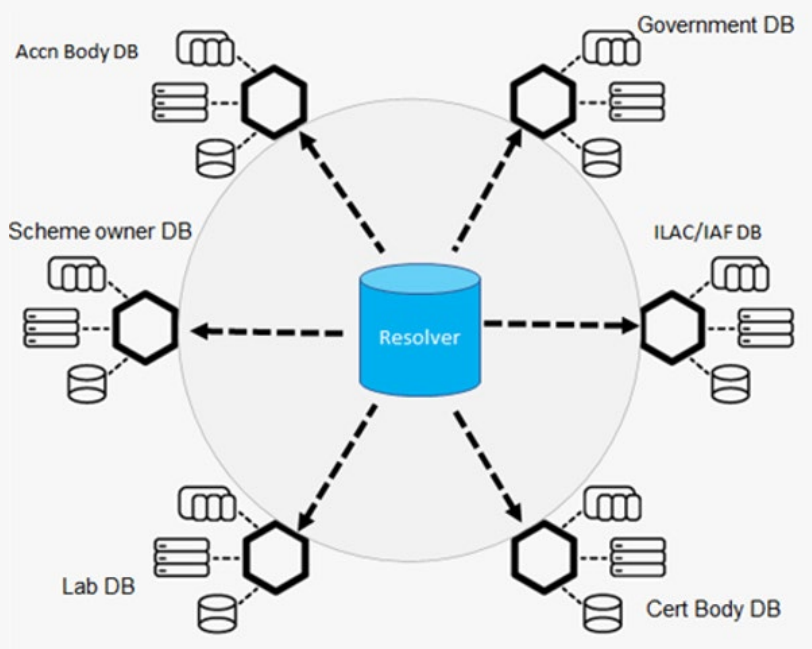

Figure 12: conformity.ID will rely on multiple distributed data sources managed by separate entities

APPENDIX B – BENEFIT AND COST CONSIDERATIONS

The benefits and costs envisaged for the proposed digitalisation of national product conformity systems are summarised in the table below. As the Framework proposed is flexible and may be progressively adopted and elaborated by different industries at a varied pace, risks are considered low. The timing of benefits realisation and costs noted would apply on a case-by-case basis.

The cost and benefit considerations listed here were drawn from an Australian government guide[29] dealing with the use of standards and risk assessments in policy and regulation.

[29] https://www.industry.gov.au/sites/default/files/2019-03/best-practice-guide-to-using-standards-and-risk-assessments-in-policy-and-regulation.pdf

Key Benefits

Factor	Magnitude	Likelihood	Timing	Comment and example
Public Health and Safety • Improvements in public and workplace • Increased community safety	Significant	High	Ongoing	Improved transparency through supply chains – enabling product recall and reducing fatalities and morbidity through information system failures.
Society and Community • Better public information • Improvements to products and public services • More reliable outcomes	Significant	Medium	Ongoing	Simplification of processes and reduced duplication of data capture. Improved public access to compliance information.
Environmental Benefits • Reduced noise/pollution • Improved amenity • Resource use accountability	Significant	Medium	Ongoing	Making circumvention of regulation more difficult and improving compliance system response times.
Competition Benefits • International and domestic interoperability (Harmonisation) • Increase in market innovation • New technology take-up	Significant	High	Ongoing	Standards application ensures technology neutrality and enables interoperability of legacy and emerging capabilities for industry. Avoids proprietary data structures which would otherwise limit competition by favouring historical platform providers.
Economic Benefits • Improved efficiency • Greater utility • Productivity improvements • Trade and market access • Economic growth • National brand trust	Significant	Medium	Ongoing	Improved conformance systems integrity reinforces national brand trust, consumer confidence and enables market access for trade growth and realising benefit of FTAs.

Cost Considerations

Factor	Magnitude	Likelihood	Timing	Comment and example
Business Costs • changes in business procedures or practices • registration fees • cooperating with audits and inspections • other compliance costs.	Minor	High	Once off & Ongoing	Reduced 'paper burden' and administrative costs through standardisation and sharing of digital compliance information. Minimal to no impact on business (industry) processes.
Consumer Costs • More information to manage and choices to make	Nil	Medium	Ongoing	Utility benefits through access to information not otherwise available e.g. compliance status reports etc. via smartphone.
Community & Environment • Net positive benefit due to improved transparency of processes and supporting data.	Nil	High	Ongoing	Reduced paper use. Informed decision making with environmental consequences.
Government costs • running education campaigns and the provision of additional information to stakeholders • provision of data collection or collation of business information • administration or inspection services • enforcement costs	Minor	High	Once off & Ongoing	No net new costs. A level of initial and ongoing support for CABs and key agencies to manage digital transformation is assumed (as a 'business as usual' activity).

Legend:

- **Magnitude** of cost or benefit - Nil, Minor, Major, Significant
- **Likelihood** of cost/benefit impact – High, Medium, Low
- **Timing** of benefits realisation or cost – Once off (immediate) and/or ongoing

APPENDIX C – GLOSSARY OF TERMS

Term	Meaning
Accreditation	Third-party attestation related to a conformity assessment body, conveying formal demonstration of its competence, impartiality, and consistent operation in performing specific conformity assessment activities.
Accreditation body (AB)	Authoritative body that performs accreditation.
Batch / Lot Number	The batch or lot number associates an item with information the manufacturer considers relevant for traceability of the trade item. The data may refer to the trade item itself or to items contained.
Brand Owner	The party that is responsible for allocating GS1 System numbering and barcode symbols on a given trade item. The administrator of a GS1 Company Prefix.
Certification	Written assurance by an independent body that a product, service, or system meets specific requirements.
Conformity assessment	Demonstration that specified requirements are fulfilled.
Conformity assessment body (CAB)	Body that performs conformity assessment activities, excluding accreditation.
Data Carrier	A means to represent data in a machine-readable form; used to enable automatic reading of the Element Strings.
Electronic Commerce	The conduct of business communications and management through electronic methods, such as Electronic Data Interchange (EDI) and automated data collection systems.
Electronic Product Code Information Services	EPCIS is a GS1 standard that enables trading partners to share information about the physical movement and status of products as they travel throughout the supply chain – from business to business and ultimately to consumers.
Global Location Number (GLN)	The GS1 Identification Key used to identify physical locations or legal entities. The key is comprised of a GS1 Company Prefix, Location Reference, and Check Digit.
Global Trade Item Number (GTIN)	The GS1 Identification Key used to identify trade items. The key is comprised of a GS1 or U.P.C. Company Prefix followed by an item Reference Number and a Check Digit.
GS1 Company Prefix	Part of the international GS1 System identification number consisting of a GS1 Prefix and a Company Number, both of which are allocated by a GS1 Member Organisation.
GS1 System	The specifications, standards, and guidelines administered by GS1.
Inspection	Evaluation of a product or process against defined specifications using experience and professional judgement.
Logistic Unit	An item of any composition established for transport and/or storage that needs to be managed through the supply chain. It is identified with SSCC.

Radio Frequency Identification	A data carrier technology that transmits information via signals in the radio frequency portion of the electromagnetic spectrum. A Radio Frequency Identification system consists of an antenna and a transceiver, which read the radio frequency and transfer the information to a processing device, and a transponder, or tag, which is an integrated circuit containing the radio frequency circuitry and information to be transmitted.
RFID Tag	A microchip attached to an antenna that sends data to an RFID reader. The RFID tag contains a unique serial number and may contain additional data. RFID tags can be active, passive, or semi-passive.
Sampling	Selection and/or collection of material or data regarding an object of conformity assessment.
Scheme	Scheme (conformity assessment scheme) - set of rules and procedures that describes the objects of conformity assessment, identifies the specified requirements, and provides the methodology for performing conformity assessment.
Scanner	An electronic device to read barcode symbols and convert them into electrical signals understandable by a computer device.
Serial Number	A code, numeric or alphanumeric, assigned to an individual instance of an entity for its lifetime. Example: Microscope model AC-2 with Serial Number 00001 and microscope model AC-2 with Serial Number 00002. A unique individual item may be identified with the combined GTIN and Serial Number.
Serial Shipping Container Code (SSCC)	The GS1 Identification Key used to identify logistic units. The key is comprised of GS1 Company Prefix, Serial Reference, and Check Digit.
Testing	Determination of one or more characteristics of a sample or product and usually performed in a laboratory.
Trade Item	Any item (product or service) upon which there is a need to retrieve pre-defined information and that may be priced, or ordered, or invoiced at any point in any supply chain.