

Table of Contents

| | |
|--|-----------|
| Executive Summary | 3 |
| Introduction | 3 |
| Four Critical Supply Chain Challenges | 4 |
| Material and Resource Scarcity | 4 |
| Lack of Visibility and Traceability | 4 |
| Product Counterfeits | 5 |
| Compromised Worker and Consumer Safety | 5 |
| Future-Proofing the Supply Chain: Three Hackathon Solutions | 6 |
| Demand Forecasting | 6 |
| Digital Twins | 6 |
| Transparency and Ethical Sourcing | 7 |
| A Circular Vision for a Resilient Future | 7 |
| From Scarcity to Abundance | 7 |
| From Counterfeits to Confidence | 7 |
| From Risk to Robots | 8 |
| Conclusion | 9 |
| Appendix | 10 |
| Glossary | 10 |

This white paper serves to document the analysis, impressions, and insights in order to support the ongoing industry efforts to identify solutions to the challenges. The information contained herein is voluntary, not mandatory. It should be noted that use of the words “must” and “require” throughout this document relate exclusively to technical recommendations for the proper application of the standards to support the integrity of an implementation. The information contained herein is for informational purposes only as a convenience and does not constitute legal advice or a substitute for legal counsel. GS1 US Inc. assumes no liability for the use or interpretation of the information contained herein.

Executive Summary

The COVID-19 pandemic has exposed the weaknesses of a lean global supply chain that has historically focused on removing excess inventories, eliminating waste, and streamlining the movement of goods. Unfortunately, when faced with the critical challenges of resource shortages, product scarcity, and limited end-to-end traceability, the supply chain became susceptible to counterfeit goods, compromised products, and operational uncertainty which caused significant delays in distribution. Never before has the consumer been so aware of the fragility of getting the right product to the right place at the right time. In response, new solutions and adaptive tactics have emerged, and organizations looking to improve their supply chain performance are quickly shifting to new processes and tools.

Set in the context of a post-pandemic “new normal,” this whitepaper will explore the benefits of a circular economy and its principles in supply chain systems. Circularity has been historically underrepresented in supply chain discussions but has now become of high interest to many leading organizations. The circular economy is a sustainable

economic system that eliminates waste, reduces pollution, and ensures the continuity of resources. In such a system, products and resources are redesigned, reused, repaired, and recycled to reduce the use of virgin materials. This cycle connects traditional waste streams at the end of a product’s life cycle to become resources upstream. The new paradigm of circular supply chains will bolster investments, reveal the availability of resources, and sustain profitable operations far into the future.

This whitepaper will elaborate on how GS1 US® has a critical role in advancing resilient supply chains and how standards, technology, and circularity intersect to help enable future-proof tactics and strategies. It will also outline ways to create more scalable, interoperable, and resilient supply networks, firmly based on global standards and leveraging today’s solutions to meet tomorrow’s demands. The catalyst for this paper came from a recent Hackathon hosted by GS1 US, where emerging technology solutions and standards were combined to develop new tools for industry in its journey towards circularity and sustainability.

Introduction

Traditionally, both B2C and B2B supply chains have been built to optimize operational efficiency and speed of delivery while at the same time minimizing costs through lean inventory practices. The pandemic has overturned this structure. COVID-19 exposed the weakness of linear supply chains by subjecting the entire world to an industry-agnostic, large-scale disruption that has lasted for months longer than anyone initially predicted¹. Even beyond the current pandemic, rapid changes in the environment and the global economy are increasing the frequency and magnitude of supply chain disruptions, necessitating a crucial overhaul of how they are structured². Specifically, the pandemic has shone a light on the issues of material and resource scarcity, limited visibility and traceability, product counterfeiting, and compromised worker and consumer environments that have quietly plagued supply chains for years.

The supply chains of countless companies across the U.S. failed to adapt to sudden disruptions due to an extreme optimization for efficiency at the cost of resilience³. Rapid supply and demand shifts exacerbated these resiliency issues.

The supply chains of countless companies across the U.S. failed to adapt to sudden disruptions due to an extreme optimization for efficiency at the cost of resilience.

Companies needed to pivot quickly, adopt new strategies, collaborate in new ways, and leverage emerging technologies in order to overcome these challenges, all while rebuilding and restructuring their fractured supply chains.

Standards help form a bridge between physical products and their digital identities; they are critical for interoperability and unique identification. Data carriers such as QR codes and other two-dimensional barcodes will be foundational to bridging the short-term solutions of today with the long-term resilience of tomorrow. One way to achieve this sustainable resilience is through circularity. In a world with finite resources, the circular economy and its principles can provide guidance to address the current challenges in a more sustainable way while also ensuring a path toward mitigating future disruptions.

¹Sep 2020, SDC Exec. *Why COVID-19 is Different from Other Supply Chain Disruptions*. www.sdccexec.com/software-technology/article/21159890/afflink-why-covid19-is-different-from-other-supply-chain-disruptions

²Aug 2020, McKinsey & Company. *Risk, resilience, and rebalancing in global value chains*. www.mckinsey.com/business-functions/operations/our-insights/risk-resilience-and-rebalancing-in-global-value-chains

³Oct 2020, Bain & Company. *Balancing Resilience, Speed And Efficiency: 90 Percent Of Retail, Consumer Goods Companies Plan To Modify Their Supply Chain Networks In Response To Fallout From COVID-19*. www.prnewswire.com/news-releases/balancing-resilience-speed-and-efficiency-90-percent-of-retail-consumer-goods-companies-plan-to-modify-their-supply-chain-networks-in-response-to-fallout-from-covid-19-301155867.html

Four Critical Supply Chain Challenges

Across the four critical problems outlined, the use of GS1 Standards can be helpful in mitigating disruption.



Material and Resource Scarcity

The lack of product availability is a two-fold problem:

1. Companies are dependent on suppliers from single/specific regions or locations.
2. Off-shore production has created a drastic difference between manufacturing abroad and manufacturing closer to the point-of-sale. This necessitates long lead teams for planning what will be manufactured and sold. Companies are not able to respond quickly to shifts in demand from consumers and supply chain disruptions.

For some companies, supplier diversification and near-shore manufacturing have been successful mitigation tactics. Foxconn, one of Apple's contract manufacturers, recently announced plans to invest \$1 billion in India to shift its product production away from China and distribute the needs of its supply chain across different regions⁴. For others, 3D printing and transformed production capabilities have shifted to keep up with unprecedented demands for specific goods, like hand sanitizers, personal protective equipment (PPE), ventilators, and medical disinfectants.

Naturepedic quickly pivoted its organic cotton from being used in mattresses to face masks via 3D printing technology⁵. With an influx of new trading partners and data points to aggregate, leveraging GS1 Standards for data sharing, such as the Global Data Synchronization Network™ (GDSN®) for product master data and Electronic Product Code Information Services (EPCIS) for product event data would ensure the reliability and quality of the data and keep them up to date between different parties in the supply chain. The benefits of near-shore manufacturing and supplier diversification can be maximized when paired with visibility and traceability.



Lack of Visibility and Traceability

A lack of visibility and traceability throughout the supply chain creates confusion, impairs a company's fulfillment capabilities, and makes it vulnerable to exploitation from bad actors. This can lead to several issues:

1. The inability to capture the right demand signals to reveal sudden shifts in demand
2. The inability to respond to sudden demand shifts with revised manufacturing plans due to resource shortages and trade restrictions
3. The inability to redistribute goods to where they are needed

While this problem exists across multiple industries and various companies recognize the importance of visibility, less than 44% currently have a solution that allows them to monitor their entire supply chain⁶. Including unique and persistent identity on products would allow inventory managers to address fluctuating demand signals to get critical supplies to where they are truly needed in real time while also gaining insight on products that are reusable or repairable. EPICS, an interface standard to track product movements, can demonstrate the benefits of unique identification by providing businesses with a wealth of data to develop strategies for quickly adapting to unprecedented changes. Once products and materials are assigned unique identification, supply chain stakeholders would be able to use EPCIS to track their products at specific times. The enhanced visibility would empower them to allocate or redistribute their products accordingly.

Sandi Michel, Director of Supply Chain Strategy at Franciscan Missionaries of Our Lady Health System and a member of the GS1 US Healthcare Initiative Executive Leadership Committee said, "The use of Global Trade Item Numbers (GTINs) and Global Location Numbers (GLNs)...can work to get the right product, to the right location, for the right physician, for

⁴Sept 2020, Fortune. *COVID proves that companies need to reduce their dependence on China.* fortune.com/2020/09/11/covid-19-us-china-business-supply-chain-diversification

⁵Apr 2020, Industry Week. *Technology Takes Center Stage As Manufacturers Pivot.* www.industryweek.com/technology-and-iiot/article/21129510/technology-takes-center-stage-as-manufacturers-pivot

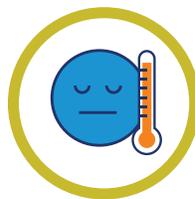
⁶Sept 2020, Forbes. *The Supply Chain Of The Future Isn't Afraid To Pivot.* www.forbes.com/sites/corywilliamson/2020/09/01/the-supply-chain-of-the-future-isnt-afraid-to-pivot/?sh=4f842c3145e4

the right procedure, for the right patient, at the right time, practically eliminating discrepancies.” A solid traceability system contributes confidence and trust to organizations in the supply chain. Traceability helps ensure that companies can confirm exactly where their products are in their life cycle and reduce the risk of bad actors taking advantage of supply chain blind spots.

Product Counterfeits



Resource and product scarcity, coupled with issues in visibility and traceability, has created the perfect storm for product counterfeits to proliferate. With safety concerns being top of mind, stay-at-home orders in effect, and brick-and-mortar stores completely emptied of basic necessities, many shoppers have had little choice but to turn to e-commerce for essentials and PPE. While there are genuine efforts across the nation to connect these essential goods to consumers, from everyday citizens to hospital staff, buyers have had reason to be suspicious of product authenticity. Amazon has banned more than one million fraudulent protective products, while China has confiscated 31 million knockoff face masks⁷. Counterfeiters have been caught selling or advertising face masks, lab coats, and infant gas masks on Facebook, Craigslist, and Etsy⁷. Verified by GS1 is a solution that can, on a global scale, help combat counterfeits by ensuring the authenticity of every product that has a globally unique GTIN. It is more critical than ever to secure supply chains via digital twins and serialized GS1 identifiers (like the SGTIN), which would not only enable the unique identification of products, but also would help ensure the authenticity of products throughout the supply chain when coupled with highly secure, non-cloneable data carriers.



Compromised Worker and Consumer Safety

The aforementioned issues of the pandemic pose significant public health threats, with essential workers fearing for their safety at work and consumers worrying about contamination in their purchases. According to the Economic Policy Institute, 55 million essential workers across 12 industries are suffering the brunt of the consequences of not having adequate protective equipment and supplies, and yet they perform tasks ranging from food preparation and packaging to retail customer service to last-mile delivery services⁸. Some companies are accelerating their automation initiatives to ensure worker well-being and consumer safety, like Ocado's acquisition of two U.S. robotics companies to create fully “dark” fulfillment centers that require no human workers, significantly reducing health risks⁹. Less-complex solutions are being leveraged as well, with smart sensors placed in warehouse and manufacturing environments for monitoring temperature and environmental changes to protect worker health in real time¹⁰.

Some companies are accelerating their automation initiatives to ensure worker well-being and consumer safety, like Ocado's acquisition of two U.S robotics companies to create fully “dark” fulfillment centers that require no human workers, significantly reducing health risks.

To scale the success and efficiency gains of these automation efforts, GS1 identifiers, like the Global Individual Asset Identifier (GIAI) or the Global Location Number (GLN), can be used to help track robotic assets as they move through physical space. These robots would then be able to interoperate with existing product identification data to create an interconnected ecosystem for automation among different industries.

⁷May 2020, Fast Company. *Counterfeiting is a billion-dollar problem. COVID-19 has made it far worse.* www.fastcompany.com/90500123/counterfeiting-is-a-billion-dollar-problem-covid-19-has-made-it-far-worse

⁸May 2020, Economy Policy Institute. *Who are essential workers?* www.epi.org/blog/who-are-essential-workers-a-comprehensive-look-at-their-wages-demographics-and-unionization-rates

⁹Nov 2020, Fortune. *British online grocer Ocado, known for its automated warehouses, acquires two U.S. robotics companies.* fortune.com/2020/11/02/british-online-grocer-ocado-known-for-its-automated-warehouses-acquires-two-u-s-robotics-companies

¹⁰Aug 2020, IEN. *Smart Technologies May Improve Employee Safety in COVID-19 Era.* www.ien.com/safety/article/21159892/smart-technologies-may-improve-employee-safety-in-covid19-era

| Material and Resource Scarcity | Lack of Visibility and Traceability | Product Counterfeits | Compromised Worker and Consumer Safety |
|---|---|---|--|
|  <p>“ As a direct result of the pandemic, the biggest issues in the industry are the collapse of suppliers (cited by 48% of industry respondents) and supplier bankruptcies (46%).” — MH&L</p> |  <p>“ Visibility directly impacts a company’s ability to fulfill goods and serve its customers. It is a facet of the supply chain that 97% of companies agree needs to be improved, yet 44% have a solution that allows them to monitor their entire supply chain.” — Forbes</p> |  <p>“ 68% of U.S. shoppers were concerned there will be more inauthentic or poor-quality products online. Their concerns are well-founded as law enforcement officers have seized over 750,000 counterfeit face masks.” — Supply Chain Dive and IP Watchdog</p> |  <p>“ United Food and Commercial Workers International (UFCW) said at least 82 grocery store workers have died from COVID-19 and 11,507 have been infected or exposed to the virus in the first 100 days of the outbreak.” — Supermarket News</p> |

Future-Proofing the Supply Chain: Three Hackathon Solutions

In recognition of the innovation opportunities present in the four identified supply chain issues, GS1 US organized a Hackathon to challenge developer and entrepreneur communities to create solutions built upon standards to increase the adaptability and resilience of supply chains during times of crisis. The Hackathon centered on three different industry segments (Food, Consumer Packaged Goods, and Healthcare) that were severely disrupted by the pandemic. Solutions that were submitted include demand forecasting, digital twins, ethical sourcing, and product life cycle tracking. The three submissions highlighted below exemplify solutions that address an immediate need while having the potential for greater future impact.

Demand Forecasting

One of the challenges during the pandemic has been a spike in natural demand for different products in one region, while a large surplus of those products built up in a different region. Through the enhancement of real-time supply chain visibility, scarcity of essential pandemic products could be mitigated. Momentum by JUSDA took first place in the Hackathon, with a solution that provides real-time visualizations to identify surpluses and shortages in particular regions to address supply and demand mismatches. The solution effectively balances that discrepancy through the enrichment of product and location master data via GTIN and GLN lookups, which are then correlated to GPS location and region. It can then

process high volumes of supply events and demand signals in real time and create updated data visualizations instantly to provide up-to-the-minute situational awareness for the quick response to logistics teams. The solution simulated spikes (normally derived from point-of-sale) that might occur during a crisis and captured supply event data formatted to the EPCIS standard. In the future, Momentum by JUSDA could leverage granular identification upstream to track components of goods so that manufacturing disruption can be minimized.

Digital Twins

To prevent the proliferation of counterfeits into a vulnerable market, such as the medical supply chain, it is critical for products to be tracked throughout the supply chain and life cycle. Digital twins, which replicate physical identity in digital visualizations, illuminate the journey of physical objects, making it easier to detect counterfeits or recall products needing to be withdrawn. The third-place winning solution, GTwin, addresses this issue of limited visibility and traceability in the medical supply chain. These digital twins are kept in sync with their physical counterparts through EPCIS event data captured from scanners, IoT devices, and internal business systems. The solution works by importing product and location information linked to GTINs of medical products and GLNs of supply chain locations while streaming EPCIS event data that reveals the journey of the products through

Beyond Sustainability: A Circular Approach to Building Supply Chain Resilience

the supply chain. This standardized data is transformed into a digital twin graph using Microsoft Azure's new "Digital Twin" service. The digital twins can be dynamically used to query for dashboard maps, events (such as sanitation or reuse), alerts, analytics, and AI/ML. The host of benefits from this solution can also be extended to other purposes as well, such as the future of recycling and upcycling initiatives across various industries.

Transparency and Ethical Sourcing

Often, worker safety is an unrecognized part of the supply chain. With limited awareness contributing to unsafe or dangerous working conditions, transparency and traceability are powerful tools for locating trouble spots in existing supply chains. The category winner for "Solution With the Greatest Impact" is Farmer-Aggregator, which aims to create a transparent, traceable ecosystem for connecting

smallholder farms to a broader market by leveraging GS1 Standards to digitize operations. Smallholder farmers are a vital pillar in food supply chains yet struggle to gain access to markets to offer sustainably grown foods. Smallholder farmers, aggregators, exporters, and end buyers register on the Farmer-Aggregator platform, and sustainability-focused buyers are able to buy from businesses that meet their traceability requirements. For the registration, entities enroll for a GS1 Prefix and list their products identified with GTINs. The platform can collect and display EPCIS data for the origin and end-to-end traceability of any product so that buyers can be assured they have access to full details of the product and its impact. The benefits can be transferable to industries where consumers are increasingly concerned about ethical sourcing and sustainable practices, such as the apparel industry.

A Circular Vision for a Resilient Future

To build resilient supply chains of the future, we must bridge short-term mitigating tactics into long-term sustainable strategies. While the technologies and tactics above address the acute problems of today, these solutions should be extended to avoid short-term, Band-Aid solutions. The current threats will be intensified in the future as supply chains face greater disruptions at a global scale. There is an observable escalation of disasters, from increased public health crises to climate catastrophes to geopolitical strife, all of which highlight the notion that human problems and supply chain problems are intrinsically intertwined. As the four problem areas continue to erode the vitality of supply chains, future supply chain resilience will need to rely on circularity and standards coming together to transform vulnerabilities into opportunities. Circularity enables products, assets, and infrastructure to be made more productive as they are kept in use longer, and supply streams will ultimately benefit from the remanufacturing of new and existing resources.

From Scarcity to Abundance

To navigate material scarcity and product recycling, it will be more critical than ever for waste streams to be transformed into value streams. We are entering an era of material and resource scarcity where finite natural resources are dwindling, and virgin material usage will become unsustainable. In such a reality, industries must design-out waste to maximize the value of the materials that they have already invested into products. As it stands today, the "take, make, waste" model of a linear supply chain turns every product past the point-of-sale into waste that ends up in a landfill. The current tactics of supplier diversification, from bringing manufacturing near shore, to sourcing from additional vendors, to 3D-printed materials, all rely heavily on the consumption of virgin

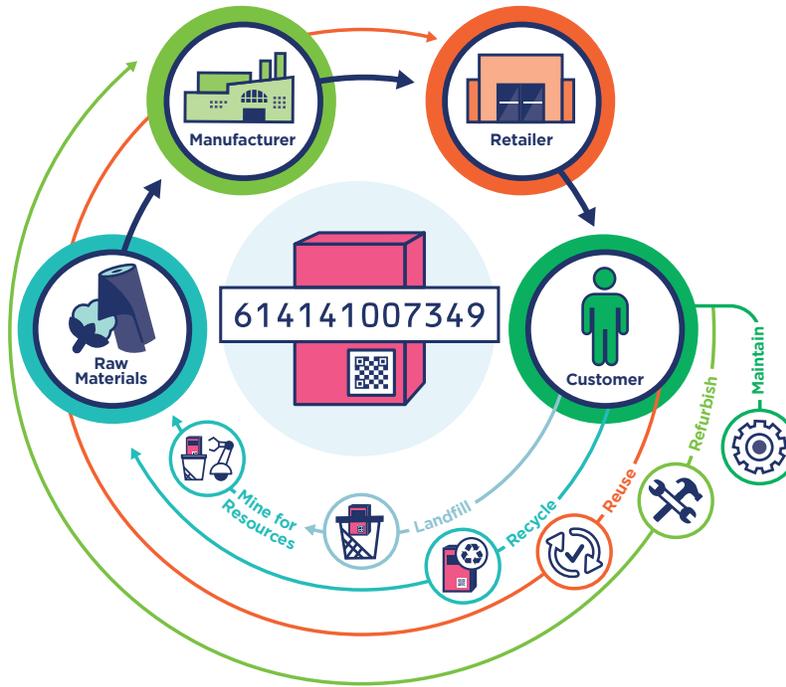
Through circularity, products, assets, and infrastructure will be made more productive as they are kept in use longer, and supply streams will ultimately benefit from the remanufacturing of new and existing resources.

materials. The flexible and sustainable approach diversifies supplies through emerging industries like waste mining and secondhand markets and recovers end-of-life products back into the manufacturing process. For example, Diageo has pledged to achieve 100% recyclable packaging and 50% supply chain emissions reduction by 2030 for its bottled products¹¹. Material maximization must first begin with assigning unique product identity to ensure the product or its parts will be continuously trackable and valuable for multiple life cycles.

From Counterfeits to Confidence

In conjunction with maximizing the value of materials, applying a persistent identity to products, components, and materials will enable visibility at the earliest stages of a product's life cycle. The definition of inventory management will expand to encompass all the components of a product, and sourcing can become more localized by tapping into recycled products. Demand fulfillment can therefore happen more expediently. With the application of persistent identity, supply chains will be made more resilient through the following benefits:

¹¹Dec 2020, WasteDive. *Diageo pledges 100% recyclable packaging, 50% supply chain emissions reduction by 2030.* www.wastedive.com/news/diageo-emissions-net-zero-carbon-operations/591460



The flexible and sustainable approach diversifies supplies through emerging industries like waste mining and secondhand markets and recovers end-of-life products back into the manufacturing process.

1. Ensuring product confidence and authentication
2. Augmenting the repair, recycle, and reuse process with comprehensive product history
3. Returning the authentic product's materials back into the manufacturing process

The abundance and availability of local resources will open up new business models around services like repairing, reusing, and recycling. Complete product transparency in these types of services will allow consumers and businesses to have the utmost confidence in the products that they are purchasing.

For example, Giotex partnered with The Movement to develop a fully traceable, recycled cotton yarn blend via a combination of tracer particles and blockchain to achieve end-to-end visibility¹². In the case of repairing or upcycling goods to divert waste out of landfills, manufacturers would place persistent and standards-based identification into the products upstream so that they can be read by any party downstream.

From Risk to Robots

Due to the pandemic, there has been a flurry of innovation and investments in automation, artificial intelligence, and robotics in supply chains, specifically for warehouses, dark stores, retail environments, and last-mile delivery solutions. However, upstream and post-consumer value chains are still underexplored areas where automation can greatly increase efficiency and safety for customers and employees alike. For example, robots are able to work in environments that are unsafe for humans, which could prevent factory or warehouse shutdowns, and employees would have less fear of workplace infections. Amp Robotics has developed a solution that uses robotics, AI, and computer vision to process 1 billion recyclables over a 12-month period, while at the same time protecting employees from potential infection¹³.

Beyond today's automation solutions, robots that are able to recognize and identify products quickly would be able to perform even more complex tasks that are too dangerous or tedious for humans, such as in the emerging industries of waste mining, material sortation, and upcycling. To maximize the potential of artificial intelligence in supply chains, it is critical to have quality training data; GS1's GDSN could be a natural fit for companies looking for a reliable source of truth for high-integrity data that amplifies the value of autonomous systems, artificial intelligence, and robots. A future where there is a greater adoption of robots could mean livelihoods can be sustained even in the face of global crises. Meanwhile, the supply chain labor force would be collectively upskilled for better jobs and economic growth.

¹²Nov 2020, Just-Style. *Giotex partners to trace recycled cotton yarn.* www.just-style.com/news/giotex-partners-to-trace-recycled-cotton-yarn_id140013.aspx

¹³Apr 2020, Recycling Today. *Amp Robotics to Expand, Hits New Milestone.* www.recyclingtoday.com/article/amp-robotics-achieves-milestone-appoints-vp-international-sales

The future of resilient supply chains is circular, and the key to reaching this state is a combination of traceability, transparency, and persistent identification.

Conclusion

The pandemic has exacerbated supply chain vulnerabilities that have resulted from linear, hyperoptimized, and efficiency-focused operational models. In response, many companies have accelerated their implementation of technology solutions that overcome the disruptions of today. But to build the long-term resilient supply chains of tomorrow, circularity and standards must become the cornerstones of future strategies.

The future of resilient supply chains is circular, and the key to reaching this state is a combination of traceability, transparency, and persistent identification. GS1 US's virtual Hackathon validated this premise with impactful standards-based solutions that could be deployed for immediate benefit while also having the potential to sustain growth and resilience into the future.

GS1 Standards help empower the scalability and interoperability of nascent solutions for a world undergoing rapid digitalization and disruption. As global threats continue to emerge, organizations must adapt their supply chains to become more flexible and resilient to overcome material scarcity, ensure sustainability of their operations, and develop protocols for product authentication across multiple life cycles.

The circular economy ecosystem harbors untapped potential in supply chains across multiple industries (i.e., retail, grocery, apparel, and healthcare), and GS1 US actively seeks to pilot

opportunities that will elucidate this vision for the future. We are engaging MIT's Auto-ID Lab to articulate the value of circularity and standards in creating more resilience in supply chains. In this process, we invite you to collaborate with us on proof-of-concepts that will shift existing paradigms and future-proof supply chains.

Participate in a pilot: Join a [GS1 US Innovation Pilot](#) as we explore how to maximize output of next-generation technologies paired with GS1 Standards.

Create a case study: Work with GS1 US to publish a case study to showcase how you have leveraged visibility to improve fulfillment and profitability.

Appendix

Glossary



Identify

Globally unique identification numbers

Global Trade Item Number (GTIN): A GTIN can be used by a company to uniquely identify all of its trade items. GS1 defines trade items as products or services that are priced, ordered, or invoiced at any point in the supply chain.

Global Location Number (GLN): The GLN is encoded in either a barcode or RFID tag to automatically identify locations like storage places in a warehouse, the destination of a pallet, or the origin of a product. The GLN extension component can be added to a GLN to provide more precision in recording and sharing of supply chain events. For example, an extension component may identify sub-locations such as storage bins, shelves, dock doors, scan, and read points.

Verified by GS1 (VbG): Verified by GS1 can help organizations answer the question: “Is this the product that I think it is?” It is a service that checks on the unique product identifier and six attributes of every product to ensure product information is complete and accurate. It enables consistent data sharing, trust, and efficiency.

GS1 Global Data Model (GDM): The GS1 Global Data Model helps you leverage your product content for a seamless shopping experience across every channel. By simplifying and harmonizing the exchange of product data around the world, the GS1 Global Data Model increases operational efficiency for brand owners and retailers and improves data accuracy and completeness for consumers.



Capture

Automatic data capture

1D barcodes: These symbols can be scanned electronically using laser or camera-based systems. They are used to encode information such as product numbers, serial numbers, and batch numbers.

2D barcodes: 2D barcodes create consumer engagement and connection to extended information about products. They enable supply chain, POS, and applications on smart devices.

Radio Frequency Identification (RFID): When unique Electronic Product Codes (EPCs) are encoded onto individual RFID tags, radio waves can be used to capture the unique identifiers at extremely high rates and at distances more than 10 meters, without line-of-sight contact. These characteristics of RFID can be leveraged to boost supply chain visibility and increase inventory accuracy.



Share

Exchange of business-critical information

Global Data Synchronization Network (GDSN): The GDSN is an interconnected network of interoperable data pools governed by GS1 Standards.

GS1 Digital Link: GS1 Digital Link extends the power and flexibility of GS1 identifiers by making them part of the web. This means that GS1 identifiers, such as the GTIN, are now a gateway to consumer information that strengthens brand loyalty and improves traceability information and business partner APIs, etc.

Electronic Product Code Information Services (EPCIS): A standard interface for sharing information about the movement and status of goods. It enables capture of visibility event data in the supply chain and supports query capabilities about those physical events in a structured format. EPCIS makes end-to-end supply chain visibility possible. Trading partners can leverage information on the location and history of individual items as they move along the supply chain, thereby increasing safety, security, accuracy, efficiency, and visibility.

Proprietary Statement

This document contains proprietary information of GS1 US. Such proprietary information may not be changed for use with any other parties for any other purpose without the expressed written permission of GS1 US.

Improvements

Improvements and changes are periodically made to publications by GS1 US. All material is subject to change without notice. Please refer to GS1 US website for the most current publication available.

Disclaimer

Except as may be otherwise indicated in specific documents within this publication, you are authorized to view documents within this publication, subject to the following:

1. You agree to retain all copyright and other proprietary notices on every copy you make.
2. Some documents may contain other proprietary notices and copyright information relating to that document. You agree that GS1 US has not conferred by implication, estoppels, or otherwise any license or right under any patent, trademark, or copyright (except as expressly provided above) of GS1 US or of any third party.

This publication is provided “as is” without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. Any GS1 US publication may include technical inaccuracies or typographical errors. GS1 US assumes no responsibility for and disclaims all liability for any errors or omissions in this publication or in other documents which are referred to within or linked to this publication. Some jurisdictions do not allow the exclusion of implied warranties, so the above exclusion may not apply to you.

Several products and company names mentioned herein may be trademarks and/or registered trademarks of their respective companies. GS1 US does not, by promulgating this document on behalf of the parties involved in the creation of this document, represent that any methods, products, and/or systems discussed or recommended in the document do not violate the intellectual property rights of any third party. GS1 US has not performed a search to determine what intellectual property may be infringed by an implementation of any strategies or suggestions included in this document. GS1 US hereby disclaims any liability for any party's infringement of intellectual property rights that arise as a result of any implementation of strategies or suggestions included in this document.

This publication may be distributed internationally and may contain references to GS1 US products, programs, and services that have not been announced in your country. These references do not imply that GS1 US intends to announce such products, programs, or services in your country.

GS1 US shall not be liable for any consequential, special, indirect, incidental, liquidated, exemplary, or punitive damages of any kind or nature whatsoever, or any lost income or profits, under any theory of liability, arising out of the use of this publication or any content herein, even if advised of the possibility of such loss or damage or if such loss or damage could have been reasonably foreseen.

GS1 US HEREBY DISCLAIMS, AND YOU HEREBY EXPRESSLY RELEASE GS1 US FROM, ANY AND ALL LIABILITY RELATING TO YOUR COMPLIANCE WITH REGULATORY STANDARDS AND LAWS, INCLUDING ALL RULES AND REGULATIONS PROMULGATED THEREUNDER. GS1 US MAKES NO WARRANTIES OF ANY KIND RELATING TO THE SUITABILITY OF THE GS1 STANDARDS AND THE SPECIFIC DOCUMENTS WITHIN THIS PUBLICATION TO COMPLY WITH ANY REGULATORY STANDARDS, LAWS, RULES AND REGULATIONS. ALL INFORMATION AND SERVICES ARE PROVIDED “AS IS.”

*GS1 US employees are not representatives or agents of the U.S. FDA, and the content of this publication has not been reviewed, approved, or authorized by the U.S. FDA. The following information contained herein is for informational purposes only as a convenience, and is not legal advice or a substitute for legal counsel. GS1 US Inc. assumes no liability for the use or interpretation of the information contained herein.

No Liability for Consequential Damage

In no event shall GS1 US or anyone else involved in the creation, production, or delivery of the accompanying documentation be liable for any damages whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or other loss) arising out of the use of or the results of use of or inability to use such documentation, even if GS1 US has been advised of the possibility of such damages.

IAPMO

In this publication, the letters “U.P.C.” are used solely as an abbreviation for the “Universal Product Code,” which is a product identification system. They do not refer to the UPC, which is a federally registered certification mark of the International Association of Plumbing and Mechanical Officials (IAPMO) to certify compliance with a Uniform Plumbing Code as authorized by IAPMO.

GS1 Digital Link Disclaimer

GS1 US recommends that any organization developing an implementation designed to be in conformance with the GS1 Digital Link Specification should consult with their own counsel to determine the compliance of such an implementation with any relevant intellectual property or other rights of third parties.

*If applicable

About GS1

GS1® is a neutral, not-for-profit, global organization that develops and maintains the most widely used supply chain standards system in the world. GS1 Standards improve the efficiency, safety, and visibility of supply chains across multiple sectors. With local Member Organizations in over 110 countries, GS1 engages with communities of trading partners, industry organizations, governments, and technology providers to understand and respond to their business needs through the adoption and implementation of global standards. GS1 is driven by over a million user companies, which execute more than six billion transactions daily in 150 countries using GS1 Standards.

About GS1 US

GS1 US® is a unique identification organization that enables companies in more than 25 industries to identify parties, places, and things in a standardized way to facilitate the global supply chain. As a neutral, not-for-profit organization, GS1 US drives industry collaboration through the use of GS1 Standards—the most widely used data standards in the world. The barcode, the most recognizable example of a GS1 Standard, is scanned more than six billion times per day globally. GS1 Standards create a foundation for emerging technologies that can improve security, visibility, interoperability, and trust between business partners. Unique identification makes it possible to take advantage of the technologies of the future—connecting consumers, patients, businesses, and products.

GS1 US Corporate Headquarters

Princeton South Corporate Center, 300 Charles Ewing Boulevard
Ewing, NJ 08628 USA

T +1 937.435.3870 | **E** info@gs1us.org

www.gs1us.org

Connect With Us



6 1414102838 2