GBBC
Global Blockchain
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STANDALONE REPORT

GLOBAL STANDARDS MAPPING INITIATIVE 5.0
DECEMBER 2024

THE FUTURE OF GLOBAL SUPPLY CHAINS

GBBC GSMI 5.0

GLOBAL BLOCKCHAIN BUSINESS COUNCIL

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GSMI 5.0 IN-DEPTH REPORT

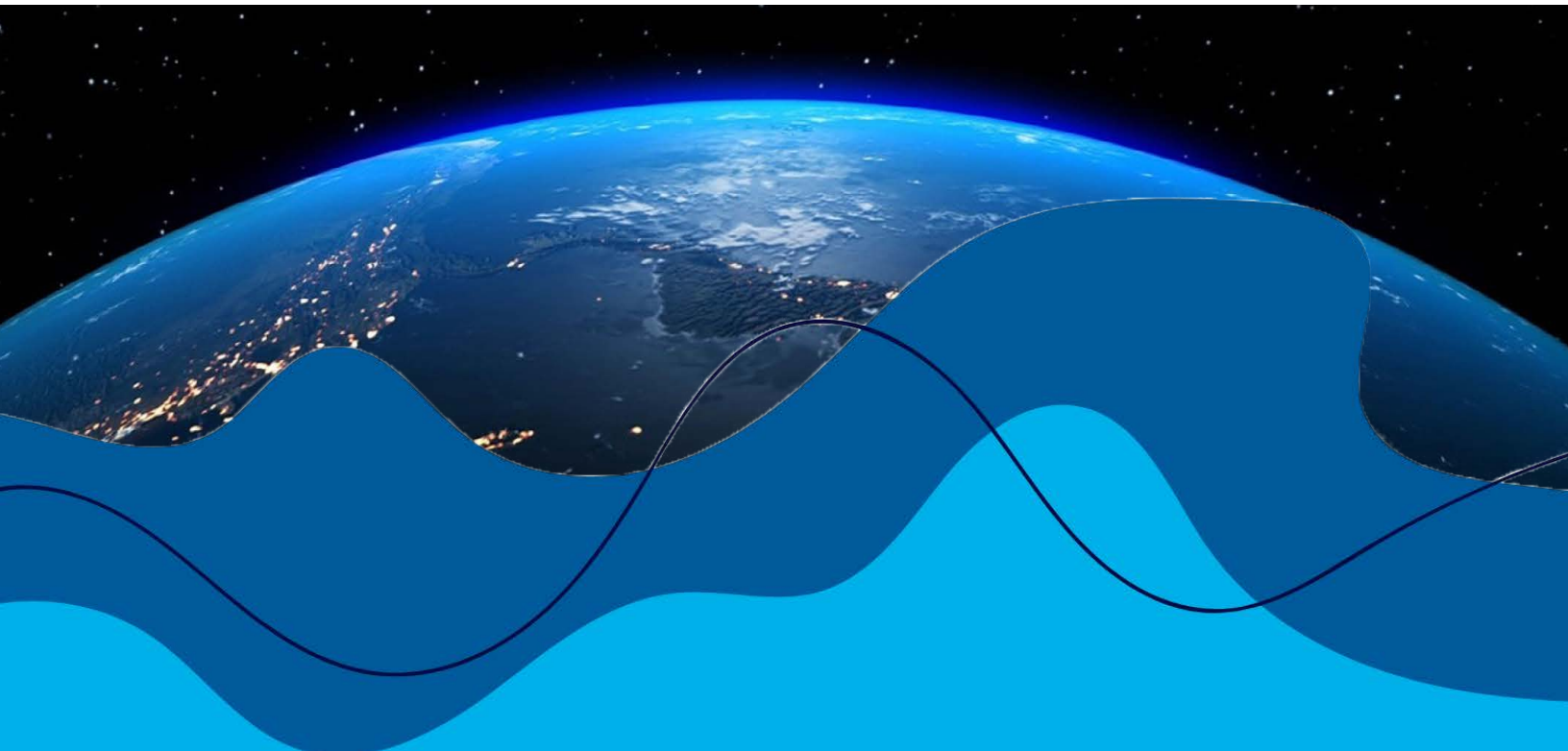
THE FUTURE OF GLOBAL SUPPLY CHAINS

GSMI 5.0 SUPPLY CHAIN – VISION

Our focus for GSMI 5.0 Supply Chain is from the International Space Station (ISS), e.g., from space. At this level, there are no companies, industries, or borders, and data knows no geographic borders. And yet, our standards entities have been built for centuries around just these items. The future of global supply chains is from this view, which will require harmonized, interoperable, and open standards, and will be a global digital ecosystem that seamlessly and instantly moves trillions of data elements around the world daily. The challenge? How do we get key stakeholders up to this level, so we can either:

1. Closely and quickly work to align the existing international standards entities currently each focused in their own lane, or,
2. Create a new digital trusted end-to-end and future-proof ecosystem.

We must simplify the processes of shipping, tracking, delivering, and returning goods, and we need to make it easy to use for all stakeholders and make financial sense. Today's systems, that are the best we have come up with so far, result in capital locked up, pollution, waste, delays, and vast resources, and they simply weren't designed at the truly global (ISS) level. This journey starts with harmonization and interoperability, which leads us to 'open' data standards, which leads us to



'digital' (including blockchain/Web3) and all of those are connected by centuries of network effects of trade, industrialization, and globalization that predict the inevitability of this outcome.

GSMI 5.0 SUPPLY CHAIN – EXECUTIVE SUMMARY

We believe that the future of global supply chains must depend on machine-verifiable (paperless) proofs to ensure the authenticity, legality, and origin of shipments. Achieving this vision requires standards that serve everyone—individuals, organizations, and nations—regardless of their size.

The purpose of this document is to evaluate the current landscape of global supply chain standards, assess our progress, and chart a path forward.

In our research, we identified over four hundred major standards organizations worldwide, collectively responsible for more than 60,000 published standards. While the volume of standards is not an issue, the challenge lies in understanding how they relate to each other, and determining which standards provide the best pathways toward inclusive and frictionless global supply chains.

A key initial contribution of this document is the distillation of over nine hundred data elements related to global shipments, drawn from the broad landscape of existing supply chain standards, into forty-eight fundamental data elements that capture the essential movement information. This simplification marks an important first step in harmonizing the data elements across standards. While key to pointing out the need for harmonization, it also became apparent that any such review of tens of thousands of standards in an attempt to harmonize would fail.

However, by pulling back out to the space level, our analysis focused on seventeen standards bodies that meet the World Trade Organization's (WTO) six criteria for global standards entities: transparency, openness, impartiality and consensus, effectiveness and relevance, coherence, and inclusion of developing countries. We evaluated these organizations based on their mission, industry focus, membership, number of published standards, and funding model. Our recommendation is to concentrate efforts on the ten standards organizations that provide open standards for digital documents, at no cost.

Data elements must be digital, so we also envision how digital identity, digital twins, sensors, blockchains and artificial intelligence can technically enable trusted and paperless global supply chains

BRIEF REVIEW OF GSMI 4.0 – SUPPLY CHAIN (2023)

To start, we used a simplified supply chain use case, where an everyday individual – let's call her Maria – ordered a gift online and, because it delivered late, had to figure out how to return it. With this initial Supply Chain effort, we started with an intentionally simplistic and normal example of something most people can do:

> ***'Maria ordered a birthday present online.'***

Unfortunately, the problem was that item arrived after the birthday party and Maria was thrown into the deep end of the global supply chain pool as she had to navigate trying to return it. What started as a simple example of a routine online purchase unfortunately turned into a late delivery, a

missed birthday gift, and then a return process that required navigating the complicated process of returning an international shipment.

What most people don't see in their everyday purchases is that when an item is initially purchased, there can be close to 50 steps to get that item from the website, across a border, to the point of delivery, and, as it turned out in our example, the reverse of that to get the item returned.

The working group then worked through the various modes of transportation, types of commerce, parties involved, data exchange, documentation, and, finally, the critical nature of the proxies of trust that have been used in these processes since trade began thousands of years ago.

Hundreds of data elements were identified involving the movement of goods, which were distilled down to about four dozen data elements most frequently used for global movement of goods, like shipper, receiver, broker, etc. Then, where possible, those items were mapped to their corresponding standards quickly pointing out that the standards could come from many different entities, and, in some cases, an entity pointed to another standards entity, making clear the case for harmonized standards in global commerce.

In this context, the International Chamber of Commerce (ICC) Digital Standards Initiative (DSI) has released Key Trade Documents and Data Elements (KTDDE), having published a parallel effort designated as the Minimum Data Elements. The standards body ASTM F49 also has a Committee for Essential Data Elements and has active work items that addressing the collection and normalization of common terms.

Table 1: Essential Data Elements for Global Movement of Goods

	Data Element	Description	Stan-dard	Free Form	Standard	Entity	WCO	DSI	OCB	CO	CI
1	Air Waybill/ Tracking #	Shipping document used for air cargo shipment that serves a contract between shipper and the airline, outlining the details of the shipment.	X		IATA 600a	IATA				X	X
					IATA 600b	IATA					
2	Broker	Intermediary who facilitates trade by negotiating transactions between buyers and sellers. In shipping, a customs broker assists with customs clearance.		X	UNTDED 3036	UNECE	X				
3	Buyer - Name	Entity or individual purchasing goods.		X	EDIFACT 3035	UNECE			X		

4	Buyer - Adress	Address for the entity or individual purchasing goods.		X	UNTDED 3164	UNECE			X		
5	Buyer - Trader ID (e.g., EORI)	Identifier of a party to which merchandise or services are sold.	X		EORI	EU			X		
6	Carrier	Organization or individual responsible for transporting goods from one location to another, such as an airline, shipping company or trucking company.		X	EDIFACT 3035	UNECE				X	
7	Commodity code (HS - Harmonized System code)	Standardized code from the Harmonized System used to classify products based on their nature and intended use.	X		WCO HS Code	WCO	X	X	X		
					UNTDED 7357	UNECE					
8	Consignee - Name (Buyer)	Entity or individual to whom the goods are being shipped or delivered.		X	UNTDED 3036	UNECE	X	X		X	X
9	Consignee - Address (Buyer)	Address of the entity or individual to whom the goods are being shipped or delivered.		X	UNTDED 3164	UNECE	X	X		X	X
10	Consignee - Contact info (Buyer)	Contact information of the entity or individual to whom the goods are being shipped or delivered.		X	UNTDED 3412	UNECE	X			X	X
11	Consignor/ Shipper - Name (Seller)	Entity or individual who is shipping or sending the goods.		X	UNTDED 3036	UNECE	X		X	X	X
12	Consignor/ Shipper - Address (Seller)	Address of the entity or individual who is shipping or sending the goods.		X	UNTDED 3164	UNECE	X		X	X	X

13	Consignor/ Shipper - Contact (Seller)	Contact information of the entity or individual who is shipping or sending the goods.		X	UNTDED 3412	UNECE	X		X	X	X
14	Country code/ Country of origin	Code representing a specific country.	X		ISO 3166	ISO	X	X	X	X	
					EDIFACT 3207	UNECE					
15	Country of export	Country from which the goods are being exported.	X		ISO 3166	ISO			X		X
					EDIFACT 3207	UNECE					
16	Country of manu-facture	Country where the goods were produced or manufactured.	X		ISO 3166	ISO					X
					EDIFACT 3207	UNECE					
17	Country of ultimate destination	Country where the goods are ultimately intended to be delivered or used.	X		ISO 3166	ISO					X
					EDIFACT 3207	UNECE					
18	Currency	Medium of exchange used for financial transactions	X		ISO 4217	ISO	X		X		
					EDIFACT 6345	UNECE					
19	Dimension	Size, measurements, or physical attributes of a product of package, such as length, width, and height.		X	UNTDED 6168	UNECE	X		X		
20	Export Reference #	Unique reference number or code associated with an export transaction for tracking and documentation purposes.		X	Free form	NONE					X
21	Exportation - Date (YYYY-MM-DD)	Date on which the goods are officially exported from one country to another.	X		ISO 8601	ISO					X
					UNTDED 2380	UNECE					

22	Exporter - Name	Entity or individual responsible for shipping goods from one country to another.		X	UNTDED 3036	UNECE			X	X	X
23	Exporter - Address	Address of the entity or individual responsible for shipping goods from one country to another.		X	UNTDED 3164	UNECE			X	X	X
24	Exporter - Contact info	Contact information of the entity or individual responsible for shipping goods from one country to another.		X	UNTDED 3412	UNECE			X	X	X
25	Full description of goods	Detailed and comprehensive description of the products being shipped, including their characteristics, quantity, and specifications.		X	UNTDED 7008	UNECE			X	X	X
26	Goods Passport ID (GPID)	Unique identifier or code for tracking and tracing specific goods.		X	Open Customs Blockchain	OCB			X		
27	Gross Weight (kg) / Total weight	Total weight of the goods, including their packaging and any other materials.		X	Int'l System of Units (SI)	ISO		X		X	X
28	HS Subheading Code (Commodity Code/ Binding Tariff Reference ID)	More detailed level of classification within the Harmonized System, providing a specific code for certain types of products.	X		WCO HS Code	WCO			X		
					UNTDED 7140	UNECE					
29	Importer	Entity or individual responsible for bringing goods into a country from another.		X	UNTDED 3036	UNECE	X				

30	Invoice - Number	Unique identifier for the commercial invoice associated with a shipment.		X	UNTDED 1004	UNECE	X	X	X		
31	Manufacturer	Entity or individual responsible for producing or manufacturing the goods.		X	UNTDED 3036	UNECE	X				
32	Net Weight/ Net Mass	Weight of the goods after deducting the weight of packaging and other materials.		X	Int'l System of Units (SI)	UNECE			X		
33	Owner	Legal entity or individual with ownership or legal rights over the goods.		X	UNTDED 3036	UNECE					
34	Payer	Entity or individual responsible for making payments related to the shipment, such as freight charges or customs duties.		X	UNTDED 3036	UNECE	X				
35	Pieces/ Number of packages	Quantity of individual items or packages being shipped.		X	UNTDED 7224	UNECE				X	X
36	Preferential origin	Country where the goods qualify for preferential tariff treatment under a trade agreement.		X	ISO 3166 EDIFACT 3207	ISO UNECE			X		
37	Quantity (# of items)	Number of amount of a specific item or product being shipped.		X	ISO 7372 UNTDED 6060	ISO UNECE			X		X

38	Seller - Name	Entity or individual selling the goods.		x	UNTDED 3036	UNECE			x		
39	Seller - Address	Address for the entity or individual selling the goods.		x	UNTDED 3164	UNECE			x		
40	Seller - Trader ID (e.g., EORI)	Identifier used in the EU for economic operators engaged in international trade, including importers, exporters, and customs agents. The EORI is a unique code assigned to facilitate customs procedures and ensure smooth and efficient trade within the EU.	x		UNTDED 3036	EU			x		
41	Sequence number	Unique numerical or alphanumerical identifier used for tracking and reference purposes.		x	UNTDED 1050	UNECE			x		
42	Ship date	Date on which the goods are shipped or dispatched.	x		ISO 8601	ISO				x	
					UNTDED 2380	UNECE					
43	Terms (F.O.B., C&F, C.I.F.)	Standardized trade terms that define the responsibilities and obligations of the buyer and seller.	x		EDIFACT 4053	UNECE	x				x
					INCOTERMS	ICC					
44	Total invoice value	Total value of the goods as indicated on the Commercial Invoice (CI).		x	ISO 4217	ISO	x	x	x		x

45	Transport document number	Unique identifier associated with the document used for shipping and transporting goods.		X	UNTDED 1004	UNECE		X			
46	Type of packaging / Handling Units	Specific packaging or packaging materials used to contain and protect goods during shipping.		X	EDIFACT 7065	UNECE	X	X			X
47	Unit of measure	Standard unit used to express the quantity or measurement of goods, such as kilograms, liters, or pieces.		X	Int'l System of Units (SI)	UNECE					X
48	Unit value	Value of a single unit of a product (e.g., the cost per kilogram or per item).		X	ISO 4217	ISO					X
					INCOTERMS	ICC					

Key Words

- **WCO - World Customs Organization**
- **DSI - Digital Standards Initiative**
- **OCB - Open Customs Blockchain**
- **CO - Certificate of Origin**
- **CO - Certificate of Origin**

"While thousands of years of trade have led us to the global supply chain of today, blockchain and emerging technologies are leading us to a future where paperless trade can become a reality, transforming industry and regulatory processes, and entire industries. That is why GBBC's BITA initiative has come to fruition, bringing together major global logistics and transportation stakeholders to thoughtful adoption of Web3 innovations toward a new generation of global commerce that can finally adopt an "International Space Station" view. BITA is working as a global harmonizer for open data standards in global commerce."

INTERNATIONAL SPACE STATION VIEW ON STANDARDS

In the process from buying to shipping to payment for any item, there are vast amounts of documentation exchanged. Standards are meant to facilitate global commerce through harmonization of processes. There are over four hundred major standards organizations worldwide, when combining international (about 10-20), regional (about10-15), national (about 160 – many are National Representative bodies of International Groups), and industry specific (several hundred). Just from the international standards entities, we have approximately 60,000 published standards. It is important to note, we are not lacking for published standards. We are lacking in harmonized, interoperable, and open standards with a truly global, particularly a global commerce, focus. We are also lacking in the language, or data-organization that can harmonize standards.

We will later discuss the definition of a standard, and the six principles set by the World Trade Organization (WTO), as requirements for global standards entities. Out of the vast landscape of standards bodies, the working group identified that there are currently less than twenty standards organizations that rise to that WTO level, meaning that they can be considered to meet the six principles for global standards. These are the entities we will review and compare in later sections. Those entities represent more than 150 years of 'standards' development, during which the world has continually evolved, including massive changes in technology. One thing immediately clear is that each of those entities has done excellent work, and they were each created for a specific reason, staffed by committed leaders in the industry.

When it comes to global harmonization, there historically has been little focus on overlaps at that International Space Station level. The goal at hand is to align silos of the standards world in support of open, interoperable, and harmonized global standards for international commerce.

With this review, it is also becoming clear that there are a couple of splits taking place in the international standards arena:

- There is a division between 'legacy,' (paper/document) vs. 'digital' (post-document), e.g., for global commerce, the 'legacy' could be thought of as the rear-view mirror, and the 'digital' could be considered the windshield.
- There is also a division between fee-based standards entities and those entities which have opened their standards for use by all. As we explore the need for harmonization, it leads us to the critical importance of 'open' (non-fee-based) standards. For true harmonization, interoperability, integration, speed, and reduced friction in global commerce, what will scale globally is open standards.

Once we get to 'open,' this really becomes a discussion about 'digital,' which is to say, a post-document (paperless) global supply chain. Many systems today utilize AI-enabled Optical Character Recognition (OCR) solutions to digitize documents and data entries While helpful to automate, simply translating a data element from a paper document into a digital format might be a step in the right direction, it doesn't connect directly to the source of that data. When data elements from existing documents can be identified down to the source, we will evolve beyond the dozens and hundreds of movement documents we have used for millennia as proxies for trust, and then we can rethink (digitalize) the processes. Once we digitize, we also get to things like digital identity, blockchain, sensors, AI and other existing and yet-to-be-developed critical emerging technologies that will transform global supply chains in the future. Open is also achieved by a decentralized, shared environment of digital data called blockchain.

Standards are an important piece of streamlining global commerce; however, there are other key components that have brought us to this point and will take us forward. Standards propel a 'network effect' which is also a key part of this discussion. Network effects have been seen before in many ways, from the earliest days of trade to the Industrial Revolution, to Globalization in the 20th Century, to now the Digital Revolution and beyond. The role we all play in embracing the global nature of what got us here, and the key impact of technology moving forward, is critical. From the space viewstandards, technology, and emerging governance models, along with existing government and regulatory components, must work for all parties, public and private, large, and small, and they must be both open and interoperable.

HISTORICAL PERSPECTIVE: WHAT IS A 'STANDARD'?

Standards have been around since the Egyptians (~3000 BCE), they exist in every aspect of our society and is it inevitable that we must work together on open, harmonized, and interoperable standards for global commerce to continue to scale with emerging digital technologies. The discussion of 'Standards' is the first specific reference of 'network effect,' but we will revisit it in other areas of this work.

Just to put a definition out there for context for this effort, standards are a formalized set of guidelines, technical specifications, or established criteria designed to ensure consistency, safety, quality, and interoperability across a given activity, product, or process.

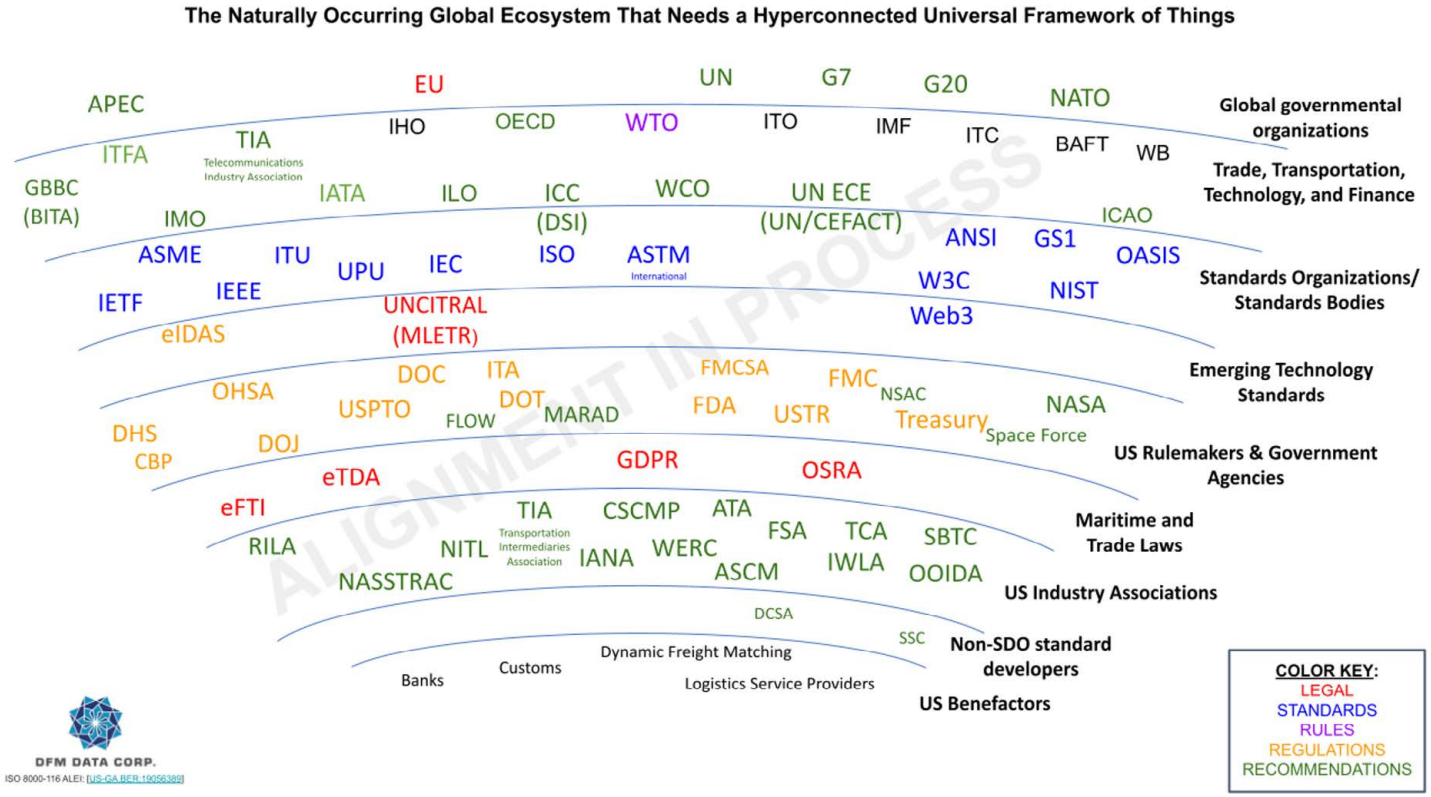
One of the earliest standards was in Egypt thousands of years ago and was the length of the forearm from elbow to the tip of the middle finger, called a 'cubit,' and it helped to standardize construction of the pyramids and other things in ancient Egypt. As society and technology developed, we then saw standardization of commercial transactions, weights, and measures in Babylon (~1750 BCE), road construction in Rome (~500 BCE), quality standards by guilds in Europe (12th century), and the metric system in 1799. By the mid 1800's, we saw standards for railroad track width, and the early 1900's brought us airline and automotive industries and standards, and now we chronologically overlap with the current International Standards Development Organizations (ISDO).

Of the group of ISDO's we will review, the International Telecommunication Union (ITU) was established in 1865, and then we see the Universal Postal Union (UPU) in 1874, and, over the next century or so, the others in our review were established including the International Standards Organization (ISO) in 1947, all the way to UN/CEFACT in 1996. Multiple entities like these were established during and after WWII (ICAO-1944, IATA-1945, ISO-1947, IMO-1948, WCO-1952).

Standards have always reflected the time, measuring the length of a typical arm – cubit – in ancient Egypt, to increasingly sophisticated uses around railroad track width 150 years ago, to safety and interoperability, to currently envisioning a document-free (paperless, digital) global supply chain. The network effect is such that each additional user makes the network more valuable to all existing users, and the associated reduction in friction leads to the inevitability of open and interoperable standards for the global supply chain on the horizon.

STANDARDS LANDSCAPE TODAY

The international standards community has spent a great deal of time mapping the various standards globally, as well as effective governance models to coordinate standards bodies. Below is a standards map referred to as 'The Onion,' produced and developed through collaboration in the DFM Data Corp Transport Unit Identifier (TUID) Working Group. This shows the various layers of standards entities and gives us a visual sense of these entities along with our International Space Station analogy. We will be focusing on the international standards entities in the third layer from the top (Standards Organizations/Standards Bodies) and those entities just above that line.



- Like a view from the ISS, this graphic starts at the global organizations level with ITFA, EU, G7, G20, WTO, UN, and NATO, which leads us to trade, transportation, technology, and finance entities.
- We then get down to our current focus area of International Standards Development Organizations, such as IEEE, ISO, etc.
- Next is Emerging Technology Standards, and then we get to additional layers around US Rule makers & Government Agencies, Maritime Laws, US Industry Associations, and Non-SDO Standard Developers in the US.

Even with this graphic doing its best to categorize these key entities, it is still apparent that each of these entities was created separately, over the last 150 years, all with acronyms we may or may not be familiar with, and this is an incredibly fragmented discussion around standards. Each of these entities tried to make sense (through standards) of an industry or country or type of movement (Customs, etc.), or other segments. They are all excellent examples of 'Best in Class' over the last 150 years, but at the ISS level, we see dozens of these across industry and geography with little to no common focus around open and interoperable global movement, such as what we currently see in e-Commerce (B2C, Business-to-Consumer) examples. We saw this extremely fragmented view at its worst during the Covid pandemic where a product wasn't on the shelf, or ships were stuck at a port, etc., which exaggerated the already elevated levels of friction (documents, resources, delays) to move products across borders. What we need is a global commerce focus on standards, and not just any one industry or segment, and it must embrace harmonized, interoperable, and open digital standards. Some international standards entities created after WWII are a snapshot of what supply chains looked like 75 years ago, prior to the 'digital' discussion, or even the internet.

KEY INTERNATIONAL STANDARDS DEVELOPMENT ORGANIZATIONS

The six **WTO/TBT (Technical Barriers to Trade)** principles required for global standards entities, which encompass what a standard should convey, are the following:

1. **Transparency:** All essential information regarding current work programs, as well as proposals for standards, guides, and recommendations under consideration and progress reports on the work programs, should be accessible to all interested parties.

2. **Openness:** Membership of an international standardizing body should be open on a non-discriminatory basis to relevant bodies of at least all WTO members.

3. **Impartiality & Consensus:** All relevant bodies should be provided with meaningful opportunities to contribute to the development of international standards, guides, and recommendations. The procedures should not give privilege to, or favor the interests of, any particular supplier, country, or region.

4. **Effectiveness & Relevance:** International standards need to be relevant and effectively respond to regulatory and market needs, as well as scientific and technological developments.

5. **Coherence:** In order to avoid the development of conflicting international standards, it is important that international standardizing bodies avoid duplication or, or overlap with, the work of other international standardizing bodies.

6. **Development Dimension:** Constraints on developing countries' effective participation in standards development should be addressed. The development dimension should be taken into consideration in the development of international standards.

Using these principles as a reference in addition to the Onion graphic above, a deeper dive into the key International Standards Development Organizations relevant for global supply listed is illustrated below. These organizations are listed in chronological order of when they were established.

Collectively, they represent approximately 60,000 standards, or the equivalent (ILO 'conventions,' UN/CEFACT 'recommendations' included).

With the goal of identifying common concepts across standards, the working group assessed the purpose of these standards in terms of what they are meant to accomplish, along with the portion of "movement" covered by them, based on the common data elements identified for all physical shipments (e.g., import/export, customs, sellers/buyers, point of origination, point of destination, etc.), industry focus, and level of adoption as defined by global presence and number of standards. Importantly, these standards entities were analyzed based on whether they offer freely available or open-source standards, as opposed to a more traditional model of selling access to standards for a fee. This led to an assessment of alternative revenue models for those entities that make their standards freely available. Standards setting entities were also categorized for being traditional document-based or digital-first.

Table 2: International Standards Development Organizations Reviewed

Organization	Year Esta-blished	Mission/ Purpose	Industry	# of Members	# of Standards	Fee-based or Open Standards	Document or Digital-based Standards	Link
ITU - International Telecommunication Union	1865	Coordinate global telecom standards, spectrum management	Telecommu-nications	193 Member States	4,000+	Open	Document, Digital	ITU
UPU - Universal Postal Union	1874	Foster the global postal system	Postal services	192 Member States	~200	Open	Document	UPU
ASME - American Society of Mechanical Engineers	1880	Advance engineering standards and practices	Engineering, (Mechanical)	~90,000	~600	Fee	Document	ASME
ASTM International - (Originally, American Society for Testing and Materials International)	1898	Develop and deliver voluntary consensus standards	General Idustry	30,000+	~12,800	Fee	Document	ASTM

IEC - International Electrotechnical Commission	1906	Develop international standards for electrical and electronic technologies	Electro-technology	~170 countries	~10,000	Fee	Document	IEC
ILO - International Labor Organization	1919	Promote labor standards, decent work, and social protection	Labor & Employment	187 countries	190 conven-tons	Open	Document	ILO
ICC - International Chamber of Commerce	1919	Develop international business standards and promote global trade	Global trade	100+ countries	~100	Fee	Document	ICC
ICAO - International Civil Aviation Organization	1944	Develop and enforce international civil aviation standards	Aviation	193 countries	~12,000	Fee	Document, Digital	ICAO
IATA - International Air Transport Association	1945	Represent and serve the airline industry through standards	Aviation	~300 airlines	~100	Open	Document	IATA
ISO - International Organization for Standardization	1947	Develop and publish international standards for a wide range of industries	General industry	167 countries	~24,000	Fee	Document	ISO

IMO - International Maritime Organization	1948	To set standards for the safety, security, and environmental performance of international shipping	Maritime	175 countries	60 Conventions	Open	Document	IMO
WCO - World Customs Oganization	1952	Develop global customs standards for the international trade	Customs	183 countries	Multiple	Open	Document	WCO
IEEE - Institute of Electrical and Electronics Engineers	1963	Foster technological innovation and excellence	Electrical, electronics, IT	~425,000	~1,300	Fee	Document	IEEE
GS1 - (Originally, Global Standards 1)	1973	Develop global standards for business communication	Retail, supply chain	115 national chapters	~150	Fee	Digital	GS1
IEEE - Institute of Electrical and Electronics Engineers	1963	Foster technological innovation and excellence	Technology	~425,000	~1,300	Fee	Document	IEEE
GS1	1974	Develop global standards for business communication	Supply Chain	115 National Chapters	~150	Fee	Digital	GS1

IETF - Internet Engineering Task Force	1986	Develop voluntary internet standards	Internet	Open community	~1000	Open	Digital	IETF
OASIS - Organization for the Advancement of Structured Information Standards	1993	Promote the development of open standards for the global information society	Information Technology	~600 organizations	~150	Open	Digital	OASIS
W3C - World Wide Web Consortium	1994	Develop open web standards	Web Technology	~450 Members	~500	Open	Digital	W3C
UN/CEFACT - United Nations Centre for Trade Facilitation and Electronic Business	1996	Develop trade facilitation recomm-endations and e-business standards	Trade facilitation	~60 counties	Multiple recomme-ndations	Open	Digital	UN/ CEFACT

INITIAL TAKE-AWAYS:

- Ten of the seventeen entities analyzed have 'open' standards.
- Seven of the seventeen entities are 'digital-based' standards, and six of those seven have open standards.
- Chronologically, all but two that are digital (5 of 7, all since 1971) are the most recent entities established (GS1-1973, IETF-1986, OASIS-1993, W3C-1994, UN/CEFACT-1996). There are two exceptions:

1. ITU, which started in 1865 with telegraph and related document-based standards, but as the technology advanced in the 1980's, started developing digital-based standards, and,
2. ICAO, which started in 1944 in the civil aviation standards space with document-based standards around regulatory and operational aspects of aviation, but in the 1990's started developing digital standards for digital navigation systems, e-passports, etc., and now their standards are both document-based and digital-based, according to the type of standard.

- The most recent four standards entities established chronologically (IETF-1986, OASIS-1993, W3C-1994, UN/CEFACT-1996) have standards that are both open and digital.

There are two recent items of note where we are starting to see some early alignment between more than one of these entities. In July 2024, UNECE (the parent organization of UN/CEFACT) and the ICC Digital Standards Initiative (DSI) called on the industry to accelerate the adoption of globally interoperable standards essential for achieving digital trade worldwide. In August 2024, ISO, IEC and ITU announced the coordination of publishing a monthly document that lists all work items from the three organizations including updates on the projects and timelines from the technical committees' work (link).With the major global standards entities discussed above, which set the basis for harmonization from their large scope and global adoption, there has also developed a hierarchy in the standards setting world. Generally, standards setting bodies that cover a broader range of data elements across the journey of movement from origin to destination, set a point of reference for other smaller and more narrowly focused standards setting initiatives. In a traditional model where standards are made available for purchase, those organizations that purchase standards are expected to commit to following those standards. In addition, auditors and certifiers who validate other organizations' compliance with standards must also purchase these same standards.

On the other hand, models that offer open-source standards may be more dynamic, providing tools for end users to configure data elements based on their own needs (e.g., different shipment types). Open-source standards may also increase users' ease of adopting standards across the supply chain:

- Sellers may assign common data elements to product at the point of export, which customs authorities may refer to at the point of entry
- Initial sellers' compliance with a standard facilitates compliance at the level of resellers, labeling companies, and larger marketplaces
- Open-source standards may also facilitate auditing and verification processes to ensure compliance with the standard, reducing the risk of manipulation of information or erroneous classification
- Global standards that are openly available will facilitate compliance across complex supply chains.[1]

When standards are made freely available, revenue models may also shift toward charging for additional documentation or services, different forms of membership fees, or public funding. This points to the shifting trend in standards models introduced above, which is taking place and will be essential for harmonizing and scaling tech-based solutions for global supply chains. This trend favors open-source rather than fee-based standards models, with digital-first (post-document) rather than paper-based models.

HARMONIZATION/INTEROPERABILITY

The initial models of standards as we know them started in Egypt, and in the thousands of years since then, standards have dramatically expanded in many ways, to include geography, industry, and technology. Yet, for the most part, once a standards entity exists it stays in its lane, so if the focus is customs, or aviation, etc., that tends to remain the focus. This has worked extremely well to map out and develop key standards in many fields as outlined in the entities we reviewed, but it doesn't account for the world of today from the International Space Station viewpoint. That is why we started this GSMI 5.0 Supply Chain effort with a view from space as our default position. Rather than building each entity out one step and one standard at a time (essentially, process improvement), looking at the global view makes it apparent that all of this will have to come together (breakthrough

thinking) to truly lean into the digital world that exists today and tomorrow, and that leads us to harmonization and interoperability. The sooner we align on the inevitability of this global view, and what that means for harmonization and interoperability, the sooner we can all work together to accelerate into that space for the benefit of a much more streamlined global supply chain.

Currently, much of the world moves at the physical speed of items, be that by water, rail, road, air, or a combination of those (multi-modal), including the paper documents we use as proxies for trust like Commercial Invoice, Bills of Lading, etc. However, critical emerging technologies promise a future where the key trusted elements from those documents we have used for millennia will move digitally and at the speed of data, and well ahead of the physical items they represent. One example would be that customs agencies and others in the supply chain could access secure data from trusted sources (verifiable credentials, etc.) to analyze and optimize that data, and, under some set of circumstances, could significantly reduce or even eliminate the traditional 'port of entry' concept, since these are known items from trusted sources. That single example helps envision the transformative nature of this technology to completely rethink global supply chains.

To accomplish that, we must bring the standards entities together at that ISS level view, so we accelerate harmonization of standards and interoperability of processes. That means aligning different standards to ensure they are compatible and can work together globally, which is essential in a world where businesses and supply chains routinely operate across borders. Where we can reduce friction across borders, we all win, and global commerce can significantly speed up. Interoperability is the goal here, where different systems, products, or services can exchange and use information seamlessly. Harmonization ensures that various local or industry-specific standards don't become isolated silos but are a part of a larger, integrated global system.

Harmonized, interoperable standards create smoother, more scalable global systems and reduce compliance costs for businesses, accelerating participation in global trade.

INTERNATIONAL COOPERATION AND REGULATORY PROGRESS

Regulatory developments today are also favoring progress toward global harmonization of standards for digital trade. Legislation may be needed to ensure support of standards, with adequate educational resources and frameworks in place to facilitate adoption. For example, the United Nations Commission on International Trade Law (UNCITRAL), which operates as a subsidiary of the UN General Assembly, has adopted a Model Law on Electronic Transferable Records (MLETR), which introduces a legal framework to allow electronic documentation to be adopted instead of paper-based documentation. Legislation related to logistics at a national level, in turn, must align with MLETR as an international framework.

The aim of MLETR is to facilitate paperless trade, through a legal environment that supports the recognition of electronic documentation as legally valid when functionally equivalent to the paper-based version of such documentation. The aim is to facilitate and expand the adoption of electronic documents at a domestic and international level. This requires supporting the increasing acceptance and use of emerging technologies including blockchain, with capabilities such as smart contracts, and data capture from Internet of Things. MLETR promotes the acceptance of electronic formats for documents including bills of lading, bills of exchange, promissory notes, and warehouse receipts, which are equivalent functionally to other transferrable formats. It recognizes the benefits of digitalization over paper-based processes for trade including faster processing, increased

security, sustainable practices in going paperless, and facilitation of inclusion for small and medium enterprises.

The international community will benefit from continued efforts to advance harmonization and interoperability, including:

- Calls to action for global adoption of unified standards for digital trade
- Open-source repositories of key trade documents, data elements, and reference data models for global transportation
- Development and maintenance of a business standard that can be applied at a national and regional level across administrations and industries
- Open-source data sets to be used for global regulatory developments supporting digital trade
- Legislation may be needed to ensure support of standards, with adequate educational resources and frameworks in place to facilitate adoption

OPEN STANDARDS

Harmonized and interoperable global data standards are necessary, are a huge step forward, and are both a grand aspirational goal and a necessity. However, back to our view from space, harmonized and interoperable data standards are just one step in the inevitable journey to create and optimize the global economy and global supply chains of the 21st century, and beyond. The next step for scale is the need for open data standards.

Traditional standards models were built around B2B (Business-to-Business), with a cost of entry for memberships, access, contributions to standards development, etc. At that time, there was little effort to focus on what is now known as e-Commerce (B2C), which generally refers to the online sale and shipment of items of minimal value, and which is currently a revenue engine in many economies. Even some Customs agencies currently have lesser requirements for that low-value **(***di minimis*, for example, <$800 USD) product to be imported, though that is starting to change. While all the entities reviewed are government agencies or 'Not-for-Profit,' all do have a revenue model. All seventeen entities generate their revenue in multiple ways, including charging for the use of their standards, membership fees, consulting services, sales of publications, training, etc., and UN agencies are funded by member states. However, those with open standards (10 of 17) do not charge for the use of their standards and gain their revenue in other ways.

While, viewed through multiple centuries of evolution, the current international standards entities each helped us get to where we are today, current and future types of commerce (B2B, C2C – Consumer-to-Consumer, aka, Peer-to-Peer, etc.) and digital and decentralized technology drive the inevitability of international movement standards needing to be open. The result will reduce friction and cost across borders, and will function as an accelerator for global commerce, to include the speed of movement. The earlier customs example where, based on trusted data moving ahead of the physical movement and approved to cross a border and resulting in no port of entry is a good indication of the difference between current processes compared to what will be much quicker global movement across borders. Current 'fee-based' standards function as 'toll gates' for global commerce activity, and while they have helped us get to where we are today, charging for standards won't help us realize the 'breakthrough thinking' moving forward of truly optimized movement at the global level.

The shift to B2C, C2C, etc., puts those membership models at risk. Where previously paying for a standard could be considered 'the cost of doing business' for large entities, increasingly, not only with the shift to B2C/C2C but also with technology advances allowing for decentralized, trusted, and more inclusive models, legacy standards entities may face the choice between becoming obsolete or transitioning to an open model for their standards to stay relevant. Charging a large entity for the use of standards may have worked for a period, but a current or future small start-up or lone entrepreneur is unlikely to be able to afford that, effectively suppressing growth globally in that type of small business. The vast majority of global businesses and employers are small and medium enterprises, and standards are essential to access global markets and increase competitiveness. Of note, IATA (est. 1945) and WCO (est. 1952) have each opened their standards recently, both of which used to be fee based, so precedence has been set.

Open standards are a key accelerant in this process. They democratize access to global trade and digital ecosystems, allowing small, medium, and large enterprises to participate without artificial barriers.

THIS IS REALLY A 'DIGITAL' DISCUSSION

Digitization of Data Elements for Movement

Now that we have harmonized, interoperable and open data standards for global movement, we finally get to the key point, which is digitizing key data elements for traditional movement documents and other key processes. This is literally -the- moment in human history where, since the start of what we originally called 'trade' (~3,000 BCE), physical items (clay tablets, papyrus, parchment, and, finally, paper) have been used as proxies for trust, moving forward the future of the global supply chain is digital. Yes, of course, there will still be physical movement, but by creating trusted and secure digital data elements surrounding that movement, we now move into a paperless (post-document) global supply chain. The ability for those key data elements about a shipment to move ahead of the physical shipment and at the speed of data will transform everything we know of global movement in all modes (water, rail, road, air, multi-modal). Once those data elements are digitized, we can and will completely rethink (digitalize) those processes, reinventing many aspects of how global supply chains operate.

When we now think of a 'digital' global supply chain, it creates a portal into multiple current and emerging technologies that will be equally transformative in this space, including digital identity, blockchain, sensors, AI, etc.

Digital Twins

An example of the value of digitization is a 'digital twin,' which is a virtual representation of an object or system designed to reflect a physical object accurately. For example, it can represent a physical package and track its trajectory, providing real-time data on the status of any given shipment. It also spans the object's lifecycle, is updated from real-time data, and uses simulation, machine learning and reasoning to help make decisions. By digitizing that data, all aspects of that physical item can be broken into distinct processes, from manufacture to movement, to sale, to resale, and so forth, and can therefore be tracked and managed accordingly, potentially into micro data and/or revenue streams.

The signed feature of blockchain capabilities, through verification, adds trust to the process. Digital twins of real-world assets are signed and verified, preserving the attributes of what makes each

digital twin unique, while providing digital connectivity to an inherently physical process of global movement of an item.

Digital Identity

As we digitize key data elements in a trusted and secure manner, one of the initial next steps will be what some consider the next 'Holy Grail,' which is digital identity. 'I am who I say I am,' sounds straightforward, but when hundreds of millions of shipments are moving globally every day, determining data points such as who created the product, from which part of the world it was created, whether forced labor was involved (forced labor=yes/no), who sold the product, who bought the product, and other key areas, can be challenging without digital solutions. It is a huge opportunity for data points tied to these processes digitally, as they are generally currently done using documents. Once digitized, current and emerging technologies can analyze and optimize that data to enhance informed decision making, such as creating predictive models (What will happen?) and prescriptive models (How can we make that happen?).

Now we get to the Customs example where those dots can be connected and, because of the hundreds or thousands of previous shipments from the shipper, that entity can be both known and trusted, or not trusted if unknown. The same goes for recurring movement to the receiver, and the dots can connect, with global scalability. Customs agencies, including U.S. Customs, are accelerating into this space, and they are also working across borders with their peers, the goal of which will be to create a true 'single (clearance) window' for movement, starting with verifiable credentials. Critical to all of this work will be that definitions such that 'identity' (and other examples in this paper – blockchain, etc.) are defined the same way by all standards entities, and not only in the eye of the beholder, or based on decades of work based on previous generations of technology.

Key terms in this space are 'DID' (Decentralized Identifier), which represents an entity (person, shipment, product) and 'VC' (Verifiable Credential), containing information or claims that can be cryptographically verified. A DID identifies who/what something is, while a VC states what we know about it. The next iteration of the ACE (Automated Commercial Environment) platform for U.S. Customs (ACE 2.0) is in development, and will be credentialed, so this is coming much sooner than later.

Back to the importance of open standards in support of B2C/C2C commerce, in regions where traditional identity is lacking, digital identities provide a means for micro-entrepreneurs to enter the formal economy, participate in global supply chains, and access financial services. By providing a verifiable credential (identity), even small entities can engage in cross-border commerce with large corporations, reducing barriers to entry. Globally, that will lead to authentication, trust, scalability, cross-border compatibility, unified systems, inclusion, fraud prevention, and smart contracts using blockchain.

As digital identities evolve, the concept of self-sovereign identity, where individuals or organizations have full control over their digital identity without relying on a central authority, is gaining traction, which could further enhance trust and autonomy in global supply chains.

In this context, many global entities have substantial data that can be used to identify and validate companies and individuals operating across global supply chains, ensuring that a given entity is in fact a trusted shipper, etc. With established common standards, there can be multiple ways to identify these users and certify them as trusted entities. With better solutions on common identifiers, traceability can be improved as well as trust. For example, the Global Legal Entity

Identifier Foundation (GLEIF) has established a Legal Entity Identifier (LEI),), recognized as ISO 17442 standard, which has been accepted as a trusted and viable commercial option in many aspects of the global supply chain, such as supporting an e-bill of lading model. This standard defines the basic reference data or a set of attributes that serve as the most essential components of identification for legal entities in financial transactions.

Blockchain, Sensors, and AI

The concept of blockchain has been envisioned for years, and many have just wanted to immediately jump into that space as a revenue model. But rather than a single company simply using blockchain, we go back to the ISS view from space, which is, for blockchain to scale it will take a pro-competitive global village, a 'coopetition,' where increasing opportunities for all stakeholders become an incentive even for traditional competitors to engage more securely in collaborative ways. Agreement to adopt common data language, driven by a semantic ontology, as well as adoption of standards, interoperability, and harmonization, are examples of such collaborative behaviors.

Scaling this globally is pro-consumer. We will all have to play in that space, and no single company will be able to put a logo on it for their exclusive use. Now that we are at the 'digital' discussion for global commerce, blockchain, even if not yet fully mature, is both a feasible, and inevitable outcome, but foundationally it will take this truly global approach.

Where authenticity (provenance, pedigree) matters, blockchain and Web3 will be transformative. 'What is the true source of that data, or that product,' and 'can that be proven' become significant changes for global supply chains using current and emerging technologies, with data recorded immutably on a ledger of verified records. Those entities, to include Customs agencies, can then use AI and other analytics and optimization tools to significantly streamline their operations, reducing friction across borders (documents, resources, delays), and speeding up global supply chains. Essentially, data recorded and shared over blockchain-based ledgers can be validated as trusted inputs going into AI algorithms to draw patterns and support better informed decision making.

Finally, sensors/IoT devices are very complementary to this entire discussion since sensors can capture the physical world and digitize the results (location, temperature, humidity, shock, light, etc.). Where desired, data from a uniquely identified sensor could be memorialized onto a blockchain for security and for immutable retention. Where certainty matters, at the highest levels, such as chemotherapy medicines and other similar healthcare scenarios, the combination of blockchain and sensors, with that data analyzed and optimized by AI, provides all stakeholders a clear sense of the future of global supply chains. As blockchain is becoming increasingly scalable and due to technological advances (e.g., interoperability mechanisms, sharding, side-chains, etc.), it is now feasible to use near real-time IoT sensor data for the majority of supply chain ecosystems. It is important to define what IoT data logs may not need to be kept on chain, to optimize business value for space utilized, while keeping real-time IoT sensor readings accessible on chain.

CREATING A NETWORK EFFECT

Standards are an important piece of streamlining global commerce, however, there are other key components and areas that have brought us to this point and will take us forward into a truly digital global supply chain. This is a network effect discussion, where the value or utility of a product, service, or system (in this case, global commerce) increases as more people adopt it. Historically, each era added network effect inertia and an expanding focus on greater geography, to the ISS view we have today:

- **Early trade** – Geography, natural resources, cultural/social exchanges
- **Development of trade routes/empires** – Maritime innovations, colonial expansions
- **Industrial revolution** – Technological advancements, mass production
- **20th century: Globalization** – Multilateral agreements, containerization
- **Digital revolution / The Information Ag**e – Digital communication, e-Commerce, supply chain digitization
- **Current / emerging trends** – Global standards, interoperability, ethical trade, sustainability

While we are currently focused on harmonized, interoperable, and open data standards, which are foundational to the transition to digital global supply chains, it is important to note that this could be considered inevitable based on the network effects and the value creation that was started thousands of years ago, and has continued to grow and expand to the global focus of today.

The sooner we focus on the global level, the sooner we accelerate adoption of those harmonized, interoperable, and open data standards, increasing value for all. This network effect not only accelerates the growth of global supply chains but also facilitates the continued expansion of international trade. As more entities digitize and rethink (digitalize) their processes, to include digital identity, blockchain, AI, etc., the overall value of the global supply chain network increases, leading to faster, more efficient, and more resilient trade. Encouraging the participation of all stakeholders, beyond suppliers and tier-1 stages of the supply chain, will create a network effect that can be a gamechanger in terms of visibility, traceability, and trust.

A PRACTICAL LOOK AT THE RESULTS OF HARMONIZED, OPEN STANDARDS AND EMERGING TECHNOLOGY

When data standards are harmonized, they allow for frameworks to be developed that define a business problem and show how this data and these technologies can be used to solve it. Standardized data allows for more efficient exchange of information and comparability between data from different parties.

Tokenization

Tokenization is the result of breaking down such an item into its digital representation, through the creation of one or more unique 'tokens,' representing digital value. The token uses a non-human readable format, the data is cryptographically secure, is stored in a cloud data vault, and can only be decrypted with the appropriate key (e.g., rules). The tokenization process is highly customizable by those issuing or transacting with the tokens, including whether sensitive business information is included. So, based on the preference of asset owners and token issuers, a token representing a shipment of penicillin may have the property of the drug shipment, but would not have the cost or the name of the end purchaser, and smart contracts can enforce specific rules around data access. Other considerations for tokens may be whether this is a private or public blockchain, or data access and privacy considerations (e.g., restricting data only to crucial stakeholders and not to all sub-contractors along the supply chain).

Frameworks

Work is underway to create blueprints of supply chain use cases through the lens of tokenization and blockchain projects, and some entities are using these blueprints to build frameworks for use case implementation. These groups include GBBC, BITA Standards Council (BITA), and the InterWork

Alliance (IWA), which have convened working groups to outline tokenization standards and frameworks. Focus areas include supply chain, carbon emissions tracking and tracing, and voluntary ecological markets and carbon credits.

The IWA maintains the Token Taxonomy Framework (TTF), the purpose of which is to clearly define innovative technology concepts and terms in the context of new tokenization use cases/scenarios. TTF provides definitions that have clear and well-understood requirements for properties and behaviors that are implementation-neutral for developers to follow and standards organizations to validate against. The taxonomy from TTF serves as underlying foundational data structure for reporting and disclosures.

The framework establishes a base Token Classification Hierarchy, driven by metadata, which is simple to understand and use, and which enables the generation of visual representations of classifications and modeling tools to view and create token definitions mapped to the taxonomy.

A Blockchain Supply Chain Use Case

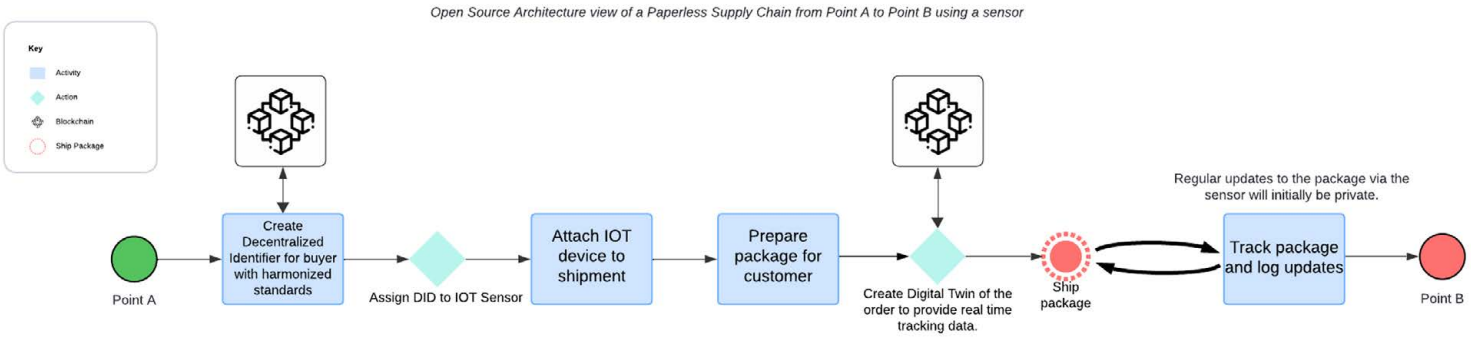
In this harmonized, interoperable, open, and digitized supply chain that is on the near horizon, foundational use cases for movement are already being created. In the following example, BITA is contemplating the following challenge using a 'crawl, walk, run' methodology for a blockchain solution, e.g., 'crawl' would be the initial technical effort to prove out the concept. 'Walk' adds features, and 'run' would be full use of the technology and use case. While this looks fairly simple, it represents a significant portion of the global supply chain of today and tomorrow:

- 'Point A to point B, across a border, with a sensor.'

So, 'crawl, walk, run' for that scenario may look like this in a few key areas:

	CRAWL	WALK	RUN
PHYSICAL MOVEMENT	Point A to point B, across a border, with a sensor. Private.	Multiple border crossings.	Provenance data exceeding the bounds of a single package.
SENSOR	Unique identity, full cell to prove out concept, use global standards.	Step down from cell device - still verify all required items, etc.	Potentially step down to lesser device - still all verifications.
PRIVACY	Full closed/private, participants only, private blockchain server.	Still private, but increased amount of public auditability.	Public? Blockchain given access controls based on permissions.
IDENTITY	Some kind of private key (registered with biz ID database).	Develop and deliver volunIncrease the # of private key parties. Verifiable credentials.	Multiple Align with global open interoperability & other standards.

In the Privacy area (and other areas, as applicable), all laws must be followed (EU-GDPR, as an example), but likely all items that are known to be 'public' would be identified up front, with the remainder considered 'private,' and adjustments could be made moving forward, as applicable. As this develops, other use case frameworks will be created that will move the 'paperless supply chain' vision forward, paving the way toward a blockchain-based supply chain as traditional signing of physical "paper" documents transitions toward digital verifications, with real-world implementations that will benefit all stakeholders.



THE GLOBAL SUPPLY CHAIN OF 2035 AND BEYOND

To create a speculative outlook on what future supply chains might look like using current trajectories we need to consider multiple factors, including, history, network effects, current and emerging technologies, and economic, environmental, and social trends. This is a 'breakthrough thinking' exercise, which gets us to a point on the horizon (let's call it our 'True North'), rather than the outcome 'process improvement' would provide, based only on previous and current small iterative steps.

We start with the ISS view which, by then, includes harmonized, interoperable, open, and digital standards, and interoperable digital ecosystems will result in trusted data flowing freely across borders and industries. When, in combination with sensors (as applicable), we know where everything is, we won't need as much, which will impact inventories. And, in combination with 3D printing/additive manufacturing and predictive analytics around procurement, not only will we more efficiently fulfill orders, but those products will also be closer than ever to the receiver, reducing shipping times, in addition to the global efficiencies previously discussed for international movement.

Smart contracts, potentially with the use of AI agents, will securely automate transactions and ensure compliance with global standards instantly. In an underlying financial supply chain comprised of all transactions involved, payments can also be made more seamlessly, and both businesses and customers can benefit from advances in financial supply chain, based on the impact of automated payment flows instructed by smart contracts and related to supply-chain events.

Supply chains will be fully decentralized, powered by blockchain or similar technologies that ensure transparency, traceability, and trust without centralized intermediaries. Every transaction, from production to delivery, will be securely recorded, enabling real-time verification of every step in the supply chain. AI will drive decision-making across the supply chain, optimizing everything from procurement to logistics in real-time, and advancements in robotics and autonomous vehicles can further maximize efficiencies. Unlike what we experienced during the Covid pandemic; predictive analytics will anticipate disruptions before they occur.

Every participant and product in the supply chain will have a unique identity, which will ensure authenticity, reduce counterfeiting, and enhance consumer trust. Supply chains will also be designed to minimize environmental impact, with many operations achieving carbon-neutral (or even carbon-negative) status. We are already starting to see Digital Product Passports (DPP) that will track an item from cradle to grave and create a circular economy. Renewable energy, sustainable materials, and zero-waste processes will be standard. Also, the ethical treatment of workers and the responsible sourcing of materials will be non-negotiable. All of this will lead to consumers, empowered by transparency, demanding higher standards of ethics and sustainability, and companies will comply, or risk being excluded from the market. To no surprise by now, regulations will be globally harmonized, interoperable, and open, to facilitate seamless international trade. Also, robotics, drones and automation will each play a key role globally.

In summary, the global supply chain of ten years from now t and beyond will be a highly integrated, intelligent, and adaptive system. It will balance efficiency with sustainability and, with the digital foundation built in the coming years, will utilize advanced technologies like AI, blockchain and further emerging technologies to create a seamless flow of goods and services across the globe. Driven by network effects, these supply chains will be more resilient, ethical, and responsive to the needs of both consumers and the environment. In this future, the supply chain is not just a logistical network but a complex, self-regulating ecosystem that evolves with the world around it.

CONCLUSION & CALL TO ACTION: A UNIFIED VISION FOR GLOBAL SUPPLY CHAIN STANDARDS

As we stand at the threshold of a new era in global commerce, the challenges, and opportunities before us are immense. From the vantage point of the International Space Station, Earth appears as a singular, interconnected system, underscoring the need for unity and collaboration in shaping the future of our global supply chains. The transition from fragmented, localized or industry-level standards to a future of harmonized, interoperable, and open systems is not just an economic imperative but a call to action for international standards entities and stakeholders worldwide.

For over a century, current day standards organizations have been foundational in facilitating trade and innovation. However, in the digital-first era, the traditional, siloed approaches must give way to a new paradigm of global collaboration, a pro-competitive ‘coopetition’ approach. No single entity can address the complexities of the evolving supply chain alone. We must break free from sector-specific approaches and work together to create open, digital definitions and standards that transcend industries and borders, fostering interoperability (e.g., between blockchain-based systems and existing systems used to manage data and processes along global supply chains) and supporting the digital identity of goods and services. Through this process, we must normalize how we consume data so that we can develop, build, and support a global supply chain (including reverse logistics

for returns) that is less impacted by hurdles or challenges that we face today. This is a collective responsibility that requires a global coalition. Initiatives that will help advance this goal include:

- Facilitating the transition toward a harmonized global system that can better link different platforms
- Promoting engagement across standards entities in a forum that supports dialogue on harmonization
- Promoting engagement with tech communities to support alignment with standards
- Identifying gaps, pain points, and ways to facilitate new model alignment
- The clear establishment of scope for these efforts, so that 'scope creep' doesn't stall or stop critical progress for success

The time is now for international standards development organizations and all other stakeholders to align in a concentrated push toward the development of these harmonized and interoperable standards. By doing so, we will accelerate the creation of a truly global supply chain that is faster, more resilient, and equitable, capable of meeting the demands of the 21st-century economy, and beyond. Inspired by the global view from space, we must build a future where the movement of goods and services is seamless, sustainable, and powered by open, collaborative standards. With that focus from the ISS view, let us begin the work together to build the harmonized, interoperable, and open standards and infrastructure that will power the commerce of the future and benefit all stakeholders.

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- FACT SHEET: Implementing the National Standards Strategy for Critical and Emerging Technology
- U.S. Government National Standards Strategy For Critical And Emerging Technologies (USG NSSCET): IMPLEMENTATION ROADMAP
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- The Standards Alliance: Phase 2 (SA2)
- NIST Awards $15 Million to ASTM International to Establish Standardization Center of Excellence

ENDNOTES:

1 With this motive, NIST awarded a grant to ASTM International for a Standardization Center of Excellence for Critical and Emerging Technologies

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