Sustainable post-COVID-19 supply chain recovery through global data standards

Building a resilient supply chain through product identification and data sharing

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Executive Summary

A digitized, standardized supply chain can mitigate supply chain shocks, and provide workable solutions the world needs today and in the future for recovery and resilience.

COVID-19 is disrupting traditional supply chain practices, and post COVID-19, the world will see altered supply chain structures. Fundamentally, manufacturing and supply chains will become more localised, which will directly impact companies' operations, costs and sourcing. In addition, supply chains will adopt more robust preparedness planning in anticipation of future pandemics and will incorporate better sustainability and resilience into their systems. These changes are expected to change the way business is conducted long after the pandemic subsides.

On an operational level, negative impacts and systemic weaknesses revealed by the present crisis have included: limited availability of staff due to lockdowns, restrictions on export-import trade flows and diversions, requirements for contactless import procedures, and the lack of visibility and flexibility in the supply chain. It is apparent that the application of open global data standards will not only enhance cross-border trade aspects during the pandemic recovery phase, but also build much-needed preparedness into border processes and supply chains to ensure future resilience.

It has been demonstrated that lack of harmonisation and standardisation of regulatory processes among governments presents significant challenges[1] to cross-border trade, and these issues are naturally exacerbated during a pandemic or other disaster, which reduces the availability of essential goods precisely when they are needed most.

Challenges to the safety and efficiency of supply chains commonly result from insufficient data or data errors. These deficiencies compel government agencies to cast an overly broad operational and regulatory net, and to undertake needless and excessive inspections, slowing the transit of goods across borders. This encumbers trade, wastes agency resources, and makes cross-border trade less efficient during normal circumstances, but even more so during a time of crisis.

Border agencies often must rely on data that they receive from intermediary parties (e.g. carriers, agents, representatives) that are not the original source of the information. Therefore, the reliability of such information may be questioned by authorities, introducing additional friction into trading processes. To remedy the above deficiencies and challenges, collaboration among all supply chain stakeholders is critical.

Key areas requiring broad cooperation include:

- Infrastructure to enable interoperability among logistics operators/platforms
- Effective paperless sharing of data between industry (including MSMEs) and government
- The use of a common, standardised informational language among supply chain stakeholders for identification, description and data sharing for goods trade

Government operations can be significantly improved by leveraging systems already employed by business, by re-using data generated by industry, and by augmenting existing border agency systems with

[1] Kevin Syslo (team lead) University of Southern California, Marshall School of Business *APEC Supply Chains: Identifying Opportunities for Improvement* (2011)

identification and classification systems already adopted by industry. Simplified, paperless and automated border procedures limit impacts on all stakeholders and can make processes safer by being contactless.

All governments need to evaluate what their priorities are, what product categories are strategically important, and what challenges need to be addressed. Therefore, a range of options is presented as general guidance, rather than mandatory instructions or rules. This approach is intended to give governments flexibility in developing preparedness plans that best suit their local conditions.

Recommendations are presented in alignment with corresponding pandemic response phases identified by WHO. This approach enables each government to select tools and processes best matched to its specific context, whether that be pre-pandemic, mid-pandemic, or post-crisis re-building. While each constituent will inevitably find itself addressing a somewhat unique combination of issues and conditions, it is strongly encouraged that all stakeholders commit to open, free, and interoperable standards to ensure a level playing field, to promote innovation and to achieve global resilience.

The GS1 team recommendations focus on the use of open, global standards for product identification and data sharing, migration to completely electronic documents along the entire international trading process, linkages between industry identifiers and the HS code, future trade agreements including global data standards, and a commitment to emerging technologies like blockchain and IoT to enhance data capture, decision-making and information sharing.

Recommendation 1:
Use standardised unique product identification across international supply chains.

Recommendation 2:
Create linkage between industry identifiers and the HS code for accelerated & accurate goods processing.

Recommendation 3:
Use standardised product classification and identification to identify and differentiate between COVID-19 essential goods, humanitarian relief items and non-essential goods.

Allow and enable digital pre-arrival clearance for all essential goods and relief items during emergencies.

Recommendation 4:
Gain efficiencies in the importation of goods by using electronic systems with the assistance of GDSN.

Recommendation 5:
Adopt standardised digital processes globally or at least regionally to further connect MSMEs into information exchange networks.

Recommendation 6:
Future trade agreements, including any agreement resulting from WTO E-commerce Joint Statement Initiative, should recommend or mandate the use of open global standards in international trade, especially in cross-border procedures.

Recommendation 7:

Include technologies like digital twins and IoT in supply chain and border processes to enhance data capture, decision-making, and information sharing. Support these with the linked data standards.

Recommendation 8:

Use electronic platforms and documents in international trade:

- Employ global data standards in eCMR to achieve interoperability.
- Adopt eMLETR globally.
- Migrate completely to e-documents and use global data standards in e- records.

Recommendation 9:

Adopt standardised barcode, data matrix & QR code, and barcode scanning anywhere along the supply chain, including the border.

Recommendation 10:

Strengthen international public-public, private-public, and private-private information sharing and collaboration

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1. Setting the Stage

"The global pandemic is … hastening some of the worst instincts of protectionism." [2]

1.1 COVID-19 amplifies existing supply chain challenges

International trade and border regulatory requirements are currently undergoing significant changes.

The world is likely to see a major shift in global supply chains structures following the COVID-19 pandemic[3]. In some industries such as healthcare, there might be a switch from just-in-time inventory management and cost-management to more localised production and warehousing. This change to more localised manufacturing and supply chains will have a significant impact on companies' supply chains operations, impacting cost, and leading to a more localised sourcing. Trade efficiencies may suffer, prices may become higher, possibly with more diversity in quality and more limited product ranges. International trade volumes will probably go down, but inspections and non-tariff measures (NTMs) and possible non-tariff barriers (NTBs) will likely become more burdensome for business. Micro, small and medium enterprises (MSME) are hardest hit by trade barriers and it leads to limited participation of MSMEs in regional and global value chains.[4] Hence, the importance of reducing extra burdens for MSMEs when trading cannot be overstated. On the other hand, bringing production and consumption closer together will likely increase regional/domestic trade significantly, which could bring opportunities to MSMEs in their home countries and regions.

Even before COVID-19 wreaked havoc on global supply chains, there were significant challenges in place, and misalignment between what the government inspection agencies considered suitable requirements for imports and what the business community considered reasonable. The food industry has significant challenges with customs clearance; this reality is reflected in a 2020 report by the ASEAN Food and Beverage Alliance highlighting the burdens caused by "[un]certainties in inspection at the border due to inconsistent customs clearance procedures, complex documentation requests, and conflicting administrative requirements".[5]

Crisis situations and humanitarian emergencies have only amplified the already existing challenges in supply chain and logistics. According to World Food Programme, platforms that facilitate public-private information sharing are fundamental to successful response to pandemics, and standards are a precondition for efficient coordination.[6] Events like the borderless COVID-19 pandemic require better coordinated, large-scale and global responses. Success of such responses will depend on international cooperation between governments, and between private sector and public sector organisations.

1.1.1 Supply chain standards are not fully utilised at international borders

This paper covers the standards for data and messaging models that underpin the exchange of information for international trade. There are three main organisations that develop messaging and data model

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[2] Andrew Crosby, "Wanted: An Unusual Suspect for the Next WTO Director General," Talking Trade, 27 May 2020, available at http://asiantradecentre.org/talkingtrade/wanted-an-unusual-suspect-for-the-next-wto-director-general

[3] https://www.supplychainquarterly.com/articles/3569-report-seismic-changes-ahead-for-global-supply-chains

[4] Non-Tariff Barriers in Agriculture and Food Trade in APEC: Business Perspectives on Impacts and Solutions, ABAC commissioned report from University of Southern California's Marshall School of Business (2016)

[5] ASEAN Food and Beverage Alliance, The Review of Food Registration Processes and Requirements in ASEAN Survey Outcomes and Recommendations (2020), p 16.

[6] https://www.gs1.org/sites/default/files/docs/events/2016/berlin/wfp_herbinger_gs1healthcareconference2017.pdf

standards. These are World Customs Organization (WCO), United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) and International Standards Organisation (ISO). Most industries engaged in shipping, ports and logistics uses UN/CEFACT messaging, and WCO data models. In addition, ISO also develops standards for barcoding and labels underpinning identification of logistics units in international supply chains. These include (but are not limited to) ISO 15459-1 for identification of logistics units (or the logistics license plate) and ISO 15394 for transport labels.

Open, international standards play an important role in trade agreements and the use of proprietary standards can be interpreted as a technical barrier to trade. The WTO Technical Barriers to Trade Agreement (TBT), binding on all members, requires that when international standards exist, members shall use them as a basis for their technical regulations. It aims to ensure that technical regulations and standards, including packaging, marking and labelling requirements, do not create unnecessary obstacles to international trade. The use of international standards supports regulatory harmonization and helps avoid the waste of resources that can result from duplicative procedures when regulators develop their own solutions. The consistent use of international standards can also mean that policy and regulatory compatibility can extend to other countries that are not party to a bilateral or multilateral trade agreement.

When discussing supply chain standards, the focus is mainly on business-to-business standards, while there is little discussion about the business-to-government standardised exchange of data. What this paper aims to focus on is how governments also can consume standardised exchange of data generated by business. In other words, how do we underpin B2G exchange of data to improve cross-border supply chains, including customs clearance?

1.1.2 Border risk management lacks data accuracy and interoperability

Border agency remits are diverse and include issues such as duty collection, biosecurity, environmental protection, illicit trade[7], counterfeits[8], and public health and safety. Risk management is used by border agencies to identify how best to apply their effort and resources. Border agency operations all share two objectives: (1) timely and efficient clearance of wanted goods, or trade facilitation and (2) reliable detection of unwanted goods crossing the border. Risk management aims to efficiently identify the wanted goods and then re-allocate agency resources to inspect 'high risk' potentially unwanted goods.

Businesses trading cross-border are forced to adapt to a continually changing trade environment—not only during the pandemic. Even in "normal" times of trade, increasing complexities and requirements at the border are significant contributors to private sector supply chain costs[9].

The principal problem with risk management experienced by border agencies can be summed up as problems with data accuracy. Insufficient data or data errors lead agencies to undertake excessive and unnecessary inspections, slowing the transit of goods across borders. This slows trade and wastes agency resources. Lack of interoperability between systems contributes to the inadequacy of data available to support border agencies' practices and decision-making.

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[7] Illicit trade is one of the greatest global challenges adversely affecting industry, governments and the general public. Collection of duty at the border is a key priority for customs globally, and illicit trade is a global issue that can cause loss of tax revenue for governments.

[8] Counterfeiting of products is a global issue that can cause injuries and death for consumers, loss of revenues for companies and loss of tax revenue for governments. Those who face counterfeiting infringements for their brand are looking for ways to detect fake products, authenticate products and their origin, and remove all counterfeit products from the supply chain. A challenge is that rights holder must be contacted to determine whether nor not goods are in fact counterfeit, and to seize goods.

[9] According to the *Digital Trade Facilitation in Asia and the Pacific* report by United Nations (UNESCAP), full implementation of the World Trade Organisation's (WTO) Trade Facilitation Agreement (TFA) together with other digital trade facilitation or paperless trade measures is projected to reduce trade costs in Asia and the Pacific by 26 per cent – or $673 billion of savings every year

1.1.3 Interoperability is not standard, but standards enable interoperability

With the increase in extended, complex and highly global supply chains, tracking and tracing containers, consignments, shipments and products from end to end has become more difficult. Conversely, there is now a higher demand both from consumers and governments for more complete supply chain information to be shared before consumption or importation of products.

Tracking and tracing throughout the supply chain can be achieved successfully if it is built upon global, interoperable standards that can act as the foundation for clear, understandable exchanges of information for all stakeholders.

Interoperability can be broadly defined as follows:

- UN/CEFACT defines interoperability in the cross border (single window) environment 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."*[10]

- The EU Interoperability framework has the following definition *"interoperability is the ability of organisations to interact towards mutually beneficial goals, involving the sharing of information and knowledge between these organisations, through the business processes they support, by means of the exchange of data between their ICT systems".*[11]

Interoperability within the context of this paper is founded upon ~~is~~ a system to identify products in supply chains and sharing data among trading partners, based on industry standards. The use of industry standards leads to better supply chain outcomes for all stakeholders such as improved product traceability and visibility across international borders; seamless sharing of regulatory documents and data accurately determining jurisdiction and risk profile for each product; and enhanced consumer safety related to unsafe, recalled or counterfeit products.

Global data standards makes it possible, on a global scale to share information through ICT systems; no matter how many companies are involved or how many borders are crossed as goods travel from one end of the supply chain to the consumer/customer. Interoperability is essential for more integrated supply chain systems that can maximize the efficiencies, while minimizing the distribution of unsafe products. When done on a global scale, MSMEs and large companies all along the supply chain can benefit.

1.2 COVID-19 disrupts an ill-prepared supply chain

The World Health Organization (WHO) identifies five phases of a pandemic[12] [13], and five similar disaster response phases are described in UN/CEFACT's 'Proposed Recommendations on Cross Border Facilitation Measures for Disaster Relief'[14]. In the following Table 1, we correlate those five phases to the ideal responses in the supply chain as it experiences this kind of emergency.

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[10] UN/CEFACT Recommendation No. 36: *http://www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE-431E_Rec36.pdf*

[11] New European Interoperability Framework: Promoting seamless services and data flows for European public administrations, European Commission (2017)

[12] WHO, '*Pandemic Influenza Risk Management, WHO Interim Guidance'*, pp. 6–8, 2013.

[13] https://www.cdc.gov/flu/pandemic-resources/planning-preparedness/global-planning-508.html

[14] UN/CEFACT: Proposed recommendations on cross border facilitation measures for disaster relief, Draft v8, (under public review)

Table 1: Pandemic/disaster phases and ideal supply chain response

Phase	WHO phase	Pandemic risk assessment	Disaster response phase	Ideal supply chain response
1	Interpandemic phase (transmission from animal to human; sporadic spread)	Preparedness	Early warning and early action (monitoring and pre-positioning)	Normal operations, monitor developments, ensure all systems and processes are operational and in good order
2	Alert phase (human-to-human transmission; governments seek WHO help)	Response	Disaster impact (data gathering)	Increase production, build inventory, add resources at logistics and distribution; invoke emergency plans
3	Pandemic phase (wide-spread outbreaks w/ human-to-human transmission; mitigation)	Response	Disaster relief (immediate, life-saving response w/ international assistance)	Execute on emergency (business continuity) plans avoiding undue supply chain restrictions
4	Transition phase (decrease of outbreaks, but uncertainty; balanced communication)	Recovery	Recovery (restoration of infrastructure and social structures)	Maintain increased levels of inventory and resources to address a potential second wave and address global differences
5	Interpandemic phase (return to normal levels; surveillance and updated preparedness)	Preparedness	Preparedness (systemic analysis and change implementation, incl. regulatory; practice drills)	Supply chain returns to "new normal," and prepares to increase resiliency for the next pandemic

By contrast, the reality of the global supply chain's response during COVID-19 in some parts of the world could be described as:

Phase 1: Lack of awareness and information
Phase 2: Inertia and frugality
Phase 3: Apprehension & confusion, scrambling in the emerging turmoil, dramatic increase in criminal activities (e.g. counterfeits, fraud, diversion, and theft), attempt to prepare for the next pandemic in the middle of the ongoing crisis, and increased awareness of the vulnerabilities inherent in global sourcing. Sudden border closures import and export restrictions, reduced port and airport operations.
(Phases 4 and 5 have not been reached, yet.)

Shortages and disruptions occurred in part because of stakeholders' focus on lean processes in order to reduce cost—i.e. lean manufacturing, lean logistics, lean supply chains. But lean strategies typically do not consider major disruptions; instead, they embrace forecasting based on history. It is certainly true that many companies have business continuity plans for temporary disruptions and outages, but only few conduct large-scale risk assessments that determine an organisation's, a network's or a government's exposure to risk and its ability to respond to major interruptions. This is a serious issue, particularly for industries providing essential goods, such as medical supplies.

Many of the problems experienced by supply chains could also have been avoided through better preparedness, continual monitoring and by orienting actions around learnings from successful disaster relief operations.

Pandemics are crises affecting everyday life and business, not unlike earthquakes, floods, and other natural catastrophes. As such, participants in humanitarian relief operations are well-aware of the supply chain challenges that have now become mainstream news as a result of COVID-19, but they typically experience them on a more localised scale. The global community can learn from humanitarian supply chains addressing local emergencies, and then scale those approaches to address a global crisis like the present pandemic.

In order to support emergency logistics, the World Food Programme's Logistics Cluster published the guide, "Downstream logistics in pandemics[15]," which advises that downstream logistics is best organised through a platform approach. The guide illustrates its point by describing in detail how supply chain pandemic preparedness plans should involve all relevant stakeholders from national governments to on-the-ground NGOs delivering essential goods to a suffering population.

Regardless of the stakeholder, throughout the COVID-19 pandemic there have been significant concerns related to interruptions of cross-border trade of essential goods such as pharmaceuticals, medical devices, consumer products, and Personal Protective Equipment (PPE) [16]. These issues resulted from a combination of factors:

- a substantial global increase in demand for PPE in many sectors (including healthcare),
- an increase in specific medication and ventilators for patients admitted in intensive care units,
- disruptions to the flow of these materials due to limited availability of logistics and manufacturing staff as a result of lockdowns,
- restrictions on export/import trade flows and diversions,
- requirements for contactless import procedures.

The pandemic not only placed a spotlight on well-known, existing cross-border issues that typically impair delivery of general disaster relief items; it also tightened that bottleneck with additional restrictions specific to COVID-19.

Businesses of all sizes, governments and consumers are concerned about the availability of a wide range of essential products, such as medicines and PPE, due to supply chain and logistics disruptions. COVID-19 has prompted bad actors everywhere to take advantage of the situation, especially via online sales, as noted by the WCO:

> *"The WCO reminds the general public to exercise extreme caution when purchasing critical medical supplies from unknown sources, particularly online. The use of these goods may cost lives. While the world is gripped by the fight against COVID-19, criminals have turned this into an opportunity for fraudulent activity. There have been an alarming number of reports quoting seizures of counterfeit critical medical supplies, such as face masks and hand sanitizers in particular."*[17]

[15] Logistics Cluster, 'Downstream logistics in pandemics', Rome, 2017.
[16] https://sloanreview.mit.edu/article/is-it-time-to-rethink-globalized-supply-chains/
[17] WCO COVID-19 Urgent Notice: counterfeit medical supplies and introduction of export controls on personal protective equipment

1.3 Hackathon research questions

How can the application of global data standards currently used by industry and government keep essential supply chains open and operating safely and efficiently during a crisis? Can they enable a sustainable transformation of the supply chain?

As goods are traded cross-border, border clearance procedures are a significant contributor to supply chain costs and time. Border procedures take time, effort and financial resources for the stakeholders concerned; a situation that has been significantly exacerbated by the COVID-19 pandemic. Challenges have included: limited availability of manpower due to government-mandated lockdowns, increases in information disclosures required by government agencies, and paper-based border procedures that could not be recalibrated quickly enough to meet emergency needs. Furthermore, the additional regulatory requirements were changing rapidly and ongoingly, further aggravating the issue. Simplified, paperless and automated border procedures reduce these impacts on all stakeholders and can make processes safer by being contactless.

1.3.1 Scope of the team paper

The scope of the paper will include:

- Infrastructure to enable interoperability among logistics operators/platforms
- Effective paperless sharing of data between industry (including MSMEs) and government
- The use of a common standardised language among supply chain stakeholders for identification/description/data sharing for goods trade

And under the above umbrella:

- Trade in goods: essential and non-essential goods
- Trade facilitation: paperless and contactless trade, e-commerce
- Sectors: medical supplies, food, SMEs, transport & logistics

1.3.2 Proposed approaches for improvements and preparedness

A conclusion of this report is that the use of global and open product data identifiers is crucial to quickly respond to rapidly changing requirements to move essential goods domestically or cross-border. Open standards for identification of products and the units used to transport them, data capture and data sharing are already broadly used by companies, consumers, and the public sector, and they play an important role in building data interoperability, which underpins visibility in global supply chains. The basic layers for interoperability are structured data and open identifiers.

We will show how standards systems—such as GS1 global data standards—already widely used by industry can also benefit government operations. With wider adoption and recognition among governments, notably border agencies, such standards can improve post-COVID-19 recovery and enable preparedness for future pandemics.

1.3.3 What are global data standards and how are they used?

In this document, the term “global data standards” encompasses various traceability, data sharing and identification measures, including identification of products, shipments, consignments and transport

units. The use of global data standards can ensure that relevant information is provided in a common format which can be easily understood and shared by all parties. This approach depends crucially on the ability to identify, track and trace products traded, allowing the flow of a product to be accompanied by the flow of data about the product, with product identification and sharing of data being done in a standardised way. Traceability is defined as the ability to identify and trace the history, distribution, location and use of products. For example, medicinal product traceability is crucial to ensure patient safety, and border agencies can benefit for risk management purposes from having full access to data on products being imported. It is important to note that standardisation is also vital to lowering the cost of cross-border international trade, as highlighted by APEC Business Advisory Council[18]. Deviations from standards cause additional investments and complexities. More important, having different requirements across regions or between economies adds complexity in operations, increasing the risk for failure and operational costs.

It should be noted here, global data standards should never be viewed as a replacement to existing systems such as the Harmonized System (HS) which is used globally by customs to classify goods, but rather as a complementary information provider that can be used in specific cases and for specific product types (e.g., food and medical products).

1.4 Why GS1 is participating in this Hackathon

Industry supply chain standards compliant with ISO standards, such as the GS1 system of standards for identification and data sharing, play a significant, and foundational role in trade. We are convinced the use of identification and data sharing standards can transform international supply chains in the same way they have impacted global retail and healthcare over the past 45 years.

As a neutral, not-for-profit and international standards organisation, GS1 works closely with businesses and governments to develop standards fit for purpose, with the stated goal to bring efficiency and transparency to the supply chain.

Standardised barcode and technology tools create a common foundation, enabling identification, capturing and sharing of vital information about products, locations and assets. Designed by consensus, global data standards are proven by business and across governments. GS1 is responsible for the ubiquitous product barcode (ISO 15459-6) that industry has been using for over 45 years, and offers globally unique transport unit identification (ISO 15459-1), data sharing frameworks (ISO 19987), as well as standards and solutions for the exchange of master data. These standards and solutions have transformed entire market sectors, as highlighted in the BBC's "50 Things that Made the Modern Economy"[19]. GS1 has been consistently in the forefront as a leading (supply chain) standards organisation with a global footprint.

As businesses are looking for easy ways to implement scalable supply chain standards, compatible with ERP systems, Transport Management Systems (TMS), Warehouse Management Systems (WMS), Customs and Trade Compliance Management Systems, and blockchain solutions, global data standards are preferred. Likewise, when Government agencies are looking for ways to strengthen supply chain integrity, global data standards are being recognised in a wide range of government applications, e.g. for registration and traceability of highly regulated healthcare products, and increasingly by border agencies.

[18] APEC Supply Chains: Identifying Opportunities for Improvement: USC Marshall School of Business ABAC Team 2011 https://www2.abaconline.org/assets/2011/4%20Honolulu%20Hawaii%20USA/2011-APEC%20Supply%20Chains_Full%20Report.pdf

[19] https://www.bbc.co.uk/programmes/p04k0066

Over the last ten years, the use of GS1 standards in cross-border trade procedures has been widely developed and trialled by individual governments and intergovernmental organisations. For GS1 to have an opportunity to also propose the use of global data standards to address urgent COVID-19 related issues, and enable a quick recovery as well as dampening the impact of future pandemics, is closely aligned with the core values of our organisation: *"GS1 believes in the power of standards to transform the way we work and live".*

1.5 Alignment of team research with existing reference projects

Significant added value can be achieved in government operations if systems already in use by business are leveraged, industry generated data is re-used, and industry identification and classification systems are invited to complement existing systems used by customs and other Government Border Agencies. This would allow business to enjoy "*trade facilitation benefits such as simplified customs procedures and fewer inspections of their goods"*[20]

Even though these concepts may seem to be considered ground-breaking, it is important to note that these types of initiatives have been developed over the past decade, and proposed by a range of academic and research organisations, intergovernmental organisations, as well as a number of governments. Table 2 lists several reference projects, all of which are explained in greater detail in Appendix 1. Government initiatives employing standards already in use by industry illustrate the reliability and robustness of a standards-based system for product identification, verification and data sharing. They also provide insight and serve as benchmarks for the implementation by other governments that face similar challenges. For example, the track and trace systems in healthcare leverage ISO/GS1 standards. These systems allow full traceability of products up to the patient, help reduce spillage, support cost containment and enable nationwide visibility into the healthcare supply chain.

It is important to note that none of these initiatives is commercially driven, or managed by private sector (for profit) stakeholders, but rather by institutions and organisations that are looking at ways to improve cross-border supply chains for the greater good—with benefits to business and government—by leveraging commonly used standards and systems built on neutral platforms (often based on open ISO and GS1 standards). This is a significant distinction compared to proprietary systems operated commercially.

[20] Yao-Hua Tan, Niels Bjorn Andersen, Stefan Klein, Boriana Rukanova Editors *Accelerating Global Supply Chains with IT Innovation: ITAIDE Tools and Measures* 2011 https://www.researchgate.net/publication/286222318_Accelerating_global_supply_chains_with_IT-innovation_ITAIDE_tools_and_methods

Table 2: Case studies and intergovernmental organisation projects chart

Note: All case studies listed below are described in more detail in Appendix 1

Project Name	Lead organisation	Description	Standards
Data Pipeline	**UNECE / UNCEFACT**	• Easing trade flow in the supply chain, including border management • End-to-end data-provision to authorities through "seamless integrated action" • Connectivity infrastructures for information sharing • Standardise and harmonise the pipeline data-carrier for all actors involved	UN/CEFACT standards
Healthcare Track-and Trace	**Ministry of Health Turkey, South Korea etc.**	• Track-and-trace systems: a) pharmaceuticals, b) medical devices • Full pedigree from manufacturer to patient	GTIN GLN
Public-Private Pandemic Supply Chain Initiative	**World Food Program (WFP)**	• Improve supply chain preparedness for pandemic • Developed concept of Pandemic Supply Chain Network (PSC Network) • Standards are precondition to efficient pandemic supply chain coordination • Trusted, web-based information platform connecting upstream and downstream participants	GS1 system of standards
Traceability in supply chains	**Interagency Supply Chain Group (ISG)**	• Focuses on medical supplies • Advocating for both effective and sustainable solutions to enable traceability • Promote the use of global data standards to provide a wider and harmonized framework for supply chain visibility, strengthening anti-counterfeiting measures and sharing of data between parties.	GS1 system of standards
Vaccine supply chain	**GAVI, the Vaccine Alliance**	• Improve vaccine visibility and traceability from manufacturer to beneficiary • GS1 data and barcode standards are required on the secondary package to improve product identification, labelling, and data exchange within the immunization supply chain	GS1 data and barcode standards
ITAIDE Research Program	**EU / DELFT**	• Information Technology for Adoption and Intelligent Design of E-Government • Develops common information model for electronic documents to improve interoperability of taxation and customs systems • Prerequisite for e-customs, the introduction of AEOs and Single Window	EPCIS (ISO 19987)
CASSANDRA	**EU**	• Focus on containerised cargo • Enhance supply chain visibility to improve business operations and cross-border security inspections • Provide supply chain actors and authorities with accurate data; focus on risk-assessment • Data-sharing concept: Data Pipeline; interoperability through state-of-the-art IT systems	EPCIS (ISO 19987)

Project Name	Lead organisation	Description	Standards
FENIX	**EU/ERTICO**	• Development of first European federated architecture for data sharing serving the European logistics community of shippers, logistics service providers, cities, mobility infrastructure providers and authorities in order to offer interoperability between any individual existing and future platforms • Goal is seamless data sharing to ensure smooth flow of goods everywhere, including cross-border	GLN, SSCC, EPCIS, IDS
EU vs Virus Hackathon	**EU**	• Effective and efficient distribution of Personal Protective Equipment (PPE) • Bringing stakeholders requiring PPE (Demand side) and manufacturers (Supply side) together in a collaborative environment facilitated by a neutral party ("Trustee") to determine the best way to allocate Available Supply with Actual (prioritised) Demand as method to ensure availability of essential goods at the right place, at the right time, in the right quantities and in the right condition (safe and usable)	GS1 system of standards
APEC Global Data Standards	**APEC**	• Adoption of global data standards to improve supply chain performance • Pilot projects in APEC economies • Targeting improvements in Efficiency,	GS1 GTIN, EPCIS (ISO 19987), RFID standards
APEC Model e-Port Network (APMEN)	**APEC**	• Port operators share information on supply chain events • Containerised cargo • Interconnection and data exchange using e-Port system	EPCIS (ISO 19987)
APEC Supply Chain Connectivity Framework II	**APEC**	• Second phase of framework for 2016-2020 (phase 1 2010 - 2015) • 5 chokepoints related to supply chain efficiencies with #1: lack of coordinated border management and underdeveloped border clearance and procedures • Reviews issues and challenges that may have hindered the region's supply chain connectivity performance from reaching its full potential, such as the adoption of automation and harmonization of regulations	Global Data Standards / EPCIS (ISO 19987)
APEC Life Science Innovation Forum Supply Chain Security Initiative	**APEC**	• Addressing substandard and falsified medical products • Deliverable: Supply Chain Security Toolkit intended to cover the entire supply chain and life cycle of medical products with recommended best practices such as the use of global data standards and tools to prevents and detect substandard and falsified medical products • Toolkit can be used together with WHO guidance on handling substandard & falsified medical products.	Global Data Standards
USAID Global Health Supply Chain Program (GHSC)	**USAID GHSC-Procurement and Supply Management (GHSC-PSM)**	• Improve the health care experience in the communities through transformative supply chain solutions • Reduce costs, improve efficiency, and improve the availability of health commodities worldwide • Achieve this goal through the implementation and use of global supply chain standards for product identification, location identification, and product master data • Suppliers must publish their product master data to GHSC-PSM through the GS1 Global Data Synchronization Network (GDSN)	GTIN, GLN GDSN

2. Analysis and Proposed Approaches for Improvements

This chapter highlights the different areas in scope for the paper and approaches to improving or resolving existing issues and preparing for future scenarios, leveraging global data standards.

2.1 Benefits of standards in the supply chain

These are the key benefits to supply chains and cross-border trade supporting B2G, B2B and B2C that can be derived from the use of standards:

- **Enhanced supply chain efficiency**: executing the processes and communication related to a shipment more quickly and at lower cost, with efficiency gains for traders and more effective operations of border agencies;

- **Enhancing supply chain resilience**: enabling better control of supply chains and the products transported, lowering risks or enhancing supply chain visibility as an anti-counterfeit tool, thereby improving consumer benefits such as product quality and safety;

- **Enhancing supply chain visibility**: enabling greater knowledge about the products being transported (e.g. when, where, what and why); enabling planning and strengthening risk management, including traceability due to regulatory requirements and recall readiness supported by lot/batch numbers; and

- **Enhancing supply chain safety and security**: enabling end-to-end product traceability; securing data, event and document exchange globally; reducing fraud and theft.

2.1.1 Standards improve supply chain efficiency

Today, consignment documentation errors, such as incorrect port of loading or shipping marks, trigger physical investigation of goods and/or manual systems to verify the integrity of the consignment documentation. These consignment documentation errors can be quickly addressed (reducing delays at the border) through electronic verification and/or use of information referenced through (product) barcodes and/or electronic messages. Border delays may cause products to go to waste unnecessarily. The meat messaging programme underpinned by bilateral trade rules between the Governments of Australia and the US, have improved efficiency in border procedures, and resulted in significant savings to industry.

CASE STUDY: AUSTRALIA MEATMESSAGING

MeatMessaging[1] addressed an industry-wide problem associated with product shipped to the US being deemed ineligible due to missing or illegible shipping marks. The MeatMessaging program is an industry-owned web-based application which facilitates the collection, processing and reporting of commercial and regulatory meat product information along the supply chain. It operates with the approval of the US government and the Australia government. The MeatMessaging platform messages assist users and regulatory authorities with the authenticity, verification and traceability of meat products. Authorised regulatory entities have access to regulatory data to facilitate compliance activities, including the GS1 barcoding standards and GS1 electronic message standards, which do not replace existing regulatory requirements; they simply assist and supplement these requirements.

MeatMessaging has provided the Australian industry with an electronic solution for reducing costs of shipments into the US following US Department of Agriculture Food Safety Inspection Service (USDA FSIS) recognition of barcodes as a means of verifying product with missing or illegible shipping marks. MeatMessaging uses the AUS-MEAT Trade Description Language (UNECE Bovine Cut Descriptions), Importing Economy Label requirements (USDA) and the GS1 Global Data Standards (for data transfer). Since 2016, 68 establishments (including seven US importers) have applied to use the portal; including the three largest meat processors in Australia. It represents more than of 70% of Australian export capacity. To date in excess of 3.4 million cartons (representing approx. 10,000 consignments) have been processed through MeatMessaging.

[1] https://meatmessaging.info/iots/home.asp

Positive identification of product brand and model allows border agencies to reuse admission decisions, based on product data. Over time, entries contain increasing percentage of products with known admission history, allowing governments to focus on unknown potentially high-risk products.[21]

Authorities often rely on data that they have received from intermediary parties (e.g., carriers, agents, and representatives) that are not the original source for the information they provide to authorities. Therefore, the reliability of the information that authorities use may be questioned. Over recent years, people realised that access to reliable data from the source may enable much more reliable decision making (e.g., in cross border risk management). These concepts go by names like "Data Pipeline" and "Linked Data". These rely on an IT system accessing another IT system to retrieve the latest up-to-date information regarding a given object (e.g., a product, a shipment, a consignment or a transport unit) based on a globally unambiguous identification key for that object.

GS1 has developed an approach called Scan-4-Transport (S4T) that combines the concepts above in a single solution that may be used commonly across all stakeholders. In effect, a 2D barcode structured according to the S4T approach may be read by any stakeholder regardless of which other stakeholder created that 2D barcode.

2.1.2 Standards increase supply chain resilience

Standards that are used to increase supply chain efficiency and effectiveness cannot be implemented instantaneously. Only when governments and private stakeholders prepare can the benefits from product and logistics standards also be reaped at the time of emergency. Since disaster supply chains distribute emergency goods, or otherwise often called essential goods (specific for that emergency), their smooth operation is especially important. This can be achieved through capacity building.

Supply chain resiliency is created by careful preparation and the implementation of solid emergency processes that are tested regularly during normal times. It is even possible to maintain high levels of efficiency during the time of emergency if all supply chain participants are prepared for the onset of disaster and are not caught by surprise. Lack of preparation inevitably leads to critical supply shortages, and vastly expensive mitigation measures.

Scholars have gone as far as suggesting the establishment of supply chain stress tests for critical supplies similar to the implementation of bank stress tests following the 2008 financial crisis.[22]

[21] US Department of Agriculture International Trade Data System (ITDS) Presentation, D. Bailey (2011)
[22] D. Simchi-Levi, E. Simchi-Levi, '*We need a stress test for critical supply chains'*, Harvard Business Review, April 2020.

When it comes to cross-border situations in times of emergency, the draft UN/CEFACT "Proposed recommendations on cross border facilitation measures for disaster relief,"[23] encourage national administrations to develop preparedness plans based on current international standards with the intent to utilise existing mechanisms rather than a separate and unfamiliar emergency procedure.

2.1.3 Standards enhance supply chain visibility

At the core of supply chain visibility is the ability to reduce or eliminate bottlenecks that occur from not knowing how much inventory is available, where it is located and what the demand levels are. Supply chain visibility is therefore inherently linked to both supply chain efficiency and resilience.

Supply chain visibility is built through the collection and interpretation of data, and ideally, real-time data. Capturing the data and sharing them is most effectively done when supply chain participants communicate through a common language and on a common platform. Global standards are at the core of this and when used broadly, they are the key to enabling end-to-end visibility.

Combined with advanced digital technologies, this visibility can be further enhanced while maintaining supply chain security.

2.1.4 Standards support supply chain safety and security

For the safety of global consumers, authorities sometimes need to recall products or urgently get access to traceability data. Global standards organisations such as AIM Global, GS1 and ISO are working together to define standards to enable data sharing by defining data carriers, business relationships, product master data with interoperable methods of attaching certificates and sensor data to items as they move through the supply chain.

Global traceability is also a key element of the flexible supply chain needed in times of crisis. By connecting the dots along the supply chain to trace the movement of products, a comprehensive picture of "who, what, where, when and why" becomes available. Tracking the movement of products from source to destination gives trading partners, border agencies, and consumers visibility and confidence in the supply chain.

When supply chain actors need to adapt and re-route goods, for example, the precise product and location information of each item in transit is critical. A standards-supported and digitally enabled supply chain can be fully transparent, thereby strengthening its overall flexibility and adaptability. Digitally enabled supply chains—especially those employing modern technologies like blockchain—also increase the amount of data that can be privately and securely included in the consignment data trail.

This level of supply chain integrity can be achieved through global data standards, which support anti-counterfeiting efforts and help reduce fraud, diversion and theft. Particularly, global standards for unique product identification and data sharing enable fully transparent supply chains.

2.2 Standardised goods identification and classification improve supply chain integrity and increase border efficiency

Unambiguous product identification and associated product data offer information on whether the product in question is in a category that is allowed to be classified as essential medical supplies, medical

[23] UN/CEFACT, 'Proposed recommendations on cross border facilitation measures for disaster relief, Draft v8', May 2020, (under public review).

equipment and personal protective equipment, consistent with national requirements, thereby qualifying for expedited processing through customs. Such data further provides information on a product's origins, its destination, and perhaps its purpose, all of which are relevant for border agencies conducting a risk-assessment of the product. A high level of transparency allows border agencies to coordinate with manufacturers to identify questionable entries or to automatically separate suspicious goods.

Recommendation 1:
Adopt standardised unique product identification across international supply chains, and include product identifier and product master data in customs systems and processes.

Products can be uniquely identified (with or without the help of global standards), but they can also be categorised in groups, which is referred to as 'classification'. An example of a class would be "COVID-19 test kit", and an associated product identifier would refer to a test kit by a specific manufacturer. The proper application of both types of identification is important:

> *"The distinction between commodity classification and product identification is vital. Classification schemes are designed to divide commodities into discrete and finite categories in order to facilitate industrial or regulatory decision-making. Product identification systems help in assigning unique identifiers to products."*[24]

Different coding systems may focus on the classification of goods, the identification of products, or both, and some examples are shown in Table 3.

Table 3: Examples of classification and identification codes

Managing entity	Classification	Identification
WCO	Harmonized System (HS)	
US FDA		Unique Device Identification (UDI)
GS1	Global Product Classification (GPC)	Global Trade Item Number (GTIN)
	UN Standard Products and Services Code (UNSPSC)	

The Harmonized System (HS) coding system is used in exporting goods to assess duties and taxes, as well as to collect global import and export statistics. The HS code is recognised by nearly all customs authorities in the world. In comparison, the GS1 Global Product Classification (GPC) coding system is widely used by traders. The GPC is a mandatory element in industry-standard global product catalogues, which means that the product data is available for a wide range of products in international supply chains.

[24] WCO PERMANENT TECHNICAL COMMITTEE (PM0356E1a) Information Management Sub-Committee 67th Meeting, Brussels, 27 April 2014; (Item IV (c) of the Agenda) WCO DATA MODEL Product Identification - Update by Secretariat

HS Code and the complexities for industry:

There is a clear need to improve the HS system with regards to user friendliness. KPMG's Global Trade Survey states that:

"*Because classification is a manual process even among very large global companies, it is a constant source of risk and complexity for trade teams…Dealing with multiple countries and thousands of SKUs intensifies the complexities and manual burden*".[25]

Going hand in hand with the GPC is the commonly used product identification code GTIN[26]. The GTIN is recognised by nearly all retailers, many manufacturers of medical devices and pharmaceuticals, and an increasing number of e-commerce platforms globally. GPC and GTIN are used extensively in fast-moving consumer goods[27] which disproportionately account for product movements across borders, including e-commerce shipments.

GTINs are used to verify product master data, including country of origin, product type, content, etc. This added product information can be automatically transmitted in a standardised manner. The GTIN is widely used in B2B exchange of product data, underpinning trade in many markets.

Border agencies are increasingly requiring traders to provide GTINs in addition to HS Codes in their efforts to get more precise product identification and granular product data to assist with border security and risk management. This information is highly useful and complementary to the HS code and increases predictability, data quality and reliability. Logically, a formal linkage between GTIN, GPC, and HS could prove very powerful and provide the world trading system with more information about products moving across borders and with new functionalities. It could simplify processes for economic operators, since the data from their systems would be recorded only once and eliminating (or significantly reducing) the need for one-off manual data input.

The concept of the code system linkage is illustrated in Figure 1. Following a GPC-HS mapping the world trading system would get access to substantially more information about products moving across borders. Governments may leverage the link between HS and GPC for risk management, and auto-populate data in importation documents.

[25] *https://assets.kpmg/content/dam/kpmg/xx/pdf/2018/02/trade-survey-02122018.pdf*

[26] The GTIN is known under different names such as UPC, EAN, SKU number, barcode number.

[27] Fast-moving consumer goods are products that are sold quickly and at relatively low cost, such as beverages, toiletries, and other consumables. *https://en.wikipedia.org/wiki/Fast-moving_consumer_goods*

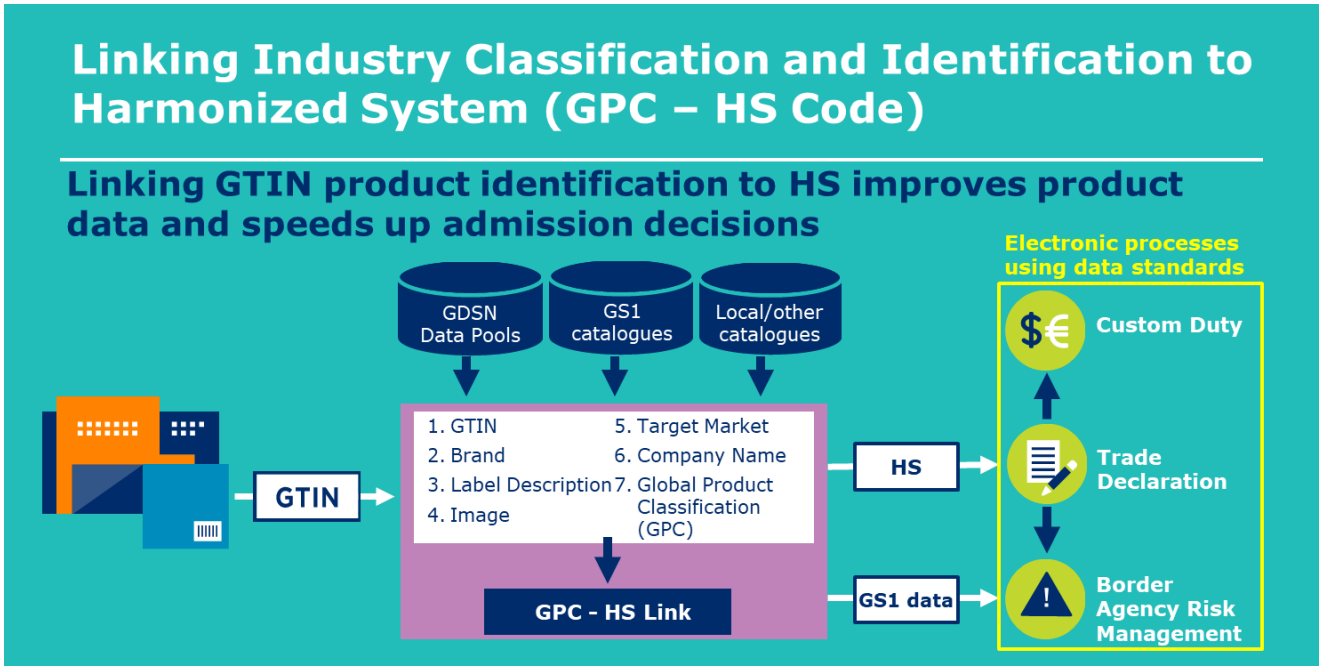

Figure 1: Linking industry classification and identification to Harmonized System

Recommendation 2a:
Create a linkage between industry identifiers and classification and the HS code for accelerated and more accurate goods processing.

Recommendation 2b:
In a first step and for more timely response to a possible second wave during the ongoing pandemic, the COVID-19 medical supply list with HS codes should include GS1 identifiers and/or other established open identification standards already widely in use in global trade.

2.2.1 How product master data and GTINs are used at customs: a step-by-step approach

This approach gives Customs access to additional verified information for products traded cross border. Customs can allow a data field in the import (and export) form for the GS1 product identification code GTIN. The GTIN is inputted by the customs broker and is part of data electronically processed through the National Single Window. This is an example of a system already in use.

Table 4: Step – by – step overview GTIN and master data use in customs

Step	Action	Associated Action
1. Data Upload	Overseas Supplier / Brand Owner publishes GTIN and associated product data to product catalogue	
2. Product Data Aggregation	Dynamic sharing of GTIN product data between product catalogue and customs system	Data aggregated continuously into a Customs GTIN Database which receives queries from Single Window System
3. GTIN Import Declaration	Customs broker includes GTIN in import declaration form in Single Window System which queries the GTIN database and returns the product data into the declaration form	Enabling auto-population of product data elements in import declaration
4. Verification	When data matches, the GTIN is verified, and processing continues using the authenticated product data.	Customs system has access to GTIN data that is verified with product catalogue data
5. Review and Release	Review and release by customs - Goods identification - Auto review - High risk alert - Quick release - Big data analysis	Customs instructing local e-port platform to release

When customs agencies are provided data organized in this way, they are then able to build their own standardised product identification databases based on admission history, and verify the validity of the GTIN by querying the associated product data from the GS1 certified data pools in exporting countries. This approach helps with risk management, but also customs classification, valuation, and rules of origin in future applications as the system becomes more robust and begins leveraging the big-data benefits of a growing dataset.

The use of GTIN in declarations not only simplifies procedures, improves declaration accuracy and efficiency, and saves labor costs, but also substantially promotes compliance declarations, and hence reduces the risk of border agency intervention. Inspections, delays in shipping, credit ratings degradation, and exemption of preferential policies, etc., due to incorrect or non-compliant customs declarations can cause losses for traders. These aspects of international trade are exacerbated during a time of crisis, as shipments of essential goods get held up at the border. When GTINs are already integrated in import declarations, and when customs agencies are prepared to process the associated data, border clearance procedures become more predictable, and planning for on-shelf availability becomes easier, even in times of crisis.

In the future, with more border agencies using GTIN and being able to share GTIN and associated product data directly customs-to-customs, there will be added benefits to the global customs community. Below are more specific examples covering medical supplies and food.

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2.2.2 Standardized product classification and identification help distinguish between essential and non-essential goods

Humanitarian organisations have long struggled with the clear identification of relief items that need to enter a country following an emergency. Because the type of relief items needed are often dependent on the type of disaster and the conditions on the ground, essential relief items are usually identified by the government in the immediate aftermath of the catastrophic event. These are typically also the items falling under special customs procedures for a limited period after disaster has struck.

The medical supplies list for COVID-19 represents such a list specific for the ongoing pandemic[28], but for the sake of clarity, the items on this list are not necessarily subject to exceptions at customs the way emergency humanitarian relief items are. Neither is this list a complete list of "essential goods", as it describes only one category of essential items, i.e. healthcare supplies. To our knowledge, no global organisation has defined what "essential goods" are—not for customs and not for trade.

But some authorities put loose boundaries around "essential goods" in the COVID-19 pandemic. They define "essential goods" for specific purposes because special guidelines and rules needed to be issued to address supply chain shortages, e.g. truck overweight permits for "essential goods." For retailers, the definition of "essential goods" is important when closing off certain areas of the store for shoppers.

All in all, "essential goods" are comprised of a wide range of products and materials. What exactly constitutes an essential good at one international border is by no means the same around the globe, nevertheless, the major categories of essential goods often are:

1) Food
2) Medical and hygiene/sanitary supplies
3) Fuel
4) Agricultural inputs and supplies
5) Chemicals, packaging, equipment and ancillary products used in the production and processing of food, medical and hygiene/sanitary supplies
6) Security, emergency and humanitarian relief items

Thousands of items fall into these broad categories, which makes it challenging to identify such items at customs, as well as to prioritize their treatment during an ongoing emergency situation.

The UN/CEFACT "Proposed recommendations on cross border facilitation measures for disaster relief,"[29] are currently under public review. These recommendations describe common disaster relief goods that are frequently needed during a disaster response, regardless of the type of disaster and that should always receive priority treatment at the border. They include items such as medicines, hygiene items, repair tool kits and more. In addition to relying on already established supply chain mechanisms, the guidelines advance the idea of establishing and implementing standardised platforms that can differentiate between essential and non-essential goods and between regular trade goods and emergency goods, which should cross borders with minimal to no administrative delay. Digital platforms and single windows are ideal solutions for this purpose.

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[28] World Customs Organization, 'HS classification reference for Covid-19 medical supplies 3.0 Edition', June 2020 *http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/nomenclature/covid_19/hs-classification-reference_edition-3_en.pdf?la=en*

[29] *https://uncefact.unece.org/pages/viewpage.action?pageId=59770365*

Recommendation 3a:
Use standardised product classification and identification to identify and differentiate between COVID-19 essential goods, humanitarian relief items and non-essential goods.

Recommendation 3b:
Allow and enable digital pre-arrival clearance for all essential goods and relief items during the time of emergency.

2.2.3 Standardised data sharing gives complete information to all supply chain participants

Based on the GS1 global standard GDSN, master data on medical supplies can be shared around the world. GDSN enables local and global healthcare trading partners, including government agencies, to automatically share trusted product data. The automated process results in a significant reduction in errors and increased efficiency. GS1 works with local healthcare communities to explain and reinforce the value of trusted data for efficiency of care, patient safety, and the role GDSN plays in exchanging accurate, reliable, complete and timely medical device and pharmaceutical product information.

2.2.4 Using data sharing to address medical supply issues in COVID-19

The Initiative to Globally Share Master Data of Medical Supplies for Epidemic Prevention and Control is one example of the successful use of GDSN in the context of epidemic prevention and control. This initiative, recently launched in China, aims at analysing and sorting product data with the purpose of identifying essential products. This is done through the relevant data elements that form a set of standard data attributes for anti-epidemic medical supplies. In addition to the existing data, any healthcare stakeholder could also ask trading partners to provide such set of standard anti-epidemic master data for other medical supplies through the global GDSN network. Having already been operational for a few months, the GDSN data pool of GS1 China is now recording more than 9000 anti-epidemic products for master data sharing from over 2000 Chinese suppliers. An efficient master data exchange for specific anti-epidemic products across the world is also offered. A workflow diagram of GDSN is presented in Figure 2.

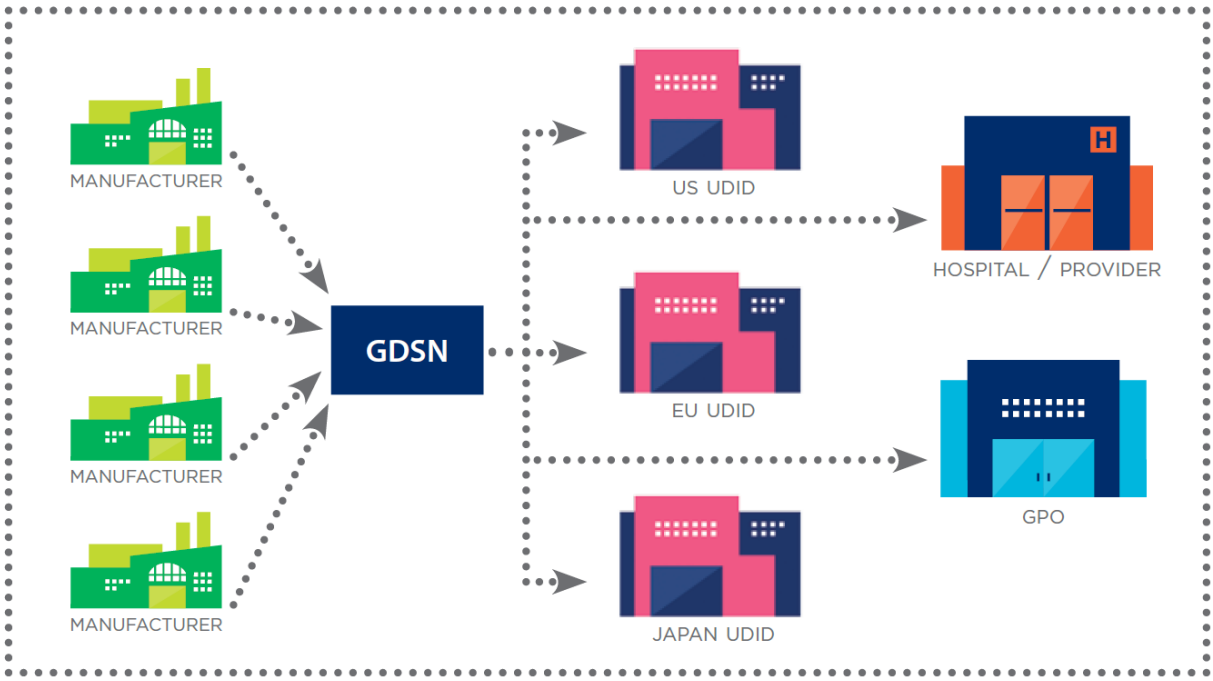

Figure 2: GDSN Synchronisation Workflow

2.2.5 Using data sharing to improve food supply

Food is typically included in the "essential goods" category and the need to supply food to a staggering number of hungry and starving people is becoming increasingly urgent. The World Food Program warns that by the end of this year it may need to feed more people than in the agency's history—nearly 140 million. That's 40 million more than was expected pre-COVID. [30]

Unfortunately, delays cannot always be eliminated. For these kinds of situations, the WCO Private Sector Consultative Group has made important recommendations for authorities to consider:

> *Many SKUs [stock keeping units/bar codes] are market specific due to things like labelling or other regulatory requirements.... In the current environment it would be helpful if border agencies could facilitate redirections, and relax or allow in-market labelling. The alternative may be the destruction of perfectly good product, either by regulatory action, or due to the perishable nature of the products, e.g. food.*[31]

With food supply chains becoming increasingly fragile due to the pandemic, cooperation between business and governments is essential, and available technology and data needs to be applied as an enabler. Smarter use of already available data will make trade processes more transparent and more efficient, improving trade facilitation, which is desperately needed at a time of crisis.

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[30] David Beasley, WFP executive director: "With COVID, we're looking at the people [at] the brink of starvation going from 135 million to 270 million people around the world." PBS Newshour, 21 July 2020. Full interview at https://www.pbs.org/newshour/show/how-the-pandemic-is-making-a-global-food-crisis-worse

[31] http://www.wcoomd.org/en/media/newsroom/2020/april/the-private-sector-consultative-group-outlines-solutions.aspx

This notion is supported by the US FDA in a July 2020 blueprint for smarter food safety:

> *As has been seen with outbreaks in fresh leafy greens and other foods over the past decade, anonymity and lack of traceability in the food system are an Achilles heel that hinders more significant progress in rapid traceback efforts to identify contaminated foods. It also stands in the way of the transparency needed to better understand the supply chain in the event of public health crises, such as the COVID-19 pandemic, and to create a more nimble, resilient, and interoperable food system.*[32]

To address this Achilles heel, GS1's specific suggestions for the food supply chain are:

1. Increased electronic data sharing at borders (via GDSN or equivalent electronic platform):
   - Traders to share regulatory documents seamlessly in an electronic, paperless system.
   - Electronic pre-arrival clearance processes to accelerate shipment cross border.
   - Border agencies' risk-targeting and intelligence tools to interface with industry databases to leverage the information for improved risk assessment.
   - Automated, electronic re-routing of perishable goods.
   - Data collected during transport to border to be used for decision-making on import of food and its safety (e.g. temperature sensor data from refrigerated product)
2. Ubiquitous, standardised product classification and identification of food items
   - Standardised product identification to support re-routing and in-market labelling.
   - Product identification code (and batch number) to be used in border control systems to identify food items and recalled products.
   - Product codes to be included in import documents to expedite customs clearance.
   - Product codes (and batch number) to be used for identification of unsafe/contaminated perishable goods that must be separated, quarantined, destroyed, or denied import.

The above recommendations are applicable to all essential goods and relief items. Traders using electronic networks such as GDSN stand to benefit from faster clearance, better predictability in the clearance process and more efficient cross-border trade. The enhanced traceability and transparency in supply chains underpinned by the increased data availability ensures more efficient controls and ultimate the availability of food and other essential goods. Specifically, for food, on-shelf availability, and the ability to plan the food supply is extremely important, and precisely this point is still a great concern in several regions of the world.

Recommendation 4:
Gain efficiencies in the importation of goods by using electronic systems with the assistance of GDSN.

[32] New Era of Smarter Food Safety—FDA's Blueprint for the Future https://www.fda.gov/media/139868/download

2.2.6 Standardised digital processes are supporting MSMEs and connect them to information exchange networks

MSMEs are an integral and indispensable part of every supply chain, and yet they are currently effectively disconnected from essential information exchange networks. Including the countless MSMEs in these networks will help solve numerous issues for the speed and resilience of flow of trade (both cross-border and nationally) caused by the lack of connectedness of MSMEs.

In a recent webinar[33], Phil Hogan, European Commissioner for Trade, explained that MSMEs make up 87% of EU exporters, exporting goods in the value of EUR 486 billion and are thus responsible for 28% of the value of all EU exports. In many economic sectors, EU MSMEs account for more than 50% of the total value of EU exports, such as textiles, furniture, printing and media, agricultural products, and wood products. Exporting MSMEs support over 13 million jobs in Europe. Clearly, MSMEs cannot be overlooked when designing solutions to improve supply chain performance and resilience.

One of the biggest and most persistent challenges in this context is the fact that MSMEs have never been truly connected to the exchange of information among supply chain stakeholders. This lack of connectedness causes problems for MSMEs and large enterprises as well as authorities.

- Large enterprises executing services for MSMEs (e.g. logistic service providers) do not get all the information that they need to execute the services for the MSMEs effectively or efficiently, which is highly unsatisfactory to both.
- MSMEs executing service for large enterprises (e.g. a sub-contractor delivering parcels for a worldwide Logistic Service Provider) do not receive all information they need to execute the sub-contracted services effectively or efficiently.
- Authorities requiring information from MSMEs receive paper-based submissions, which are often incomplete, difficult to read or otherwise hard to process efficiently.

A main reason why these challenges have persisted is that the cost of investing in electronic connections with their business partners is prohibitively high compared to the perceived benefits. Hence, many MSMEs have never established those connections.

Large corporations may use Global Trade Management (GTM) systems that help them keep track of the myriads of complexities involved and avoid the numerous pitfalls inherent in current manual cross-border procedures. For MSME organisations, these GTM systems generally are beyond their capability (financially, organisationally and in terms of skills required). In effect, complex cross-border procedures (and the need for advanced IT systems to manage them) create barriers for MSME to engage in international trade.

The European Union recognised the above challenges and published its "Digital Strategy"[34] as a next step towards the Digital Single Market in February 2020[35]. Its programmes invest significant funds in establishing better infrastructures to exchange information among all stakeholders in European Supply Chains (including MSMEs), in effect "Connecting Europe". These types of market initiatives can be critical to responding effectively to a crisis.

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[33] https://ec.europa.eu/commission/commissioners/2019-2024/hogan/announcements/speech-commissioner-phil-hogan-eurocommerce-webinar_en, June 2020.
[34] https://ec.europa.eu/digital-single-market/en/content/european-digital-strategy
[35] https://ec.europa.eu/digital-single-market/en

The FENIX[36] project (described in more detail in Appendix 1) aims to deliver an information exchange infrastructure as envisioned above. Federative networks of platforms like FENIX are great enablers for MSME to digitally connect to the exchange of information and further improve both the flow of information and of goods. MSMEs would have to invest only once in connecting to the federative network and would thereby be connected to all stakeholders and services that are connected to the federative network of platforms. That model makes the investment in IT connectivity much more affordable for the MSMEs.

The scan-4-transport (S4T) approach mentioned above and described in more detail in section 2.3.5 ("contactless trade") offers an additional way for MSMEs to become better integrated into supply chains. When 2D barcodes on transport unit labels follow the S4T approach, MSMEs do not need to receive advance electronic information because the data they require is embedded into the barcode on the label. They may scan and process the barcodes using standard mobile phones.

2.3 Trade facilitation is improved by digitally enabled customs

A key strategic objective of border agencies is to facilitate trade. This essentially means improvement in clearance times. Something that can be achieved through redeployment of manpower to improve clearance during peak periods, and by improved border processes. According to WCO *"Digitally-enabled Customs has the potential not only to improve efficiency and reduce trade costs but also to achieve enhanced trade facilitation"* [37]

Recommendation 5:
Adopt standardised digital processes globally or at least regionally to further connect MSMEs into information exchange networks.

Risk management is used by border agencies primarily to identify how best to apply their effort and resources. This is not only to maximise seizures of contraband or to minimise phytosanitary, biosecurity or public health risks, but also to facilitate legitimate trade. There are many areas where global data standards could assist border agencies in the border processes and risk management, including:

- Providing supplementary information to facilitate trade
- Reducing data errors that lead to unnecessary shipment delays, leveraging auto-filling and structured master data
- Implementing a number of articles in the WTO Trade Facilitation Agreement

We also believe that there is potential to better link the global data standards thinking outlined in this paper, including benefits for government to piggyback on industry data, to improve trade facilitation in general and support the implementation of the WTO Trade Facilitation Agreement.

An important area of trade facilitation is the authoritative identification of traders, authorized economic operators, and other participants. For the sake of brevity, the discussion of stakeholder identification is excluded from this paper. However, the principles described in this document are also applicable to entity identification: standardised, authoritative and globally unique identification of businesses participating in all areas of trade improve supply chain efficiencies, resilience and transparency.

[36] https://fenix-network.eu/ (A European FEderated Network of Information eXchange in logistiX)
[37] IT Guide for Executives, World Customs Organization (2018)

2.3.1 WTO Trade Facilitation Agreement

Streamlining and making risk management practices more effective will be essential for meeting WTO trade facilitation objectives.

Article 7 of the WTO Trade Facilitation Agreement sets out that WTO member economies are to establish or maintain procedures designed to speed up release once goods have arrived in the customs area:

- Procedures for the release and clearance of goods for import, export or transit
- Pre-arrival processing of import documentation and other import-related formalities
- Establishing effective border risk management practices
- Rules for Authorized Economic Operators
- Handling of perishable goods

2.3.1.1 Pre-arrival processing

In the context of article 7, global data standards can assist in pre-arrival processing procedures (articles 7.1.1, 7.1.2), depending on country adoption. This would involve electronic B2G product information submissions. The pre-arrival information provided by unique product identification and unique consignment reference (UCR) would provide border agencies with valuable information for risk assessments in advance of arrival.

The product identification will give access to detailed product information. This information is readily retrievable from global registries, product catalogues, National Product Catalogues and GDSN. An identifier (or a class like GPC) that signalled the product was something other than stated in shipping consignment documents (or electronic data submissions) could act as criteria to trigger closer scrutiny of the shipment on its arrival and thereby help prioritise border agency resources.

Global data standards (compliant with ISO 15459) may be used as an UCR value. Using the UCR value combined with concepts like Data Pipeline and Linked Data, may provide access to more detailed information regarding the shipment or commercial transaction related to the customs submission. This additional information may be used to further enhance risk assessment.

2.3.1.2 Border risk management

For risk management in the context of the trade facilitation agreement, articles 7.4.1, 7.4.2, 7.4.3 and 7.4.4 are relevant. Risk management is meant to concentrate customs controls on high-risk consignments and expedite the release of low-risk consignments.

Opportunities to leverage global data standards - depending on country adoption - can be found in articles 7.4.3 and 7.4.4, especially in the parameters relating to identification and speedy release of low-risk consignments by use of selection criteria such as shipping history, shipping routes and compliance history of traders. These parameters would include unique product identification, access to product global registries, leveraging of industry product classification systems and industry visibility platforms.

2.3.1.3 Perishable goods

For perishable goods (articles 7.9.1, 7.9.2, 7.9.3, 7.9.4), the aim is to achieve the release of goods within the shortest possible time, giving them priority in inspections, and ensuring proper storage pending release. Article 7.9.2 provides an opportunity to implement the use of global data standards - depending on country adoption - in providing identification and speedy release of perishable consignments.

Article 10.4 focuses on the establishment of single windows[38], enabling traders to submit documentation through a single-entry point. There could be a potential to leverage global data standards—depending on country adoption—supporting the implementation of Single Window (10.4.4) with product identifiers and data sharing standards.

2.3.2 Maintaining e-commerce customer satisfaction by extending the use of established retail standards to digital sales platforms

With the rapid growth in e-commerce and the associated need for governments to identify parcels, parcel contents, as well as shippers, the value of standards is becoming evident. To support the current shift to cross-border e-commerce, trade standards should be based on and compatible with open global standards for end-to-end supply chain management systems already used by e-commerce platforms and retail for global trade, as well as by many logistics service providers all over the world. This applies to goods and services in both B2C and B2B environments. ISO standards for the identification of transport units, commercial transactions, product, consignment and shipments are already widely used in this context by both economic operators and accepted by authorities worldwide.

2.3.2.1 WTO E-Commerce Joint Statement Initiative

Notable progress on the multilateral level includes the WTO E-Commerce Joint Statement Initiative, where work is ongoing. Issues being addressed by that initiative that are relevant to this paper include some of the focus areas under "Enabling digital trade/e-commerce", most notably:

- Customs, digital trade facilitation and logistics (e.g. paperless trading)

New Zealand has submitted proposed text that suggests taking into consideration digitalization of border clearance processes of the WTO Trade Facilitation Agreement.[39]

These are important developments that can help align future agreements, and even though we have limited insight into the ongoing discussions under the WTO E-Commerce Joint Statement Initiative, it is important to consider a future agreement not only aligned with WTO Trade Facilitation Agreement as suggested by the New Zealand Ministry of Foreign Affairs and Trade, but also one that is closely aligned with significant regional regulatory initiatives. This is especially the case given that these initiatives, most notably the recent developments in the EU, will have a global impact, as exporters selling into the EU market need to comply with EU rules. E-commerce initiatives that are proposing the use of open global standards ensure quick and easy implementation for industry and global alignment of supply chains.

2.3.2.2 New Framework Governing Cross-Border E-commerce in European Union

In the EU there have been significant regulatory developments on the framework governing cross-border e-commerce. European regulations related to the import of low value consignments (LVC) will hugely affect global ecommerce. The applicable set of regulations goes by the name of "EU VAT Ecommerce package"[40]. The regulations will come into force 1 July 2021. Most relevant elements from the regulation:

- All imports into the EU of a non-zero sales value will have to be declared and applicable VAT has to be paid;

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[38] UNECE, 'Recommendation and Guidelines on establishing a Single Window, Recommendation No. 33', New York and Geneva, 2005.
[39] Communication to WTO on the Joint Statement of Electronic Commerce dated 5 July 2019, circulated at the request of the delegation of New Zealand. https://www.mfat.govt.nz/assets/WTO-disputes/Paperless-Trading-and-E-Invoicing.pdf
[40] https://ec.europa.eu/taxation_customs/business/vat/modernising-vat-cross-border-ecommerce_en

- Customs declarations have to be done electronically (paper is no longer accepted);
- Each Transport Unit must be identified uniquely;
- The data element containing the Transport Unit ID (DE 2/3) is mandatory in the data set (H7) to be used for the electronic customs declaration;
- E-commerce platforms are deemed sellers even if they never take ownership of the goods sold by the merchants using the ecommerce platform for selling to customers;
- The commercial transaction (sales order) ID should be provided also in the data set submitted as customs declaration to EU Member States.

The need to declare LVCs will increase the number of customs declarations at least ten-fold; some EU countries estimate an increase exceeding a factor of 30. This means the vast majority of all import declarations in the future will be linked to e-commerce parcels. The data sets used for these customs declarations allow for the use of ISO 15459 compliant ID Keys to be used in the essential data elements of the data set (e.g. for UCR <Unique Consignment Reference>). Therefore cross-border e-commerce will see by far the biggest benefits from using global data standards compared with other sectors of international trade. This is true especially in case ISO 15459-1 compliant ID Keys would become the common identifier for e-commerce parcels (see Figure 3 below[41]).

Figure 3: GS1 proposes to use one common ID and one label for all stakeholders

Recommendation 6:

Future trade agreements, including any agreement resulting from WTO E-commerce Joint Statement Initiative, should recommend or mandate the use of open global standards in international trade, especially in cross-border procedures.

[41] The bottom barcode on the label is compliant with ISO 15459-1.

2.3.3 New technologies support future-proof supply chain infrastructures

Digital technologies have been around for some time, but are continually advancing through ongoing innovation. They are essential building blocks needed to achieve the safe, secure and efficient flow of goods in future supply chains and build the resiliency needed, especially for times of crisis. Perhaps more importantly, digital technologies are a conduit to broad data and information exchange, and they enable sophisticated risk assessments and decision-making that are critical to successful supply chain management.

Merging well-established technologies with new ones offers good ways to develop better responses based on data. For example, engineering and manufacturing companies, energy sectors or infrastructure planning firms use digital twins[42] to run simulations of their operations, thereby optimising processes and creating safer environments. The same can and should be done more widely in logistics and in border and customs processes. Data produced through simulation with the digital twin produce valuable information for decision-making. In logistics, the ideal digital twin is that of an entire physical supply chain network including all aspects from container to warehouse to (air)port. At the border, the ideal digital twin is comprised of everything from arrival area to physical sampling to containment to release.

Combining digital twins with smart sensors in the physical world (e.g. RFID sensors) enables fast machine learning and artificial intelligence, further enhancing the ability to predict future events, such as the failure of a piece of equipment, or the ability to detect questionable goods at the border. In other words, real-time data from numerous sensors anywhere in the supply chain network can be sent to the cloud and in combination be manipulated to deliver information that otherwise would not have been available. This is the use of the Internet of Things (IoT) at its best.

Other variations of digital technologies are digital platforms such as Single Windows. These are already in use and should be more widespread, but most of them are built on traditional IT systems. By integrating distributed ledger technologies (DLT) into digital trade platforms, processes have the potential to become more transparent, more secure, and overall, more trusted. However, blockchain or DLT are no panacea[43].

The clearance of goods at the border, risk management and electronic document exchange between international participants may all be enhanced with modern and emerging (information) technology. It is therefore only logical to make digital technologies part of the solution when looking to improve border processes.

2.3.3.1 Standards elevate the value of advanced technologies

Modern technologies usually evolve without standards in place and thereby don't guarantee interoperability with the vast installed base of traditional technology or even with other modern technologies. This limits their true potential and the positive impact technology can have, regardless of the environment in which technology is used. As explained in Section 1.1.3, when it comes to facilitating smooth international trade, interoperability at the border is essential. Document ECE/AGAT/2020/INF.5 addresses some of the interoperability challenges that arise in the absence of standards, and the role of

[42] Digital twin refers to the exact digital representation of a physical object, system, process or person. The definitions have changed over time: B. R. Barricelli et al., '*A Survey on Digital Twin: Definitions, Characteristics, Applications, and Design Implications*', IEEE Access, 2019 (Digital Object Identifier 10.1109/ACCESS.2019.2953499). D. Jones et al., '*Characterising the Digital Twin: A systematic literature review*', CIRP Journal of Manufacturing Science and Technology, 29A, 2020, pp. 36–52.

[43] *http://www.unece.org/fileadmin/DAM/cefact/GuidanceMaterials/WhitePaperBlockchain.pdf*, Section 3.1 page 22-23.

advanced technologies play in overcoming COVID-19 disruptions.[44] Work is currently underway to develop interoperable blockchain-based systems. Notably, in ISO/TC 307 Blockchain and distributed ledger technologies, with ISO/TC 307/SG 7 specifically focusing on "Interoperability of blockchain and distributed ledger technology systems". [45]

In practice, there are already large numbers of planned and ongoing pilot projects aiming to leverage blockchain in international trade and cross-border processes. But currently few, if any that also include the B2G exchange of data using blockchain technology. Figure 4 illustrates how standards support the critical linkage between the data inside the blockchain and the information generated from those date for the purpose of decision-making in business applications.

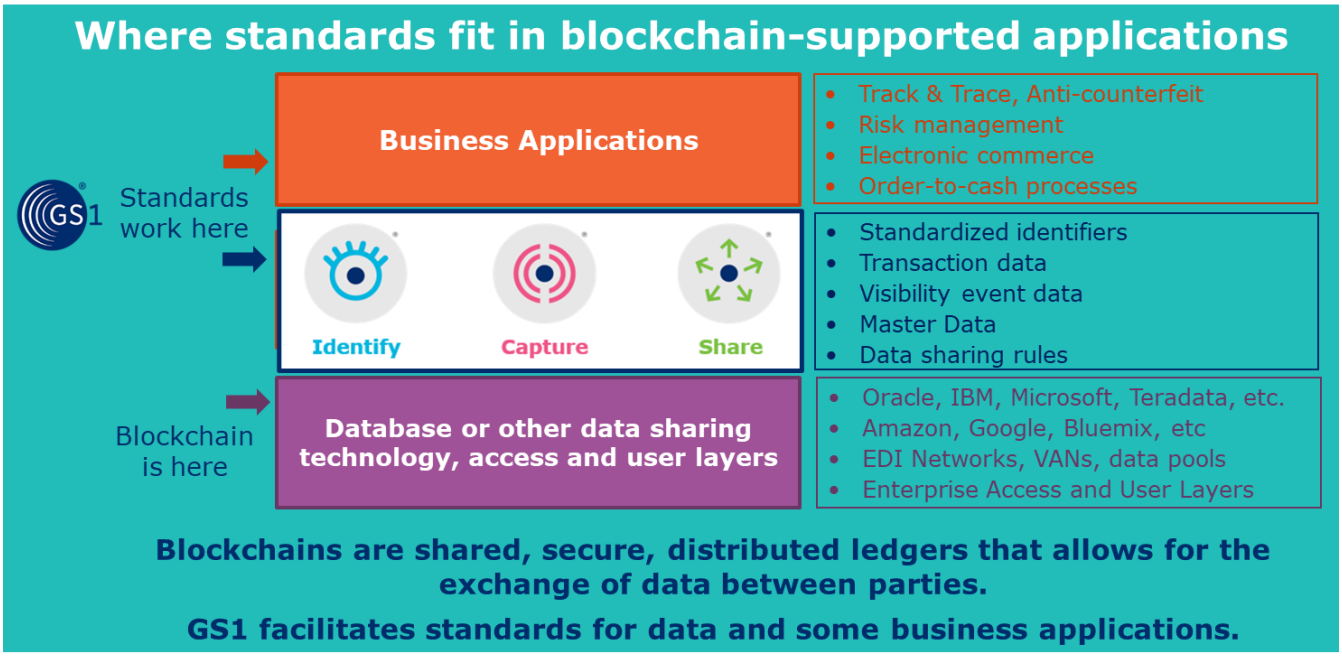

Figure 4: Standards work at the interface of blockchain databases and business applications

On a domestic level blockchain has been tested for supply chain traceability purposes, underpinned by global data standards for product identification and data sharing. It has become evident that traceability systems can interoperate to transmit and exchange information about a product's journey throughout the supply chain to support end-to-end traceability. In pilots, interoperability between solutions has been made by using a range of global data standards such as GS1 unique identification of products and locations, and GS1 Electronic Product Code Information Services (EPCIS) as a standardized data model.[46]

The (new) GS1 Digital Link Standard together with its resolver functionality extends the power of product identifiers by making them part of the web. That means that product identifiers, such as the GTIN, serve as gateway to information that improves supply chain traceability information, authenticity information, patient safety information and more.[47]

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[44] Economic Commission for Europe, Centre for Trade Facilitation and Electronic Business, 'Report on the impact of COVID-19 outbreak on international trade and logistics and the ways advanced technologies can help overcome such disruptions', Geneva, July 2020.

[45] https://www.iso.org/committee/6266604.html

[46] *https://www.mmh.com/article/gs1_us_foodlogiq_ibm_food_trust_ripe.io_and_sap_complete_food_traceability*

[47] https://www.gs1.org/standards/gs1-digital-link

At customs, the GS1 Digital Link Standard has the potential to support the authentication of medical supplies and other valuable and high-risk items, conveniently allowing the user to draw upon reliable information directly from the manufacturer as well as other stakeholders in the supply chain.

The GS1 Digital Link is also a good tool to support safe clinical care, which is an important objective in any kind of health crisis. Manufacturers, distributors and hospitals can use the GS1 Digital Link to access relevant information online, in addition to the standard barcode data. [48]

Recommendation 7:

- Include emerging technologies like digital twins and IoT in supply chain and border processes to enhance data capture, decision-making, and information sharing.
- Support these with the relevant linked data standards.

2.3.4 Interoperable paperless trade is good for productivity, health and the environment

According to World Economic Forum, *"Paperless trade refers to the digitization of information flows required to support goods and services crossing borders*".[49] According to the Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific cross border paperless trade is *"trade in goods, including their import, export, transit and related services, taking place on the basis of electronic communications, including exchange of trade-related data and documents in electronic form"*.[50] Supply chain operations will benefit from converting their paper documents into a digital form. At the same time, information sharing, data security and productivity can be increased through the digitization of information flows.

Paper processing is expensive and wasteful because it costs time, requires storage space, and strains natural resources. And now, in times of COVID-19, paper can even pose a danger to human health because the virus may survive several days on its surface. These are all good reasons to minimise the use of paper and strive for its complete elimination in trading operations.

Going forward, in the context of this report, paperless shall mean *the access to electronic data sets in trade processes to achieve business and regulatory objectives as well as or better than using paper documents.*

[48] GS1 Digital Link flyer: https://www.gs1.org/docs/Digital-Link/2019.GS1-Digital-Link.pdf
[49] https://fr.weforum.org/whitepapers/paperless-trading-how-does-it-impact-the-trade-system
[50] https://www.unescap.org/resources/framework-agreement-facilitation-cross-border-paperless-trade-asia-and-pacific

There are currently a number of long running and important initiatives focusing on paperless trade led by international and intergovernmental organisations. The United Nations Network of Experts for Paperless Trade and Transport in Asia and the Pacific (UNNExT) is a community of experts established by UNESCAP and UNECE, mainly involved in the implementation of paperless electronic trade systems and trade facilitation. World Economic Forum and UN/CEFACT have also worked on Paperless Trade in the context of the WTO TFA article 10.

The main purpose of *paperless* in the context of supply chains is to improve their performance by facilitating more efficient trade processes. In times of COVID-19 or similar transmittable diseases, paperless trade supports contactless trade, reducing exposure to potential sources of virus carriers and reducing the need for virus-related hygiene. Over the past decades there have been numerous supply chain initiatives to replace paperwork with electronic information exchange.

In air cargo, the electronic Air Way Bill (e-AWB)[51] was developed over a decade ago. The International Air Transport Association's (IATA) relentless advocacy for adoption of e-AWB has resulted in it being the default contract of carriage for all air cargo today; paper-AWB may still be used, but it is far less common. Currently, more than 1 million e-AWBs are issued monthly and over 67% of the global air cargo networks is using the e-AWB regularly.

The Convention on the Contract for the International Carriage of Goods by Road (CMR)[52] waybill has been the most widely used paper consignment note for international road transport for over half a century (since the convention was signed in 1956). In February 2008 an additional e--protocol was added to the CMR convention, which entered into force in June 2011. The e-protocol provides a legal framework and standards for the use of electronic means to record the CMR consignment note.

However, individual countries must ratify this protocol in their national legislation such that authorities can no longer demand to see the paper version of the CMR in case an electronic version (eCMR) is presented by an economic operator.

[51] *https://www.iata.org/en/programs/cargo/e/eawb/*
[52] CMR, short for "Convention relative au contrat de transport international de marchandises par route" *https://en.wikipedia.org/wiki/CMR_Convention*

As of 13th July 2020, 27 countries have ratified the eCMR protocol[53] (Figure 5).

Figure 5: Current ratification of eCMR
(green = ratified, orange = intended ratification, yellow = expected ratification)

In order to be considered a legally accepted electronic CMR, the IT system generating and processing the electronic consignment note must meet certain standards. Numerous IT solution providers have developed software implementing the standards set in the eCMR protocol, but unfortunately, the solution providers have implemented the eCMR protocol in their proprietary software thereby preventing interoperability with other systems. But - interoperability is a precondition for wide adoption of eCMR around the world.

When cargo or goods are transported from a sender to a receiver at least three different participants are involved - a sender, a receiver and a carrier. Each of those participants may use a different eCMR service provider with its respective propriety eCMR solution. In this scenario, it is possible that none of the systems can communicate or maybe only two. But in order get the full picture of the transportation and retrieve the required transportation information, it is necessary that each of these solutions can easily exchange information with all other eCMR solutions involved.

The situation typically becomes more complex when a transport crosses multiple borders as interoperability across country borders is even less likely. The responsible authorities in each country often use different eCMR solutions to execute their transportation-related control tasks. The eCMR is designed to provide this information, and it should easily be made available in the eCRM solutions used in those countries.

The lack of interoperability leads to two fundamental conclusions:

1) Unless there is a seamless flow of information among the relevant stakeholders, economic operators will still need to carry the paper versions (even though they may have an electronic version also).
2) Without seamless electronic information flows, having the eCMR only adds cost for the economic operator and there are virtually no benefits from the eCMR.

[53] https://transfollow.org/ratification-ecmr-protocol-eu/ ; https://www.unece.org/trans/trans/conventn/latest.html

Standardisation bodies like UN/CEFACT and GS1 quickly realised that global data standards would be required to enable the interoperability among the eCMR solutions. UN/CEFACT with the support of a wide range of subject matter experts developed the eCMR Reference Data Model[54] based on the paper CMR and eCMR protocol. This model makes it possible for the individual eCMR solutions to exchange a minimum data set among them.

Although the model is a very good starting point, it does not resolve all interoperability challenges among stakeholders. Currently, GS1 is working with eCMR stakeholders to define unambiguously how various standards (including the UN/CEFACT RDM) may be used to solve the remaining challenges to interoperability that stand in the way of widespread adoption of eCMR in transport and logistics.

Recommendation 8a:
Use electronic platforms and documents in international trade: Employ open global data standards in eCMR to achieve interoperability

The e-AWB and eCMR initiatives were conceived and developed completely independently from each other. Even though both initiatives cover electronic versions of a Consignment Note, the terminology for data-elements as well as formats and code lists differ. Furthermore, the legal frameworks covering the electronic versions of these Consignment Notes are also different (and sometimes contradictory). Consignment Notes are among the most frequently shared documents in supply chains and replacing them with electronically transferable records (or data sets) would bring many benefits to supply chains.

The Model Law on Electronic Transferable Records (MLETR)[55], which was adopted in 2017, serves as enabling law for digital trade and has consequences for any cross-border situations. Technology neutral, it applies the same legal framework to electronic and paper-based documents. Article 12 of MLETR explicitly makes reference to "applicable industry standards" to be used in electronic transferable records and recommends that these would be "preferably internationally recognised." MLETR states that "the use of international standards may promote the emergence of a common notion of reliability across jurisdictions." Chapter IV is entirely dedicated to the cross-border recognition of electronic transferable records. The Model Law is a critical bridge to bring digital international trade to live and facilitate paperless cross-border processes.

Recommendation 8b:
Use electronic platforms and documents in international trade: Adopt eMLETR globally. Migrate completely to electronic documents along the entire international trading process and use global data standards in electronic records.

[54] *https://www.unece.org/uncefact/mainstandards.html* - Transport & Logistics eCMR several resources.
[55] United Nations Commission on International Trade Law, 'UNCITRAL Model Law on Electronic Transferable Records', New York, 2018.

2.3.5 Contactless trade enhances health and safety and is not difficult

Contactless trade is a new business need that emerged from the COVID-19 pandemic and it sounds harder to achieve than it is. Participants throughout the supply chain and border authorities can quickly achieve contactless processes in many operations by applying well-established proven barcoding technologies. Combined with the ubiquity of mobile devices and with global standards for creating, structuring and processing the barcodes as well as global web standards, getting to contactless trade is actually surprisingly simple.

In the context of this paper contactless shall mean to *enable processes and tasks performed by any constituent anywhere in the supply chain without the need to physically touch objects, paperwork or persons.* One of the main purposes of contactless is to contain the spread of disease—any disease.

As discussed in section 2.3.4, many tasks and processes in supply chains rely on paperwork that needs to be signed by a person. That means there are at least two persons that touch that paper within a short timeframe from each other, which in times of an epidemic or pandemic may constitute a risk to the health of both persons involved[56].

However, paperless processes are not necessarily contactless. Examples of contact in paperless trade are touching of computer keyboards and mice, and touch screens. Conversely, there are processes and tasks that are paper-based and yet do not require touching the paper. Examples of this are shipping labels that are applied automatically.

Machine-readable barcodes on labels have been a long-time staple to massively improve supply chain operations. Barcodes can be read from a safe distance using a scanner, which may be a special device with associated software or simply an app that utilised the mobile phone camera to read the code. No matter how, scanners are ubiquitous and used all over the world. Mobile devices can also digitally display barcodes on their screen that other mobile devices or fixed readers can then recognise from a safe distance without contact between those devices.

eCMR solutions (see section 2.3.4) rely quite heavily on two-dimensional (2D) barcodes displayed on mobile devices -and also read by other mobile devices thus avoiding the need for actual contact between the devices. Assuming interoperability, the persons involved in such transactions can maintain a safe distance from each other. But as previously stated, interoperability in eCMR is by far not guaranteed. This further substantiates the need for global data standards in eCMR and our recommendation for fast adoption of applicable standards.

A similar issue exists for 2D barcodes used on transport and logistic labels all over the world. Large quantities of information are made available on the label through the 2D barcode. A common (global) standard approach guarantees that all other stakeholders can read that 2D barcode correctly and subsequently process the object that the label is affixed to—without ever touching a package, container or other shipping unit.

GS1 has worked with a large group of stakeholders from a wide variety of backgrounds to develop the Scan-4-Transport (S4T for short) approach for that purpose. A S4T label example is shown in Figure 6. The 2D barcode (middle right) is structured according to the S4T approach.

[56] Many parcel carriers have stopped collecting signatures (on paper or on glass/screens) during the COVID crisis for this very reason.

Figure 6: Scan-4-Transport label with 1D and 2D barcode.

The S4T approach relies on three main pillars:

1. It can make use of very widely adopted ISO standards for 2D barcode formats (such as QR code and Data Matrix).
2. It builds on the web-standard for URI (Uniform Resource Identifier). This standard makes it possible to include a "pointer" to the web-service where additional / up-to-date information for the object to which the 2D barcode is affixed may be retrieved. This requires the use of globally unambiguous identification keys for the object concerned (e.g. ISO or GS1 ID Keys).
3. The data elements required to correctly handle the object without having to access the web service are included in the 2D barcode in a standardised way such that it is clear for all stakeholders exactly what information each data element contains.

Therefore, an operator processing a barcode may execute the task based on the data elements contained in the barcode. This means operators and service providers do not need to receive any information prior to executing the task. Any information needed is right there with the shipment. The operator may also use the URL contained in the barcode to access web services (and the appropriate ID Key) to retrieve the latest information available for the object and execute his tasks based on that.

This real-time access to the source of reliable information (rather than relying on "data" passed on by intermediaries) is an extremely useful tool to increase the flexibility of the supply chain in case of disruptions, especially in times of humanitarian crises. And, reading a barcode virtually never requires contact with the shipment or label.

Recommendation 9:
Adopt standardised barcode, data matrix & QR code, and barcode scanning anywhere along the supply chain, including the border.

2.4 Collaboration is the key to success

Open global data standards and digital technologies are very important. However, the key to successful implementation of the above recommendations is collaboration among all supply chain stakeholders. Governments need to work with one another on trade agreements and trade rules. They also need to work with the private sector to understand what works best for their specific needs. And private sector stakeholders must work together to incorporate standards from the emergence of a new technology (e.g. blockchain) to retrofitting existing systems and processes (e.g. eCMR) to achieve interoperability.

Our final and most important recommendation is therefore:

Recommendation 10:
Strengthen international public-public, private-public, and private-private information sharing and collaboration.

3. Recommendations to Achieve a Resilient and Efficient Global Supply Chain Post COVID-19

3.1 Establish a standards-enabled global supply chain

GS1 strongly urges that trade agreements and trade rules should recognise the use of open global standards in international trade, especially in cross-border trade procedures. The commitment to open, free, and interoperable standards ought to be reinforced by all stakeholders to ensure a level playing field and to promote innovation. However, since economic and political environments vary from country to country, it would not be advisable to impose highly prescriptive recommendations or methodologies for implementing any particular global data standard. Instead, the key principle is that the adoption of a common global (business) language is crucial and powerful; how, when and who implements such systems needs to be evaluated by each individual government based on its circumstances and priorities.

Governments determine what product categories are strategically important and decide which challenges to address first. Following COVID-19, governments are also more likely to become increasingly engaged in shaping sustainable, resilient supply chain networks because the well-being of their population depends on a functioning framework during the next crisis. As such, a desirable and recommended outcome is the inclusion of implementing open global data standards in the preparedness plan. In section 1.2, we described an ideal supply chain response to each of the WHO pandemic phases. Since the world is currently still in the middle of the *pandemic phase* (phase 3), we are not suggesting that the new implementation of global data standards or novel advanced technologies should be made a priority now, but should rather be postponed until *recovery* has begun (phase 4). The quiet *interpandemic phase* (phase 5) allows time to develop and execute on a comprehensive preparedness plan that includes the adoption and implementation of open global standards. This hackathon project offers constituents the opportunity to gain a head start on executing phase 4 and even phase 5, as illustrated in Figure 7.

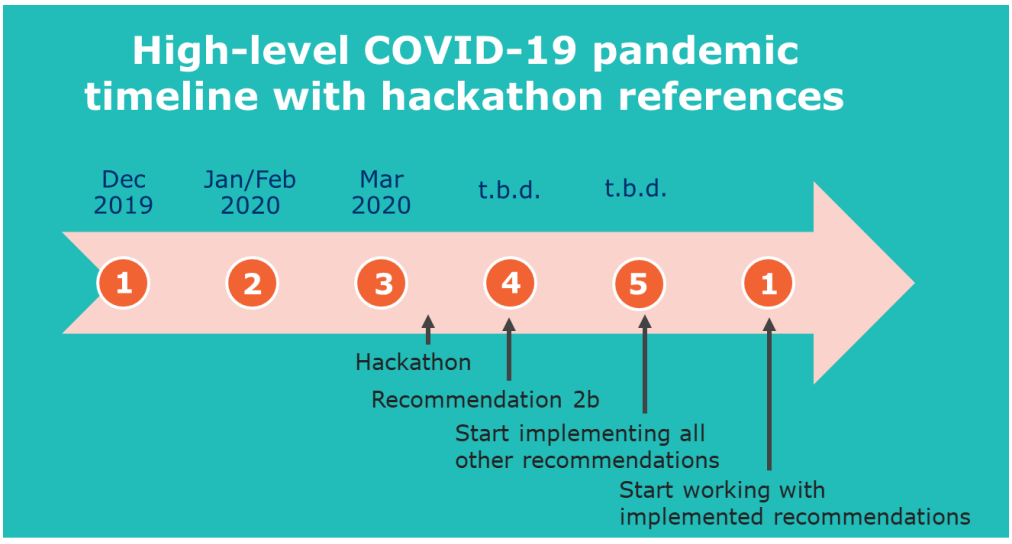

Figure 7: GS1 recommendations in reference to COVID-19 pandemic timeline

All recommendations described in Table 5 below should be prepared in phase 4 and phase 5 of the COVID-19 pandemic and should be implemented no later than the onset of the next crisis. Ideally, recommendations corresponding with the five phases would be executed much sooner and would serve to support the ordinary day-to-day trade environment without the urgency imposed by a pandemic.

Table 5: Recommendations for the adoption, implementation and use of global data standards in times of crisis and normality

Phase	WHO phase	Supply chain response	Recommendations	
1	Inter-pandemic phase (transmission from animal to human)	Normal operations, monitoring, ensure all systems & processes are operating well	• Strengthen international public-public, private-public and private-private information sharing & collaboration • Fully utilise standardized processes and digital technologies for optimal supply chain efficiency, safety and security (as implemented in phase 5 of previous cycle). • Run stress tests on existing and newly developed processes to ensure supply chain resilience.	Past COVID-19 phases
2	Alert phase (human-to-human transmission; governments seek WHO help)	Increase production, build inventory, add resources at logistics and distribution; invoke emergency plans	• Continued use of standardized processes per normal. • Establish essential goods list. • Use standardised product classification and identification to identify and differentiate between COVID-19 essential goods, humanitarian relief items and non-essential items. Create crisis-specific HS code linkages. • Allow and enable digital pre-arrival clearance for all essential goods during the time of emergency.	
3	Pandemic phase (wide-spread outbreaks w/ human-to-human transmission; mitigation)	Execute on emergency (business continuity) plans	• Utilise phase 2 implementations. • Maximise international stakeholder collaboration including data sharing to increase supply chain flexibility and adaptability in response to rapid and unforeseen changes in goods routing, etc. • Use standardised barcode, data matrix & QR code, and *scanning* anywhere along the supply chain, including the border to support product authentication and contact-free processing. • Collect data for phase 4 and 5 analysis.	Current COVID-19 phase
4	Transition phase (decrease of outbreaks, but uncertainty; balanced communication)	Maintain increased levels of inventory and resources to address a potential second wave and address global differences	• Continued strong international collaboration, monitoring and data sharing. Maintain high levels of flexibility for flare-ups or sudden onset of second wave illnesses. • Identify second-wave supply chain bottlenecks and execute phase 2-style preparation. • Update linkage between industry identifiers and the HS code specific to the pandemic/crisis. • Update relevant databases and e-forms. • Collect data for phase 5 analysis.	Future COVID-19 phases (phases to implement recommendations)

5	Inter-pandemic phase (return to normal levels; surveillance and updated preparedness)	Supply chain returns to "new normal," and prepares to increase resiliency for the next pandemic	• Analyse data, complete gap analysis, and develop mitigation plans in preparation for "new normal."
			• Future trade agreements, including any agreement resulting from WTO E-commerce Joint Statement Initiative, should recommend or mandate the use of open global standards in international trade.
			• Create (update) linkage between industry identifiers and the HS code for accelerated goods processing.
			• Adopt (update) global standardisation:
			  ○ Standardised unique product identification and digital processes across international supply chains (w/ priority on high-risk goods, such as medical supplies) and in customs systems and processes
			  ○ GDS in eCMR to improve interoperability
			  ○ Linked Data standards with resolver function to support authentication of high-value items, e.g. medical goods
			• Adopt (refine) digital technologies:
			  ○ Emerging technologies like blockchain and IoT in supply chain and border processes to enhance data capture, decision-making, and information sharing
			  ○ Standardised digital processes globally or at least regionally
			  ○ Implement eMLETR globally. Migrate to standards-enabled e-documents throughout international trade
			  ○ Digital pre-arrival clearance processes, especially for essential goods and relief items	

We strongly believe that implementing global data standards will increase supply chain resilience, flexibility and transparency to a degree that allows the supply chain to react smoothly during crisis situations with minimal interruptions. At the same time, standards bring tremendous advantages during periods of "ordinary" business operations by improving supply chain efficiency and security.

By mandating the use of standards in international trade agreements, their use becomes part of established, standard operating procedures, virtually eliminating the need for specialised processes during an emergency.

3.2 The standards-enabled supply chain can adapt to pandemic phases in times of crisis

Following COVID-19, a standards-enabled supply chain will follow the cycle of other disaster phases with adequate responses, as illustrated in Figure 8.

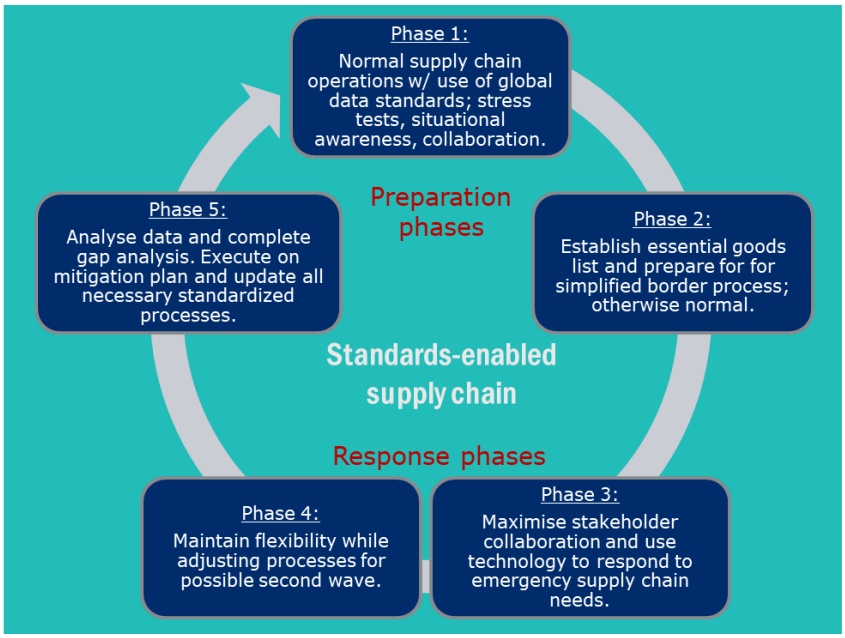

Figure 8: The five phases of the pandemic supply chain

In phase 1, the supply chain continues to operate at a normal pace and under normal procedures. Stakeholders continually monitor the situation and keep communication channels open. Critical supply chain networks for critical goods (e.g. medical supplies) should test their abilities and make necessary adjustments. Frequent emergency drills during periods of normalcy might be too costly for all supply chains, but they would pay dividends in stabilising critical supplies in the event of crises that arise either suddenly or incrementally.

In the case of a gradually developing crisis, the stakeholders launch preparatory activities in phase 2. These include establishing an essential goods list and building inventory of these items. This is also the time to pre-position essential goods where they are likely to be needed first. Governments invoke simplified border procedures and pre-arrival clearance in anticipation of the imminent crisis and make provisions for re-routing of goods at the border or in-market. People need to be (re-)trained on any

extraordinary procedures and all required technology must be activated. It is important that from this time forward, rigorous data collection takes place.

By the time the crisis reaches its worst state (phase 3), all stakeholders are already prepared to act on the emergency plan. The resilient, standards- and technology-enabled supply chain can rely on its tools and processes, and for the most part should not experience any major disruptions.

As the emergency subsides in phase 4, the supply chain remains alert and maintains a high degree of flexibility. During this relaxation time, limited short-term adjustments can be made that can address the possibility of worsening conditions.

As life returns to normal (phase 5), all established processes are reviewed and adjusted, based on information newly acquired through the crisis. Data captured along the way can be turned into actionable improvements and valuable lessons for the future.

4. Conclusion

At the onset of COVID-19, the novel virus was not well understood, and therefore its potential impact was underestimated. It was realised too late that the virus' contagiousness represented a critical threat to human life and the economy—via direct physical harm, and via indirect social and economic consequences.

As the virus spread, a rather unprepared global trading system experienced disruptions so serious that governments were forced to rapidly modify their core economic policies and philosophy to protect their people, the economy and jobs.

It cannot be stressed strongly enough that international public-public, private-public and private-private information sharing, and collaboration are critical to recovering quickly from the turmoil of the current pandemic. Such cooperation will also be necessary to achieving the sustainable change to complex institutional and trade environments needed to weather the next pandemic. New and revised trade agreements will offer a powerful force for positive change to achieve these goals.

In addition, government preparedness plans help ensure that changes are sustainable with more complex measures that lend themselves better to creating long-lasting change rather than merely addressing easy solutions or "low-hanging fruit."

Adoption of global data standards for product identification and data sharing will enhance the sustainability and resilience of the global supply chain and cross-border trade not only in the face of a global health crisis, but also when the economy is operating normally. Thoroughly tested in many situations and continually improved and modernised for nearly half a century, these standards have proven to be reliable work horses in the supply chain. New standards cannot be implemented overnight, and certainly not in the middle of a crisis, but COVID-19 has given us a unique opportunity to re-assess systems that have faltered, and to prepare for change once life return to normal.

In addition, digital technologies provide tremendous enhancements to current processes and enable contactless and paperless trade. When these technologies are combined with global data standards, they can bring future-proof transformations to international trade that will survive normal times and crises alike. The language of global standards enables interoperability between devices and systems, and it accelerates novel possibilities for data and information sharing. However, the implementation of hardware and software solutions relying on digital technologies requires time, and more importantly, substantial funding, which in many cases must be approved by governments. It is therefore important that new technologies are highlighted in preparedness conversations and planning.

When backed by international trade agreements and trade rules, global data standards and digital technologies have the power to transform cross-border trade fundamentally by significantly increasing supply chain resilience, efficiency, safety and security.

The scale of sustainable change contemplated here, if implemented, will help ensure the stable distribution of essential goods—especially food and medical supplies—at all times, will stabilize consumer goods prices, and will positively impact businesses and national economies both large and small.

Appendix 1:
Case studies and intergovernmental programs supporting the use of Global Data Standards

Global Case Studies

UNECE / UNCEFACT Data Pipeline

The UNECE Data Pipeline project website states that *"Connectivity infrastructures for information sharing such as data pipelines enable better quality of data, supply chain visibility and information sharing. They open new possibilities for system-based audit and the development of smart software applications to offer value added services to business such as automated planning and scheduling and for border agencies such as automated monitoring and targeting. In such a pipeline approach, the quantity of data in the pipeline therefore grows as the goods move from seller and shipper to consignee and buyer. These pipelines will need to have a sequence of generic milestones, but these will be individually constructed based on customer needs; so each one may be different."* This project is currently ongoing under UNECE and according to the project website it will *"aim to define the pipeline concept provide guidance on defining these generic milestones, identify the generic actors involved in such pipelines, standardize and harmonize a pipeline data carrier which would cover all data requirements for such procedures."*[57]

Track and Trace for Healthcare Products

An important aspect is to also highlight successful government initiatives employing standards already in use by industry. They illustrate the reliability and robustness of a standards-based system for product identification, verification and data sharing. They also provide insight and serve as benchmarks for the implementation by other governments that face similar challenges.

Leveraging these systems of standards, i.e. ISO / GS1, the Turkish government set up two track-and-trace systems in healthcare, one for pharmaceuticals[58] and one for medical devices[59]. These systems allow full traceability of products up to the patient, help reduce spillage and contain the costs and support great insight nationwide in the healthcare supply chain. In South Korea the Government has implemented a national system for drug traceability. Functionalities of the system are outlined in the Figure A1 below.

[57] https://uncefact.unece.org/display/uncefactpublic/Pipeline+Data+Carrier
[58] *https://www.drugtrackandtrace.com/*
[59] *https://www.who.int/medical_devices/Sun_am_SAF_5_OZDILER.pdf?ua=1*

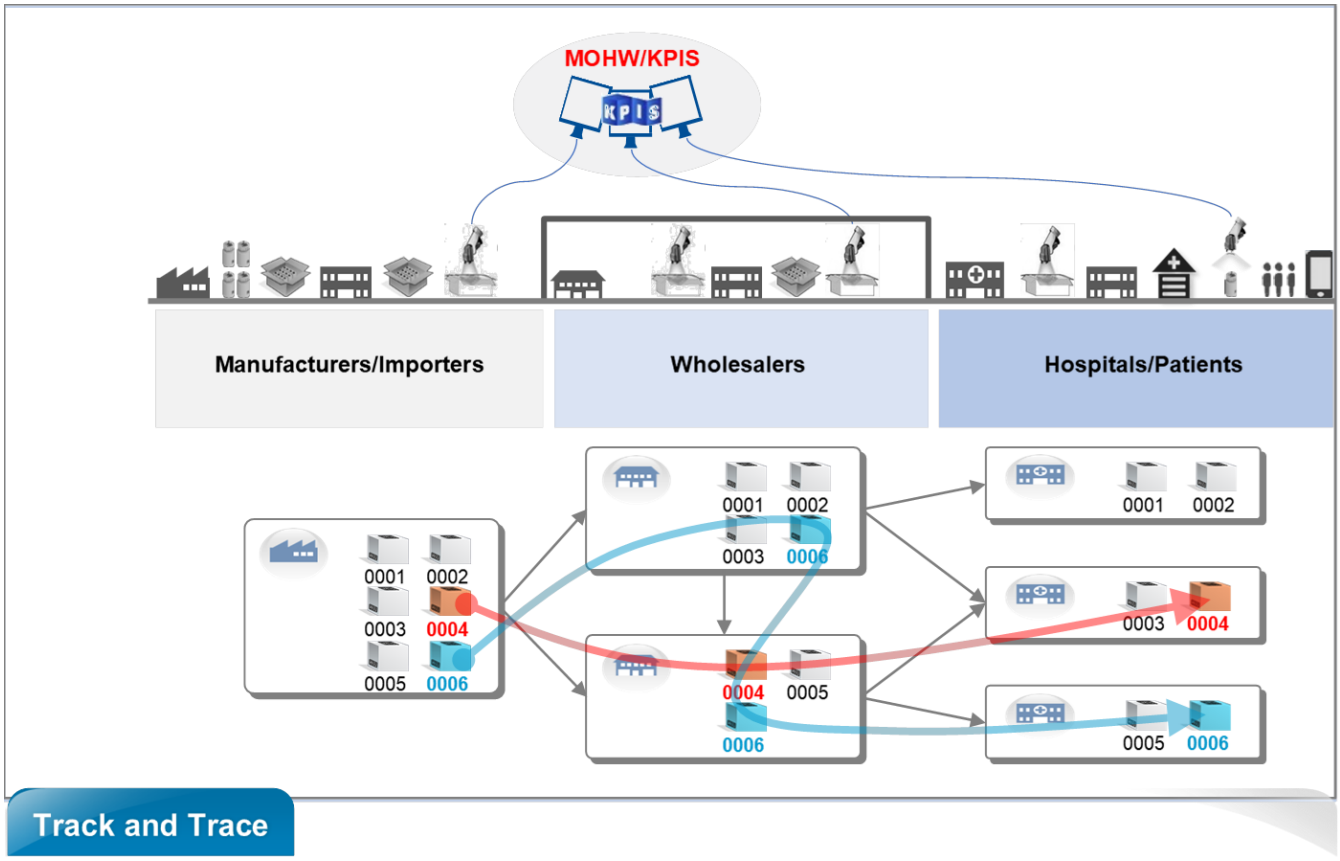

Figure A1: Concept Information Platform

These implementations from two countries should be seen as early adopters of a global approach to tracking & tracing healthcare products all over the world.

Public-Private Pandemic Supply Chain Initiative

Following the Ebola epidemic in 2015, the World Food Program (WFP) launched a public-private supply chain initiative with WFP, WHO, UNICEF, OCHA, FAO, World Bank, Henry Schein, UPS, NEC, BD, J&J, CDC, GS1, University of Minnesota and WEF as partners. Long before COVID-19 it was recognised that in a pandemic, inadequate supply chain preparedness would be a significant contributor to loss of lives and extraordinarily high costs.[60]

As a result, the initiative concluded that platforms facilitating information sharing are fundamental to adequately respond to potential pandemic supply chain interruptions. At the heart of the group's proposed solution is a trusted, web-based information platform connecting upstream and downstream participants as shown in Figure A2.

[60] https://www.gs1.org/sites/default/files/docs/events/2016/berlin/wfp_herbinger_gs1healthcareconference2017.pdf

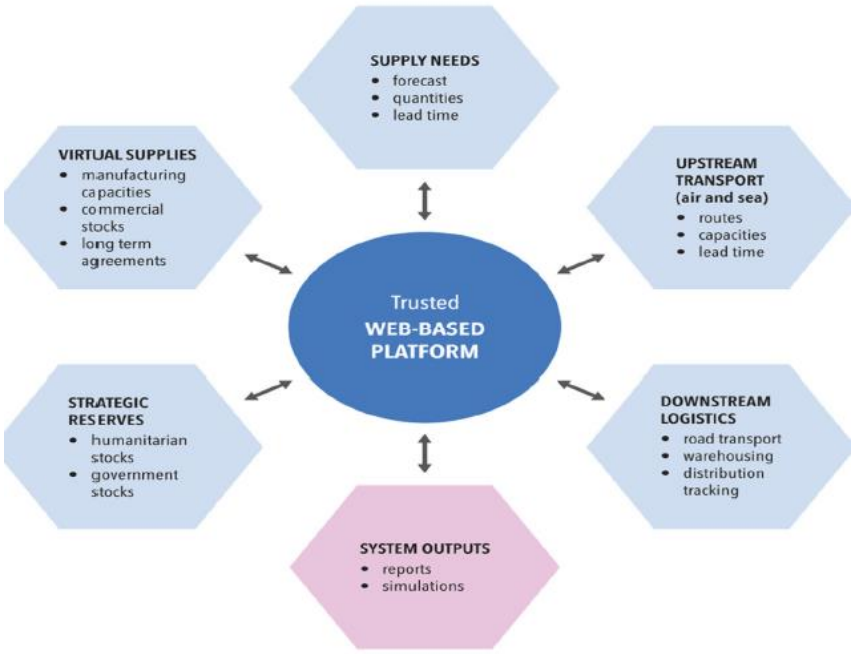

Figure A2: Concept Information Platform

The initiative further developed the concept of the so-called PSC Network (Pandemic Supply Chain Network), in which standards were the precondition to efficient coordination—a first in the coordination of disaster preparedness and response (see Figure A3).

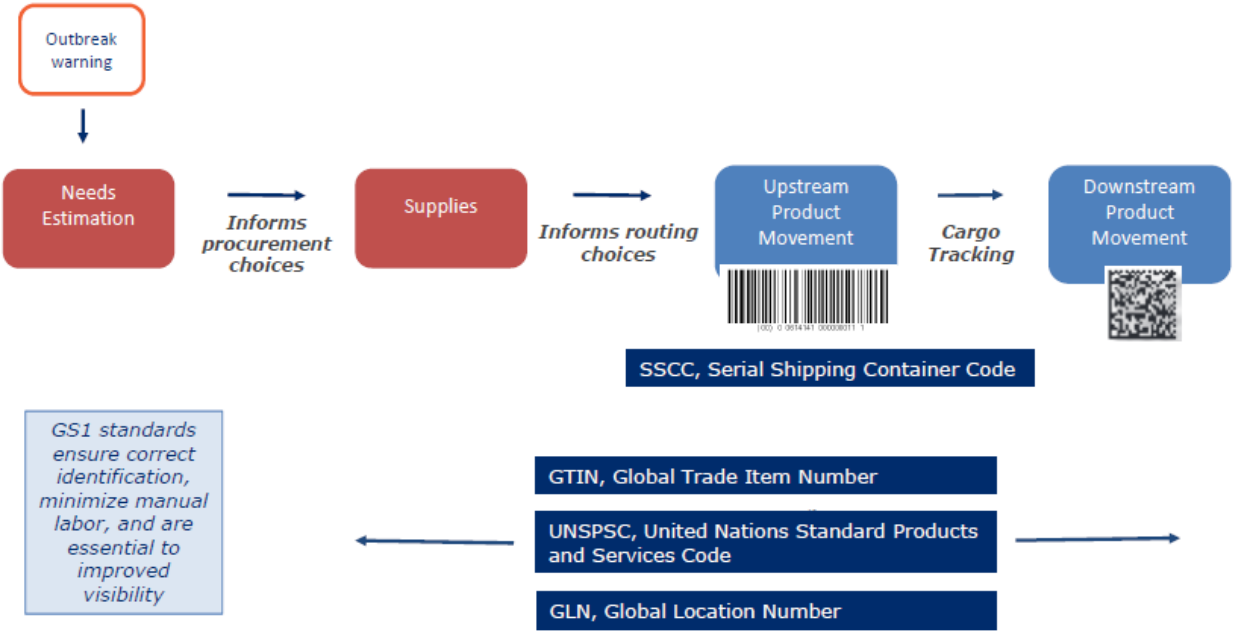

Figure A3: GS1 standards support speed, data accuracy and visibility in the supply chain

Interagency Supply Chain Group

The Interagency Supply Chain Group (ISG) promotes coordination both globally across programmes and locally through national leadership with the overall aim of improving the efficiency and effectiveness of in-country supply chains. The ISG is an informal partnership of 15 major actors involved in providing supply chain support to countries, including: the Bill and Melinda Gates Foundation, DFID, Global Affairs Canada, the Global Drug Facility, KfW, the Global Fund, Gavi, NORAD, UNDP, UNFPA, UNICEF, USAID, World Bank, WFP and the WHO. *"Since 2014, the international development community has promoted the use of global data standards (GS1) to provide a wider and harmonized framework for supply chain visibility, strengthening anti-counterfeiting measures and sharing of data between parties."* [61]

GAVI, the Vaccine Alliance

UNICEF and the World Health Organization (WHO) recognise benefits from harmonized global identification and serialization standards for vaccines, as this can improve visibility and traceability. The organisations are recommending the use of GS1 standards for vaccines. Since 2019 it is a requirement the use of GS1 standards for any vaccine tenders finance by GAVI.

"*GAVI, the Vaccine Alliance is planning to require GS1 data and barcode standards on the secondary package to improve product identification, labelling, and data exchange within the immunization supply chain. Starting 1st October 2019, for vaccine tenders backed by GAVI financing issued by UNICEF, it will be a requirement to have GS1 barcoding on the secondary packaging by latest 31 December 2021*."[62]

European Case Studies

ITAIDE Data Pipeline

In the European Union's ITAIDE research programme the piggyback principle is promoted, where customs can re-use high-quality data from businesses in the supply chain. This is because current data such as manifest, bill-of-lading etc. is not accurate enough for the advanced risk management needed in customs. Instead the piggybacking, by re-using business's own control data and business intelligence is proposed for customs/tax control purposes. Cases studies include food- and pharmaceutical supply chains, among others.

The book *Accelerating Global Supply Chains with IT-Innovation: ITAIDE Tools And Methods* gives an overview of all the trials under the ITAIDE initiative, and aims to show how innovations in IT can help global trade improve in terms of efficiency, safety and security.[63]

CASSANDRA

CASSANDRA is a European Union funded project addressing "*the supply chain visibility needs of both business and government in the international flow of containerized cargo. The main strategic goal is to enhance supply chain visibility to improve business operations as well as government's cross-border security inspections".*[64]

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[61] https://www.gs1.org/sites/default/files/docs/news/ISG_Position_Paper_GS1_August_2017.pdf
[62] https://www.unicef.org/supply/stories/gavi-announcement-vaccine-manufacturer-gs1-compliance
[63] Accelerating Global Supply Chains with IT-Innovation: ITAIDE Tools And Methods; Editors: You-Hua Tan, Niels Bjorn-Andersen, Stefan Klein, Boriana Rukanova), 2011
[64] https://cordis.europa.eu/project/id/261795/reporting

CASSANDRA stands for the Common assessment and analysis of risk in global supply chains, and it ran from June 2011 to May 2014 as part of the European Commission's Seventh Framework programme for Security. The project stressed the value of piggy backing which was a new approach for risk assessment for both business and government, which essentially means the reuse of business data and activities by Customs, and therefore making Customs risk assessment more efficient.

Specifically, CASSANDRA focused on supply chain visibility needs of business and government in the international flow of containerised cargo. The main strategic goal was to enhance supply chain visibility to improve business operations as well as government's cross-border security inspections. But also increasing flow of containerized cross-border trade, and growing emphasis on security. CASSANDRA's overall goal was to deliver stakeholder benefits for business with improved performance, for customs with improved efficiency and effectiveness, and general society by facilitating EU and global trade.

FENIX

The European Union launched its "Digital Single Market" strategy[65] in 2014. February 2020, the EU published its "Digital Strategy"[66] as a next step towards the Digital Single Market. These programmes invest significant funds in establishing better infrastructures to exchange information among all stakeholders in European Supply Chains (including MSMEs), in effect "Connecting Europe". The EU "Strategy for Data"[67] applies for the exchange of all kinds of data, including the data helpful for trade facilitation and the smooth flow of goods across borders.

Through funded projects involving many economic operators and authorities, the EU developed the concept of a "Federative network of platforms"[68]. The FENIX[69] project aims to deliver a federative network of platforms "To support the transition to seamless data sharing". This network will serve the European logistics community of shippers, logistics service providers, mobility infrastructure providers, cities, and authorities in order to offer interoperability between any individual existing and future platforms.

The European Commission's Digital Transport and Logistic Forum to create a viable federative network of platforms as enabler for B2A and B2B data exchange and sharing by transport and logistics operators inspired the FENIX project. The EU views this federative network of platforms as a "Commodity for data sharing in supply and logistics". These federative networks will also provide levels of trust and security that companies and organisations require to be able to join such a network of platforms (as illustrated in Figure A4). In effect, the federative networks would function as "trusted technology" among the users of this network.

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[65] https://ec.europa.eu/digital-single-market/en
[66] https://ec.europa.eu/digital-single-market/en/content/european-digital-strategy
[67] *https://ec.europa.eu/digital-single-market/en/policies/building-european-data-economy*
[68] *https://www.dtlf.eu/sites/default/files/public/uploads/fields/page/field_file/executive_summary2_reading__0.pdf*
[69] *https://fenix-network.eu/* (FEderated Network of Information eXchange in LogistiX)

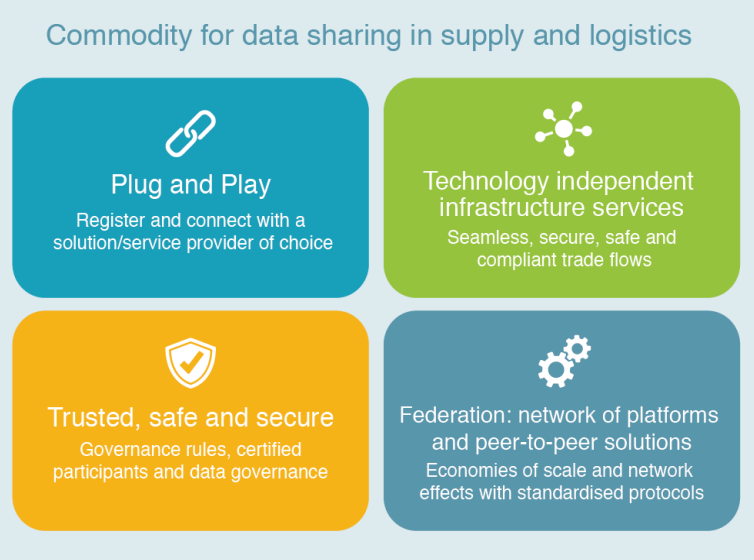

Figure A4: Four factors are contributing to data sharing in supply and logistics

To leverage platforms and initiatives such as the EU FENIX Federative network of platforms would be a means to securing the flow of (essential) goods also in times of crisis. Best practices (like FENIX) developed in one Region should be re-used in other regions because ultimately the physical flow of cargo is global and thus the flow of information should be global also.

PPE (Personal Protective Equipment)—EU Hackathon

The European Commission recently organised the EU vs Virus hackathon[70] A team under leadership of ALICE ETP[71] developed a solution/concept that they call CO3-VID.

The objective is to effectively and efficiently organise the distribution of PPE to all those that need them when we re-start non-essential activities (and even essential ones) in society again. PPE availability will be key to being able to rapidly re-start those activities safely (minimising the risk of the pandemic breaking out again).[72] The idea may be summarised as follows.

Bring stakeholders requiring PPE (Demand side) and manufacturers (Supply side) together in a collaborative environment facilitated by a neutral party (called the Trustee)[73] to determine the best way to allocate Available Supply with Actual (prioritised) Demand may be a good way to ensure availability of essential goods at the right place, at the right time, in the right quantities and in the right condition (safe and usable).

- The PPE distribution network may ensure essential (economic) activities will get priority in case the specific PPE may be in short supply and in situations with many normal transport / logistics networks (severely) disrupted
- The CO3-VID solution will also be based on (or at least totally support) implementation of global data standards (GDS) enabling the PI principles to be implemented in the PPE distribution network.

[70] https://euvsvirus.org/
[71] ALICE ETP is a not-for-profit organisation dedicated to the improvement of Transport & Logistics (based on Physical Internet principles). GS1 is a member of ALICE ETP
[72] See also this video:*https://devpost.com/software/co3-vid-collaboration-concepts-to-fight-co-vid*
[73] The concept for this kind of collaboration was developed in the EC-funded project CO3 http://www.co3-project.eu/

3M has used the capabilities of its pan-European distribution network (which are the same as the ones proposed in the CO3-VID solution) to ensure it has basically met all its commitments for OTIF (On Time In Full) delivery to its customers all over Europe regardless of the transportation disruptions that have occurred so far.

Asia-Pacific Case Studies

APEC Global Data Standards

Asia-Pacific Economic Cooperation (APEC) Leaders and Ministers have recognised that a wider use of global data standards can improve supply chain performance.

To enhance the understanding of the Global Data Standards (GDS) and its benefits, costs, and solutions to possible obstacles and challenges, a suite of pilot projects was conducted among APEC member economies to provide first-hand experience in global data standards to track the movement of selected products along APEC [74] supply chains. The supply chain included APEC member economies Australia, China, Hong Kong China, Malaysia, Mexico, Peru, and USA. The project leveraged GS1 identification standards embedded in barcodes as well as RFID, and data was shared via a data sharing platform using the GS1 EPCIS standard.

The pilot projects and the project report completed by the APEC Policy Support Unit (PSU) have demonstrated that global data standards could serve as an effective trade facilitation tool to improve supply chain performance by enhancing efficiency, integrity, visibility and innovation. It also strengthens institutional connectivity by contributing to better compliance by supply chain stakeholders and enhanced risk management of customs and border agencies in the APEC region. Yet, challenges to adoption remain, one of which is the lack of awareness among government of the possible uses and benefits.

APEC Model e-Port Network

Ports play an important role in the supply chain acting in the first place as a transportation hub as well as an information hub. Shippers and logistics operators need to be able to share information documents with operators and administrators of other ports to achieve “end-to-end” visibility. Thus, the APMEN Visualisation of Sea-Freight Logistics Project75was commissioned to improve the visibility, integrity and transparency of cross-border trade in the Asia-Pacific by automating the exchange of Sea Freight data between APMEN member ports using GS1 global data standards.

The pilot project aimed to develop comprehensive global data standards to support the exchange of critical sea freight data between ports, and other key process stakeholders including Freight Forwarders, Cargo Owners, Transport and Logistics providers and Government Agencies; Test these global data standards using a purpose-built testing platform based on EPCIS standards.

The exchange of critical sea freight data between ports can deliver benefits including greater transparency in container movements, improved planning of port operations through increased visibility, more efficient track and trace operations, better access to data for port management systems, and better customer service support to port community stakeholders.

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[74] Study on the Application of Global Data Standards for APEC Supply Chain Connectivity - Phase 1 <*https://www.apec.org/Publications/2017/02/Study-on-the-Application-of-Global-Data-Standards-for-APEC-Supply-Chain-Connectivity-Phase-1*> and Phase 2 <*https://www.apec.org/Publications/2017/11/Study-on-the-Application-of-GDS-for-Supply-Chain-Connectivity-Phase-2*>

[75] *http://mddb.apec.org/Documents/2019/CTI/CTI1/19_cti1_042.pdf*

APEC Ministers Responsible for Trade, reaffirmed the importance of the Asia Pacific Model E-Port Network (APMEN), in the Port Moresby Statement (2018). Ministers welcomed the progress of APMEN and encouraged economies to enhance cooperation and capacity building in this area.

APEC Supply Chain Connectivity Framework Action Plan

The APEC Connectivity Framework is targeting to *"To reduce trade costs across supply chains & to improve supply chain reliability in supporting the competitiveness of business in the Asia Pacific region"*.

APEC has recognised that global data standards facilitate international trade and increase the efficiency and predictability of cross-border trade procedures at national borders, which is something that could contribute to APEC efforts to ensure supply chain efficiency. This includes supporting the implementation of the current version of the APEC Supply Chain Connectivity Framework Action Plan II (2017-2020). Global data standards would especially support implementation of actions under chokepoint 1: Lack of coordinated border management and underdeveloped border clearance and procedures, and chokepoint 2: Inadequate quality and lack of access to transportation infrastructure and services.

The five chokepoints are the following:

APEC Supply Chain Connectivity Chokepoints	Approach
Lack of Coordinated Border Management and under-developed Border Clearance and Procedures:	MRA of AEO, Global data standards, National Committee on Trade Facilitation, SWS Interoperability.
Inadequate Quality and Lack of Access to Transportation Infrastructure and Services:	PPP, APMEN, multi-modal transportation.
Unreliable Logistics Services and High Logistical Costs:	e-payment systems, logistics services and work force development, SMEs.
Limited Regulatory Cooperation and Best Practices:	APEC Trade Repository, procedural and regulatory transparency in the development of trade-related policies.
Underdeveloped Policy and Regulatory Infrastructure for E-Commerce:	Create access to reliable and accessible shipping options for MSMEs, Establish streamlined customs clearance procedures for e-commerce.

APEC Life Science Innovation Forum Supply Chain Security Initiative

Comprehensive product quality and supply chain security requires a multilayer approach that includes prevention, detection, and response strategies and actions. To address the issue of substandard and falsified medical products, regulators, industry stakeholders, representatives from non-governmental organizations, international organizations, and academics came together to create the "APEC Roadmap to Promote Global Medical Product Quality and Supply Chain Security: Supply Chain Security Toolkit".[76]

This was a collaborative multi-year project commissioned by APEC with oversight by its Life Science and Innovation Forum (LSIF) and the Regulatory Harmonization Steering Committee (RHSC). The

[76] https://www.gs1.org/sites/default/files/apec_usfda.pdf

Supply Chain Security Toolkit is intended to cover the entire supply chain and life cycle of medical products (i.e. raw materials to use by patients) and focuses on developing— and implementing through training programs— processes, procedures, and tools directed at enhancing global medical product quality and supply chain security, including the application of global data standards. The Toolkit contains recommended best practices such as the use of global data standards and tools to prevents and detect substandard and falsified medical products before they reach the consumer and to efficiently respond to incidents involving substandard and falsified medical products. In addition, the Toolkit can be used in conjunction with the World Health Organization's (WHO) guidance on developing a plan for preventing, detecting, and responding to actions, activities, and behaviours that result in substandard and falsified medical products.

United States of America Case Studies

USAID Global Health Supply Chain Program (USAID-GHSC)

The United States Agency for International Development (USAID) has recognised the importance of global standards in delivering humanitarian goods more efficiently to recipients in need. Since 2018, the USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) seeks to further improve the "*health care experience in the communities through transformative supply chain solutions*."[77]

"Central to achieving this goal is the implementation and use of global supply chain standards (namely GS1) for product identification, location identification, and product master data. Thus, adoption of global standards has become a central part of the GHSC program to reduce costs, improve efficiency, and improve the availability of health commodities worldwide. "[78]

To aid trading partners, USAID has published comprehensive implementation guidelines. "*Endorsed by the Global Drug Facility, Global Fund, UNDP, UNFPA and USAID, the Global Standards Technical Implementation Guideline for Global Health Commodities is a resource developed for International Procurement Agency (IPA) trading partners to inform the implementation of global standards for product and location identification, labelling, and data exchange.*"[79]

At the end of 2019, GHSC-PSM launched phase 2 of the supply chain improvement programme. Phase 2 requires suppliers to publish their product master data to GHSC-PSM through the GS1 Global Data Synchronization Network (GDSN). GDSN allows real-time data sharing and updates on products among all participating trading partners. GHSC-PSM leverages best practices from other GDSN implementations, such as the Australia Health Purchasing Victoria. The programme is further recognising suppliers who are performing exceptionally well under the new rules on its website.[80]

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[77] *https://www.ghsupplychain.org/PSM*
[78] http://ghsupplychain.org/globalstandards
[79] "Global Standards Technical Implementation Guideline for Global Health Commodities," Version 2.1, March 2019, available at http://ghsupplychain.org/globalstandards
[80] http://ghsupplychain.org/news/gdsn-deadlines-go-live-top-performers-are-recognized-ghsc-psm

Appendix 2: Terms and Concepts

Name	Description
Electronic Product Code Information System & Core Business Vocabulary	The EPC Information Service (EPCIS) standard (ISO/IEC 19987) defines a data-sharing interface that enables supply chain partners to capture and communicate data about the movement and status of objects in the supply chain. The EPCIS specification provides technical standards, as well as a standardized set of service operations and associated data elements. In addition, the EPCIS standard also incorporates data standards for how to populate EPCIS data elements. (See Core Business Vocabulary below.) The Core Business Vocabulary (CBV; ISO/IEC 19988) provides data standards for populating EPCIS data elements. The CBV provides lists of acceptable values for how to express what business process was operating on an object and the status of the object upon exiting the process. It includes syntaxes, vocabularies, and element values (with definitions).
Electronic Data Interchange	Electronic Data Interchange (EDI) is the computer-to-computer exchange of business documents in a standard electronic format between business partners. GS1 EDI is a subset of the international EDI standard developed under the United Nations. It provides global standards for electronic business messaging that allow automation of business transactions commonly occurring across the entire supply chain. It covers master data alignment, order and delivery and financial settlement management, as well as transport and warehouse management. The main business partners in scope for this are retailers, manufacturers, material suppliers and logistic service providers.
GDS Master Data; National Product Catalogue; Global Data Synchronization Network	The Global Data Synchronization Network (GDSN) provides an efficient and effective approach to (1) storing GS1 Identifiers with their associated attributes, (2) checking to make sure that the identifiers and attributes are properly defined and formatted, and (3) sharing that information with supply chain partners. The GDSN is a network of interoperable data pools. The GDSN-certified Data Pools store and manage supply chain information for their users. The GDSN offers a continuous, automated approach to data management that ensures that supply chain information is identical among trading partners, increasing data accuracy and driving costs out of the supply chain.

Name	Description
Global Shipment Identification Number	The Global Shipment Identification Number (GSIN) is used for shipments comprised of one or more logistics units intended to be delivered together. The logistics unit belonging to a particular shipment keep the same GSIN during all transport stages, from origin to final destination. GSIN meets the WCO requirements for Unique Consignment Reference (UCR) and is compatible with ISO/IEC 15459 (part 6, grouping of transport units).
Serial Shipping Container Code	The Serial Shipping Container Code (SSCC) is the globally unique GS1 Identification Number used to identify individual logistic units (i.e., an item of any composition established for transport and/or storage that needs to be tracked individually and managed through the supply chain). SSCCs serve as "license plates" from the carton level to the trailer load level to facilitate simple tracking of goods and reliable look-up of complex load detail. SSCC is compatible with ISO/IEC 15459 (part 1, unique identifiers for transport units—the ISO Licence Plate).
Global Location Number	The Global Location Number (GLN) is a globally recognized identification number used to uniquely identify legal entities, trading partners, and locations in electronic commerce transactions. The GLN can be used to identify • a functional entity (like a hospital pharmacy or accounting department), • a physical entity (like a warehouse or hospital wing), or • a legal entity (like a health system corporation). The attributes defined for each GLN [e.g., name, address, GLN type, location type] help users to ensure that each GLN is specific to one unique entity within the world. A GLN Registry is the single source for location information, offering a comprehensive list of locations/legal entities with corresponding Global Location Numbers (GLNs). GLN is recognised in ISO Standard 6523 (International Code Designator for GLN is 0088).
Global Trade Item Number	The Global Trade Item Number (GTIN) is the globally unique Identification Number used to identify "trade items" (i.e., products and services that may be priced, ordered or invoiced at any point in the supply chain). GTINs are assigned by the brand owner of the product, and are used to identify products as they move through the global supply chain to the hospital, pharmacy, super market or ultimate end user. GTIN is compatible with ISO/IEC 15459 (Part 4, Individual Products and Product Packages).

Name	Description
Application Identifiers	GS1 Application Identifiers (AIs) are a finite set of specialized identifiers encoded within barcodes to indicate the type of data represented in the various barcode segments. Each AI is a two, three, or four-digit numeric code. (When rendered in human-readable form, the AI is usually shown in parentheses. However, the parentheses are not part of the barcode's encoded data.). Each data element in a barcode is preceded by its AI. For example, the AI for GTIN is 01. Thus, when "01" appears in the encoded content of a barcode, it means the next 14 digits comprise a GTIN. There are AIs for various types of information to enable supply chain partners to communicate item-specific information wherever the barcode is scanned (e.g., expiration date; lot number; batch number).
Data Carrier	A Data Carrier provides machine-readable representations of Identification Numbers that facilitate automatic identification and data capture. In order to accommodate a variety of environments and applications, the GS1 System supports a number of barcode symbologies (i.e., GS1 Barcodes) and two RFID tags [i.e., GS1 Electronic Product Code / Radio Frequency Identification Tags (EPC/RFID Tags)].
RFID tag and data content in shipping container identification	Different readers and tags will be used for different layers of the visibility system: In most cases passive UHF Gen 2 tags will be used. If active tags or HF tags are used, then different readers need to be installed for different tags. Tag commissioning is the process of associating an EPC with a particular object (product, shipment, asset or container). A tag may have been encoded and applied in this step, or may have been previously encoded. Cartons/Items: Tag issuance, cargo tagging and commissioning is the first key fundamental steps for cargo track and trace using EPC/RFID technology. Tag issuance is referring to the printing (labels) and encoding of tags. Tagging is referring to the process of slapping an RFID tag on to the cargo units. Cargo units can be a carton box, pallet unit or container etc. which requires track and trace visibility. Pallets: If pallets already have an EPC/RFID tag the tag should be read when the cartons are loaded on the pallet and the cartons aggregated to the pallets. If the pallets do not have an EPC/RFID tag the tag will need to be applied to the pallet and the tag commissioned.
XML Messages and Schemas	XML is a mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. An XML schema is a description of a type of XML document, typically expressed in terms of constraints on the structure and content of documents of that type, above and beyond the basic syntactical constraints imposed by XML itself. XML messages and schemas are used as open, standardised interfaces that allow for seamless integration of well-defined services in inter-party environments.

Name	Description
WCO Unique Consignment Reference	WCO recommended the creation of a Unique Consignment Reference (UCR) to identify cross-border shipments. The goal of the UCR was to provide Customs with a standard way of identifying unique shipments for effective risk assessment and audit-based controls. In turn, this would help Customs facilitate international trade. The World Customs Organization (WCO) published guidelines for the unique consignment reference (UCR) in 2004. These guidelines require the sender (consignor) of goods to identify physical grouping of several transport or logistic units to be identified with a single UCR. This UCR is used by customs authorities to identify these groupings of transport units when undergoing import or export processes. The UCR is an integral part of the customs declaration messages. The requirements to a complex scenario are that the UCR has to identify several transport or logistic units that travel under one single customs declaration (or dispatch advice). The GS1 Application Identifier that meets the WCO requirements is GSIN. The SSCC is the identification of a single logistic unit, The Shipment Identification (GSIN) identifies a grouping of such units. When storing the information in transaction files, users should foresee two different data fields. This should not be a problem because the two keys identify different things and therefore need to be stored in different places. The GS1 SSCC and GSIN can be used as a UCR number for Customs purposes. In fact, using the GS1 SSCC or GSIN would provide companies with enhanced traceability in international supply chains. Exporters, carriers, customs agencies, importers would benefit from: predictability of information, enhanced security and reduced compliance costs.

Name	Description
Single Window	The establishment of Single Window is championed by the United Nations, World Customs Organization (WCO), World Trade Organisation (WTO), and the Asia-Pacific Economic Cooperation (APEC) The international best practices for the development of Single Window can be found in, among others, the "Recommendation and Guidelines on Establishing a Single Window" by the United Nations Centre for Trade Facilitation and Electronic Business in 2005, WCO Compendium "How to Build a Single Window Environment" Volume 1: Executive Guide (2011)", as well as "Single Window Planning and Implementation Guide (2012)" by ESCAP. *"Single window is a single information technology platform for the submission of B2G documents for meeting regulatory requirements of trade in goods. The need for traders to approach different government agencies individually would be obviated. Information collected through the Single Window will be harmonised and standardised and shared between relevant government agencies electronically."*[81]

[81] Development of Trade Single Window in Hong Kong Consultation Paper (April 2016); *https://www.cedb.gov.hk/citb/doc/en/trade_single_window_consultation_paper_e.pdf*

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