GS1 US

The Global Language of Business

Research Insights and Position Paper

Powering the Future of Retail

Building on the Foundation of the U.P.C. Barcode

VDC Research
Insights for the Connected World

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Background The Case for Change

A standard is an agreement to do something in a certain way that is widely accepted.[1] Created over 45 years ago, the 12-digit Universal Product Code (U.P.C.) barcode—or data carrier—stores, or encodes, the Global Trade Item Number® (GTIN®). Originally implemented to facilitate price look-ups at the point-of-sale/purchase (POS) register, the U.P.C. barcode continues to be a critical component in retail.

Driven in part by technology developments, consumer expectations have rapidly expanded and evolved over the past decades. These changes have accelerated in recent years. The internet has made information accessible 24/7, and smartphones and digital assistants put this data at consumers' fingertips. Consumer and retailer demands for product information (from ingredients to freshness to reviews), traceability, authentication, and the seamless facilitation of checkout and returns go well beyond the original price look-up function of the current U.P.C.

Despite improvements in the performance and reliability of the U.P.C., driven by innovations in printing and scanning technologies, enabling wider use cases requires the adoption of more robust data carriers capable of carrying more data to support current consumer needs. Data standards beyond the U.P.C. exist today; however, these standards have not been implemented given a wide range of legacy technology and cost barriers that are now rapidly changing.

Industry working together as a community to effect change has never been more important. While we cannot underestimate the scope of change required, research indicates broad support across the ecosystem to work together to realize shared objectives:

- Streamline operations for both retailers and brand owners
- Leverage a single identifier to enable accurate traceability, authenticity, and effective returns management
- Reduce the complexity of multiple labels or codes on a single product—and the overhead that it creates
- Seamlessly share and use product data, often captured by scanning the data carrier, within operations and with trading partners

"The retail sector at large does not have the necessary tools to address product identification in the context of today's market conditions and operational realities. GS1 US has an opportunity to set the direction for next-generation product identification standards that can be leveraged to better address mounting retail complexities."

VDC Research

The need for more data is already evident on packages cluttered with proprietary barcodes to drive consumer engagement and enable more advanced use cases for retail, brand management, and supply chain.

A single barcode symbology that contains all of this information, in addition to product identification, could provide benefits for every stakeholder along the supply chain. The newfound ease of capturing and sharing this data through a single interaction creates greater visibility and increases operational efficiencies.

Quickly evolving technologies like image recognition are on the horizon, yet most retailers and brand owners do not view these as viable options for mainstream retail in the near term. And while we expect that there will never be another solution with the longevity of the U.P.C., many agree a near-term solution is required to address a growing list of use cases.

This paper presents industry perspectives on the landscape, considerations, and options for a migration path beyond the U.P.C.

"Adding more data, such as lot number and date of expiration and best by dates, is not an afterthought. This is just a necessary evolution."

Retailer

1. Sept 2017, AIM Matters, Standards Issue. Steven A. Brown.

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Tier 1 Research About the Research

GS1 US®, in partnership with VDC Research, funded a study called Beyond the U.P.C. in mid-2018. Thirty-eight in-depth phone interviews were conducted with Tier 1 retailers[2] and brand owners/manufacturers, as well as solution providers, academic institutions, and industry associations. In addition, more than 200 retailer decision-makers were surveyed on the current state of POS hardware and software systems, their plans for system upgrades, and the use and evolution of standards-based data carriers (see **Figure 1**—Companies Interviewed for Tier 1 Research).

The primary focus of the Tier 1 research was enabling the POS use cases (see **Figure 2** on page 5—Prioritization of Point-of-Sale Use Cases) that are currently limited by the U.P.C. barcode. There is no intent to change the method of identifying products with a GTIN—the number encoded in the U.P.C.

Figure 1 Companies Interviewed for Tier 1 Research

Retailers	Brand Owners		Solution Providers	Academia	Industry Associations
• CVS • eBay • Kohl's • Kroger • Publix • QVC/Qurate Retail Group • Target • Tory Burch • Wakefern Food Corporation • Walmart • Wegmans	**Apparel**	• Herman Kay Co. • VF	• Avery Dennison • Bizerba • Datalogic • Digimarc • Fujitsu • Honeywell • IBM • Scandit • Toshiba • Zebra Technologies	• Auburn University • MIT/Auto ID Labs	• Food Marketing Institute (FMI) • Grocery Manufacturers Association (GMA)
	CPG	• Bumble Bee • Coca-Cola • Kraft Foods • PepsiCo • Procter & Gamble (P&G) • The J.M. Smucker Company • Unilever			
	Healthcare	• Abbott Laboratories • Johnson & Johnson • Pfizer			

2. Retailer and brand owner tiers are defined by revenue (USD$) as Tier 1: $1B+; Tier 2: $100M-$1B; Tier 3: $10M-$100M

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Figure 2 Prioritization of Point-of-Sale Use Cases

	Inventory Accuracy	Improved Consumer Engagement	Product Authenticity	Traceability	Freshness/ Waste Prevention	Returns Management
Pharma	★	★	★	★	★	
OTC	★	★			★	★
Apparel	★	★	★	★		★
Health & Beauty	★	★			★	★
Baked Goods	★	★			★	
Fresh Foods/Produce	★	★	★	★	★	
Hardlines	★	★				★
Beverages	★	★			★	
Grocery	★	★			★	
	★ Priority		Nice to have		Unimportant	

Note: Regulated healthcare was considered out of scope for this research.

Source: Beyond the U.P.C. Research, 2018

While different retail sectors have their own unique priorities, certain priorities are universal, such as achieving a better understanding of consumer buying habits and improving accuracy at the POS. To enable these use cases, the B2B and B2C digital ecosystems (retailers scanning at POS, consumers using their smartphones) need to capture more than just the information embedded in a U.P.C. Product description, manufacturer name, and price—the attributes most often associated with the base-level U.P.C. barcode—are just the beginning of what today's consumers and supply chain trading partners need to know.

Data-rich carriers that are more robust than U.P.C. barcodes, such as 2D data carriers, RFID, digital watermarking[3], and others, enable myriad benefits to industry and consumers alike. But this requires transitioning from the GTIN to dynamic data (data beyond the GTIN—e.g., lot and batch number, serialization) via a data-rich carrier.

The ultimate use case for change comes from the need to provide data while minimizing disruption at the POS. The amount of change management required cannot be overstated: from the technology itself to associate and customer self-scanning training and competing priorities for capital investment in the face of rapid change. This is complex, important work that industry is undertaking.

The results of the Tier 1 research are set forth below, along with recommendations and next steps needed to enable this change.

3. See Appendix 1

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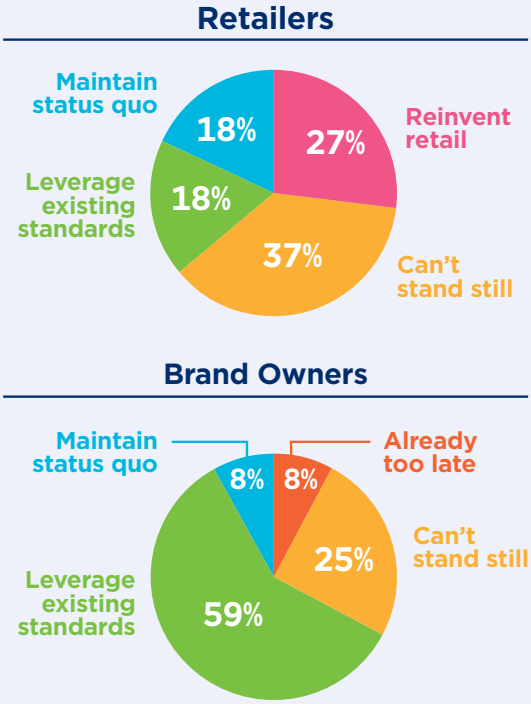
Key Findings

The majority of the Tier 1 research participants expressed both a desire for change and a clear expectation that GS1 US provide leadership and education for industry moving forward. But retailers and brand owners have differing views on the need to update barcode symbology. There was general consensus among the Tier 1 research respondents that retail has changed dramatically and, overall, was ill prepared to respond to this rapid transformation. Moreover, retail's infrastructure has not kept pace and was not designed to support the level of agility and visibility required to succeed today. However, retailers and brand owners diverge on what should be done to support these needs, as shown in **Figure 3**.

There is no single "quick fix," and often the change required is as much technology related as it is operational. Industry participants are also struggling with competing priorities and the need for more capital expenditures in the face of rapid change.

- Respondents who expressed a need to "reinvent retail" believe there is a fundamental shift occurring in commerce and greater-than-incremental change is needed to keep pace. Fundamentally, these organizations see a clear need to "extend" the definition of products to include—when relevant—variable information such as provenance, date and lot, and content and ingredients. The ability to read and consume these larger datasets will require investments to upgrade core barcode scanning technology, POS infrastructure, and backend systems.
- Those who indicated that industry "can't stand still" likewise believe that real change is necessary to stay competitive.
- Participants who indicated the need to "better leverage existing standards" believe that robust systems are already in place, but implementation has not been consistent enough to be truly effective. Brand owners expressed a significant opportunity for greater trust and data sharing among retailers and brand owners.
- A minority of participants suggests industry "maintain status quo" and does not see change as a priority.

Figure 3 Prioritization of Point-of-Sale Use Cases



Source: Beyond the U.P.C. Research

Whether respondents believed in reinventing retail, maintaining the status quo, or fell somewhere in between, all recognized real motivators and hurdles to change highlighted in **Figure 4**. The biggest motivators come

Figure 4 Sample Feedback—Motivators and Hurdles to Change to a More Robust Data Carrier

Motivators to Change

- Consumer Insights
- Consumer Experience
- Regulatory Compliance
- SmartLabel®
- Packaging Clutter
- Competitive Pressures
- Labor Costs and Safety

Hurdles to Change

- Trust, Quality, and Integrity of Data
- Use Case/ROI
- Packaging Size and Redesign
- Complexity
- Capital Investment
- Critical Mass
- Price Point of Product

Source: Beyond the U.P.C. Research

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from those use cases where more and more product data is requested or required by trading partners, regulators, and/or consumers. On the other hand, hurdles to change are largely influenced by the cost and disruption to products and packaging, often driven by the potential return on investment (ROI). While more robust data carriers also bring the promise of streamlined data sharing, one hurdle that remains constant is trust. Lack of trust in data quality and partner integrity limits respondents' beliefs that a single data carrier can solve some of the challenges faced today. Working together to bridge these gaps, brand owners and retailers could share POS data to strengthen their partnerships and better understand the consumer.

Current State of POS Systems and What Has to Change to Realize These Benefits

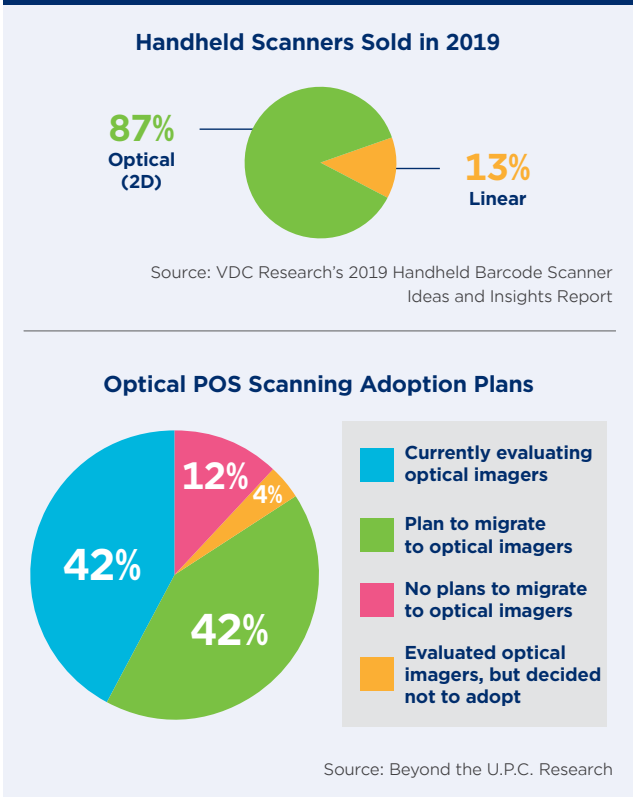
POS Modernization: Investment is Already Underway

A shift from laser-based to optical (camera-based) scanning hardware is a necessary step to enable the broader adoption of data-rich carriers. More than 30 percent of retail respondents have already implemented optical scanning technology at POS, and most other retailers indicated they have plans in place to adopt or are currently evaluating adoption, as shown in **Figure 5**. Optical scanner adoption is on the rise for high-volume retailers, such as those in the grocery, mass merchant, and hypermarket spaces, due to the ability to read many types of data carriers easily, while generating higher throughput at the checkout when compared to laser scanners. Five to ten years ago, this hardware change represented a significant barrier to adoption of new data carriers. However, in the last five years, there has been an increase in adoption of optical solutions as costs have decreased.[4]

"The U.P.C. is an opportunity to collect and globally share what products are, and the information shared can be extended to include things like expiration date, nutrients, and authenticity."

Retailer

Figure 5 Migration to Optical Scanner Technology is Already Underway



But upgrading POS systems from laser-based to optical scanning is not enough to realize the benefit of a more robust data carrier. Upgrading and integrating the backend systems and infrastructure components that drive POS is also necessary to process the additional information contained in a different data carrier. To fully realize the benefits of adopting data-rich barcode symbologies, any system touching POS data—databases, edit routines, algorithms, and other computations—will need to recognize the codes and accommodate the datasets.

4. VDC Research, Automatic Identification and Data Capture Research Services, continuous market and technology monitoring. For over 20 years, VDC Research has tracked shipment levels of technologies including, but not limited to, Stationary Point of Sale Systems and Barcode Scanners, with detailed tracking of the shipments and installed laser- versus image-based (linear and 2D) technologies. VDC conducts and publishes this research quarterly and annually.

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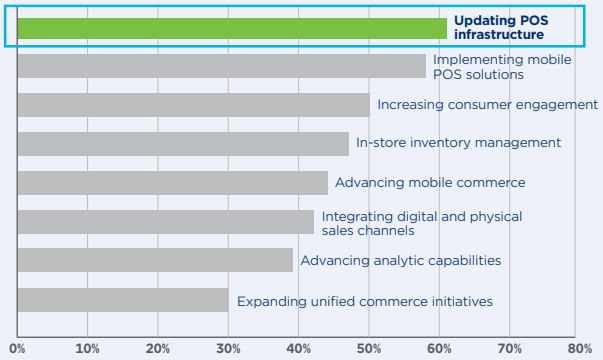
Figure 6 Organizations' Leading Technology-Driven Strategies for the Next 18-24 Months



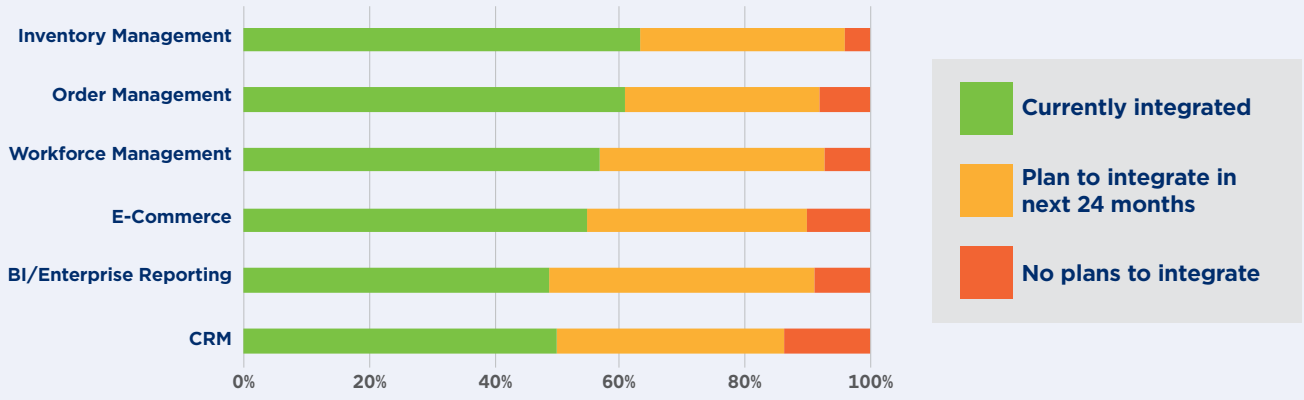
Source: Beyond the U.P.C. Research

Retailers indicated that updating POS infrastructure is the highest priority amongst their technology-driven strategies over the next 18-24 months, as reflected in **Figure 6**. Sixty percent of survey respondents indicated they have infrastructure already in place or plan to upgrade their POS systems and/or add capabilities to their current POS systems in the two-year horizon.

Many retailers have highly fragmented and siloed POS systems—often due to growth from mergers and acquisitions—and have postponed investment in POS. This landscape is beginning to change as more retailers are integrating their POS architecture and applications with other critical enterprise applications, such as order management, warehouse management, and workforce management systems, as shown in **Figure 7**. Standardized, structured data captured at POS can improve data quality and completeness in enterprise systems, proving the case for integrating POS and backend systems, but data-rich barcodes and carriers are required for this to work.

As evidenced by the efforts underway with pharmaceutical products and apparel, a critical requirement for retail transformation is the ability to provide item-level serialization through data-rich carriers such as 2D data carriers or RFID. Key to any of these initiatives is the ability for the underlying applications and databases to be able to consume and process these richer product identifiers and for retailers to synchronize efforts with their trading partners. What often happens, however, is that the full, encoded serialized data is not being read and that the codes are "collapsed" into existing data structures—for example, to update quantities on hand—substantially eroding the potential value of true item-level serialization.

Figure 7 Level of POS Integration With Enterprise Applications



Source: Beyond the U.P.C. Research

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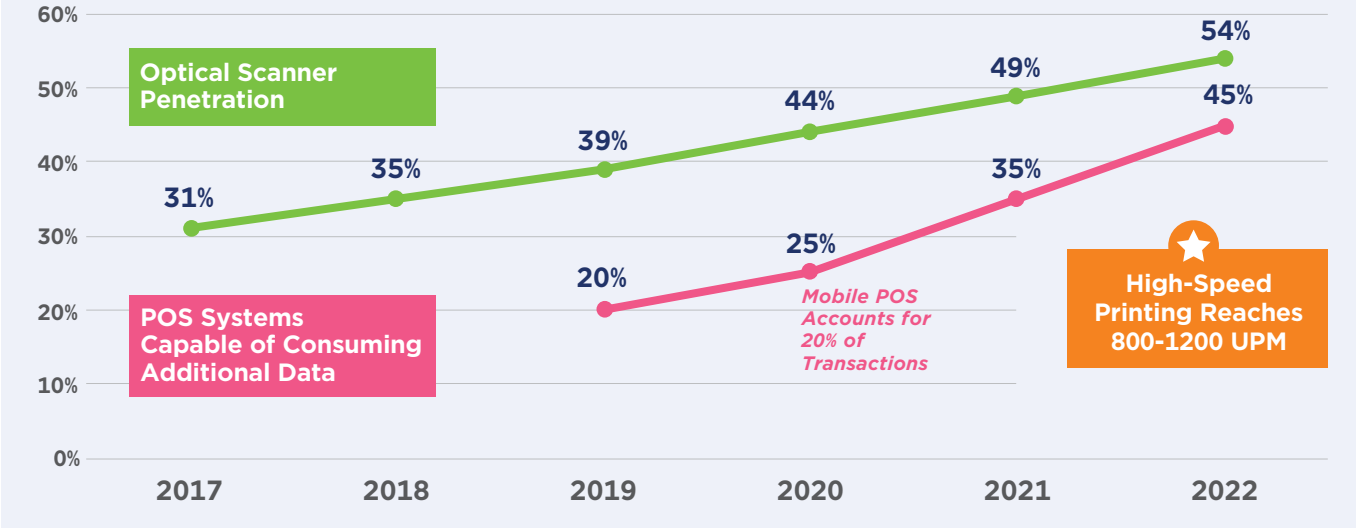
Figure 8 Five-Year Projection for Key Technologies



Source: Beyond the U.P.C. Research

Convergence of Key Technology Adoption

The convergence of key technologies necessary to support industry migration to data-rich barcodes is already starting and will grow considerably in the next three to five years, as shown in **Figure 8**.

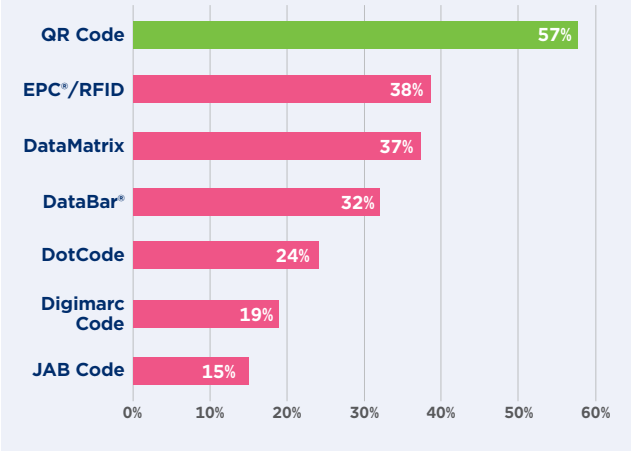
- Technology to print and code individual items with GTIN and dynamic information (e.g., batch, lot, expiration date, etc.) at high speeds of 800-1200 units per minute (UPM) will be implemented.
- The penetration of optical scanners deployed at Tier 1 retailer check lanes will be greater than 50 percent.
- About 50 percent of the retailers' systems will be able to process more than just the GTIN and will include dynamic data.

Lack of industry alignment on how to optimize these new technologies is already starting to lead to proprietary solutions, causing confusion and inefficiencies in the supply chain. Many data carriers are capable of delivering the benefits industry desires; however, **Figure 9** illustrates that the QR code was the most popular selection among respondents as an updated barcode symbology. Currently, it is advantageous over other data carriers since it can be read natively by mobile operating systems such as Google Android or Apple iOS. The GS1 DataMatrix is familiar to some industries, primarily regulated healthcare, and is popular due to its ability to be etched/printed on smaller items.

"We're trying to make sure that the consumer gets the best experience. At the end of the day, that's what it's all about."

Solution Provider

Figure 9 Data Needs and Data Carriers as Ranked by Respondents



Source: Beyond the U.P.C. Research

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Timing and Path Forward

Many of the survey respondents believe that the transition to a data-rich carrier is possible in the very near future and, in some cases, is already in place. Some retailers and brand owners are already engaged in developing and implementing 2D strategies to enable data-rich capabilities (e.g., managing fresh and pre-prepared foods, serialization, consumer engagement via SmartLabel®, and traceability).

Figure 10 shows that most respondents see one to five years as a realistic timeframe for transition.

Tier 1 research participants expressed that the issue was complicated, and there is a desire for change with a clear expectation that it is GS1 US's role to lead the industry migration. Accordingly, GS1 US has compiled the following recommendations to support the migration from the U.P.C. barcode to a 2D data carrier, such as QR code or GS1 DataMatrix for Healthcare:

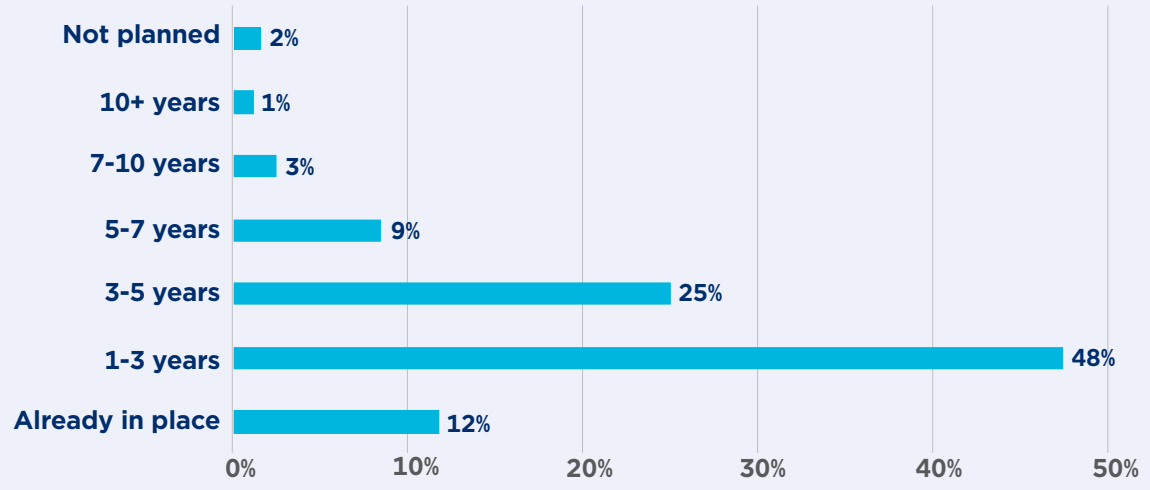
"What's a realistic timeframe? We start in 2020 and by 2025, we sunset the U.P.C. Two years is way too fast. Ten years is way too long."

Retailer

Flexible Architecture—A Period of Dual Barcoding

The range of current situations and priorities means that industry needs a flexible architecture that supports the use of dual barcodes during the transition period, and where no one is significantly disadvantaged, while others move forward at their own pace. The credit card industry offers a good analogy given its use of human-readable numbers, magnetic swipe, NFC "tap to pay," and chip EMV technologies.

Figure 10 Industry View on Transition Timing



Source: Beyond the U.P.C. Research

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"The first sunrise date on DataBar on coupons was 2014, then extended to 2016, but we got there. The same thing could happen for U.P.C. and 2D."

Industry Association

GS1 Digital Link—Common Data Structure for Physical and Digital (online)

In 2018, the GS1 Digital Link Standard was ratified as an industry standard for data carriers and data attributes to be expressed in the language of the web. It incorporates a Universal Reference Identifier (URI) into a data carrier that provides consumers with a link to brand-authorized product information. This data can then be leveraged by traditional applications, such as POS, as a common language to provide important supply chain information. GS1 Digital Link offers tremendous promise to industry, and GS1 US will communicate the pilot results and implications of GS1 Digital Link in a future white paper.

Recommendations for Brand Owners

Dynamic (vs. current GTIN only) information needs require changes to printing and packaging. Widespread, higher-speed dynamic printing capabilities (800-1200 UPM) are on the three- to five-year horizon. As these capabilities are in development, brand owners can implement product packaging strategies to incorporate dynamic and GTIN data, while supporting the multiple barcodes recommended in the flexible architecture. Brand owners should understand that their retail partners have expressed a higher level of urgency to move "Beyond the U.P.C." and have prioritized investing in POS and other supply chain systems.

Recommendations for Retailers

For those who have not already transitioned, the POS replacement horizon is three to five years. Retailers can incorporate support for 2D data carriers on technology roadmaps and hardware and software procurement plans (RFP).

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Addendum, February 2020

Tier 2 and Tier 3 Research Industry Perspectives

"Tier 2 and 3 retailers and brand owners are surprisingly similar to Tier 1 in terms of the need to adopt 2D data carriers."

VDC Research

Introduction

Tier 1[5] retailer and brand owner findings completed in May 2019 were followed by research with Tier 2 and Tier 3 retailers and brand owners to provide a complete view on how industry wants to move forward and how GS1 US can support the community.

Research Methodology

The Tier 2 and Tier 3 research was conducted in August and September 2019 through a series of online surveys with retail IT decision-makers and in-depth interviews. Due to the specialization and fragmentation of Tier 2 and Tier 3 companies and their reliance on partners to provide recommendations and solutions, the interviews were primarily with the solution providers who service this market. See **Figure 11** for list of research participants.

Figure 11 Primary Research Methodology

Twelve In-Depth Interviews With Retail Solution Providers and Industry Association:

- Scandit
- Socket Mobile
- Toshiba GCS
- Zebra Technologies
- Applied Data
- Oracle
- Aptos
- Fujitsu
- Honeywell
- HP
- NACDS (National Association of Chain Drug Stores)
- Bizerba

Survey fielded among Tier 2 and Tier 3 retail technology decision-makers with POS scanning and application solution selection, specification, and/or support responsibilities. Total sample size of 409 U.S.-based retail respondents stratified across target retail sectors.

Tier 2 and Tier 3 Use Cases: It's Still About the Data

Tier 2 and Tier 3 brand owners and retailers have many of the same use case priorities as Tier 1:

- Inventory Accuracy
- Consumer Engagement
- Product Authenticity
- Traceability

They also communicated a stronger need for regulatory compliance and scanning 2D symbols.

1. Regulatory Compliance

Full traceability from manufacturing to sale is needed for regulated products such as tobacco, alcohol, cannabidiol (CBD), and healthcare. To comply with regulations, smaller retailers and especially convenience stores felt a sense of urgency to upgrade their infrastructure to capture additional information such as serialization and batch/lot number.

5. Retailer and brand owner tiers are defined by revenue (USD$) as Tier 1: $1B+; Tier 2: $100M-$1B; Tier 3: $10M-$100M

2. Scanning 2D Symbols

The need to scan 2D data carriers was evident in the Tier 2 and Tier 3 communities, as they are strongly focused on loyalty programs and need the ability to scan 2D barcodes on loyalty cards and apps. In addition, they communicated a need to scan 2D data carriers to accept mobile app payments and scan driver's licenses for age verification in order to comply with regulations mentioned in the above use case.

Technology Readiness

Moving beyond the U.P.C. will require capital investment and technical infrastructure changes. Tier 2 and Tier 3 have smaller budgets and fewer IT staff to implement these changes, and they have a greater dependency on solution providers and contractors to maintain and upgrade systems.

Technology readiness consists of five enabling components as outlined in **Figure 12**. Readiness will progress at different speeds, but at minimum, brands need to be able to print and encode a 2D carrier and retailers need to scan and ingest the encoded Global Trade Item Number™ (GTIN®) at POS.

Figure 12 Technology Readiness

	Technology	Tier 2	Tier 3
Brands	Printing/Packaging	Printing U.P.C. and human-readable dynamic data (e.g., batch/lot number); pharma can print DataMatrix at 300 UPM	
Retailers	Scanning	Transition to optical scanners beginning	
	POS Transformation	Large capital investment needed—desire to transform POS	Investigating more agile POS solutions
	Back Office Integration	Burdened by legacy systems, will begin to integrate systems	Burdened by legacy or non-existent systems
All	Analytics using machine learning (ML), artificial intelligence (AI), robotic process automation (RPA)	Transition beginning, no data scientists, business-driven solutions needed	Waiting for value proposition, no data scientists, business-driven solutions needed

1 Printing/Packaging

Currently, brands are printing the U.P.C. barcode and human-readable attribute data and/or multiple barcodes on the package. The migration to a 2D carrier would allow companies to use one data carrier for a wide range of use cases. Printing and packaging lines may require capital investment to print a 2D carrier, incorporating both the GTIN and attribute data. The pharmaceutical industry has been printing and encoding GTIN and attribute data in the GS1 DataMatrix barcode on their regulated products for several years.

2 Scanning

For decades, the hardware norm was linear, or laser, POS scanners which can only read 1D barcodes like the U.P.C. Linear scanners are being phased out as retailers upgrade to optical scanners which can read 2D carriers. Tier 1 has mostly transitioned to optical scanners. Handheld scanners typically have a 5-year life span, and Tier 2 and Tier 3 will be migrating to optical scanners as equipment ages.

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3 POS Systems

POS systems need to be able to ingest the GTIN and associated attribute data. Tier 1 is already upgrading POS—mostly due to the requirements of omni-channel commerce and mobile POS. Tier 2 is generally burdened with legacy systems—however, omni-channel commerce is an expectation for all retailers, and they need to modernize their systems. Some Tier 3 retailers are the most agile, with cloud-based POS systems already implemented, while others struggle with budgets and older infrastructure.

4 Backend Systems

To fully leverage the attribute data, it must be consumed and integrated into backend systems, such as inventory, supply chain management and merchandising systems. All tiers have legacy backend systems—integration is complex, and this appears to be the most significant bottleneck in the industry.

5 Analytics

All Tiers are struggling with how to turn the data into business knowledge or insights. Retailers and brands are drowning in data, but it is falling to the floor largely because outdated backend systems cannot process it. Serialized data that is collected for inventory accuracy and visibility is often collapsed to reflect more immediate information, such as on-hand inventory at specific points in the supply chain when it could offer a great opportunity to look at data in non-traditional ways. Tier 1 has the resources to hire teams of data scientists. Tier 2 and 3 are either just starting to look at the data or don't even know where to begin. The industry needs technical solutions to make data analytics automated and actionable. There is a tremendous opportunity for brand owners and retailers to share data and insights and to strengthen their partnership.

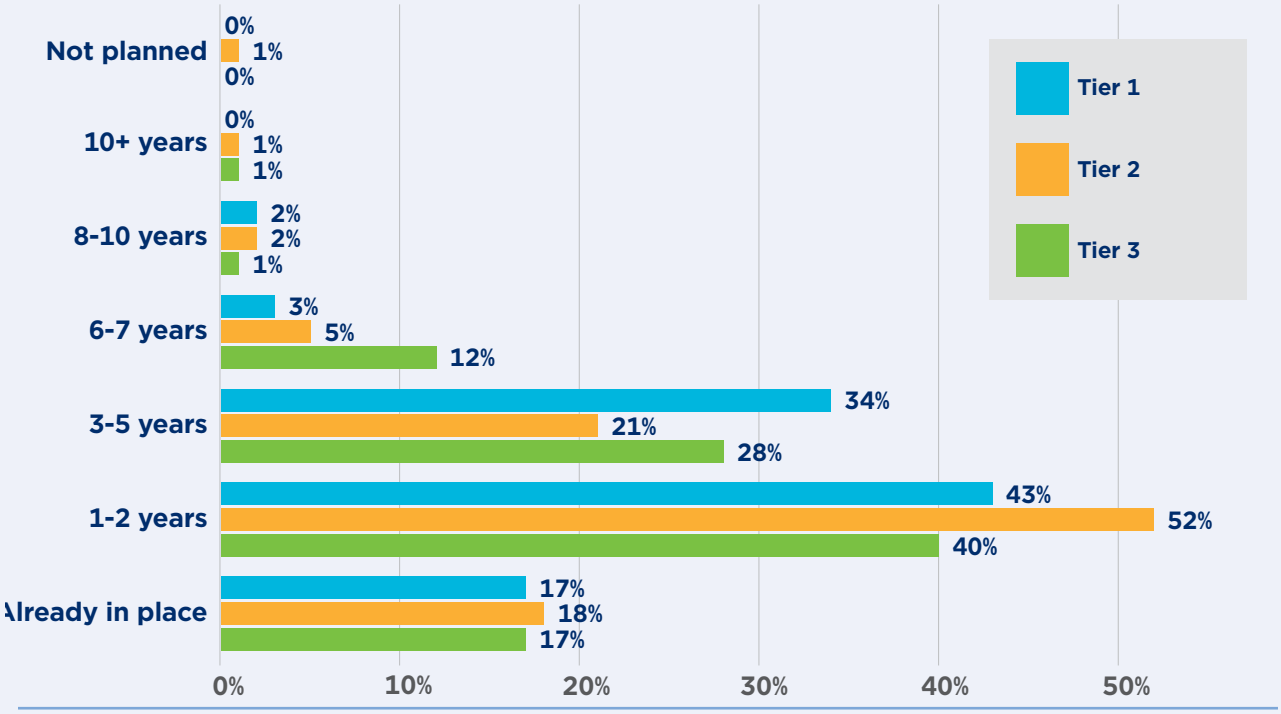
"In the case of 2D imagers, there has been an unusual chain of adoption, where the new technology started at Tier 3 and moved up. Our estimate is that mid-tier will be even further out, with the trend circling back around to Tier 1 and filtering down through mid-tier retailers. In addition, it is only as these codes become more pervasive that GS1 will see the additional benefit. Mid-tier adoption is probably in the 5+ year range."

Solution Provider

"It may be 5-7 years until the market sees mass adoption. Retail is a slow-moving industry, and most upper-tier organizations are handcuffed by legacy items, whether it is other devices in POS or operating systems or lack of internal strategy and cooperation."

Solution Provider

Figure 13 Timeframe for Migration to Data-Rich Barcodes Scanning at POS for Tier 1 and Tier 2 and 3 Retailers



Roughly three-quarters of Tier 1 and Tier 2 and 3 Retailers will transition to the next generation U.P.C. solution within five years.

Source: Beyond the U.P.C. Research

Timeline for Next Generation of Data-Rich Barcodes

The transition to a data-rich carrier is already happening with the deployment of 2D solutions to manage fresh and prepared foods, consumer engagement via SmartLabel®, and with the proliferation of proprietary barcodes on pack to manage other needs.

The timeline expressed by Tier 2 and Tier 3 is similar to Tier 1: a transition from U.P.C. to a data-rich carrier would ideally be 3-5 years. However, the industry "long tail" will need a slightly longer transition period. See **Figure 13**—Timeframe for Migration to Data-Rich Barcodes Scanning at POS for Tier 1 and Tier 2 and 3 Retailers.

Conclusion

The U.P.C. barcode is here to stay for the foreseeable future. For some products, the U.P.C. is adequate for product identification and getting items through the POS; however, the migration to additional data carriers on pack has already started to meet more robust data needs.

Tier 2 and Tier 3 companies are on the same trajectory as Tier 1 organizations in terms of use case priorities and their technology readiness to implement solutions for data-rich barcodes. Smaller retailers and brand owners may lag by two or three years, but not enough to impact the industry timeline to move Beyond the U.P.C.

Industries will move at slightly different speed driven by use case priorities, ability to leverage the data, and technology modernization. As long as GS1 Standards are used for the data structure for both the 2D carrier and the U.P.C., products will continue to be accepted at POS during the transition period.

Note: 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.

Next Steps

Within your industry and business, we have identified the following five steps needed to move "Beyond the U.P.C."

Ensuring interoperability is easiest when industries align on use cases, attributes, and preferred data carriers. However, this alignment has not been achieved—thereby necessitating the Tier 2/3 work (See **Addendum** on page 12 within this document), global engagement with other markets, and continued work within specific GS1 US Community Engagement industry verticals. While further work is underway, immediate guidance is necessary for those who do not want to wait. GS1 US is developing tools to help industry choose the best standard data elements and corresponding data carrier for each use case. This includes guidance to ensure POS systems continue to "beep," no matter the data carrier selected. See **Figure 14** Decision Tree—Guidance on Data Attribute and Data Carrier Selection for Specific Use Case on page 17 for guidance on what carrier is best suited for specific use cases and the standard data elements required. Refer to **Figure 15**—Data Carrier Options table on pages 18–19 for details on each carrier.

The GS1 US Community Engagement industry initiatives will be discussing the priority of these five required steps during 2020 and developing guidance documents, as needed.

1. **Determine the top use cases you are trying to address that are not solved by U.P.C.**
2. **Identify what standard attribute data is required to solve the use case(s)**
3. **Use the GS1 US decision tree to determine which data carriers can meet those needs** (see **Figure 14** on page 17—noted above)
4. **Based on data carrier and attribute choice, determine scanning, printing, data processing, and storage upgrade requirements**
5. **Based on attribute choice, determine what platform(s) is necessary for the query and sharing of data**

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Figure 14 Decision Tree—Guidance on Data Attribute and Data Carrier Selection for Specific Use Case

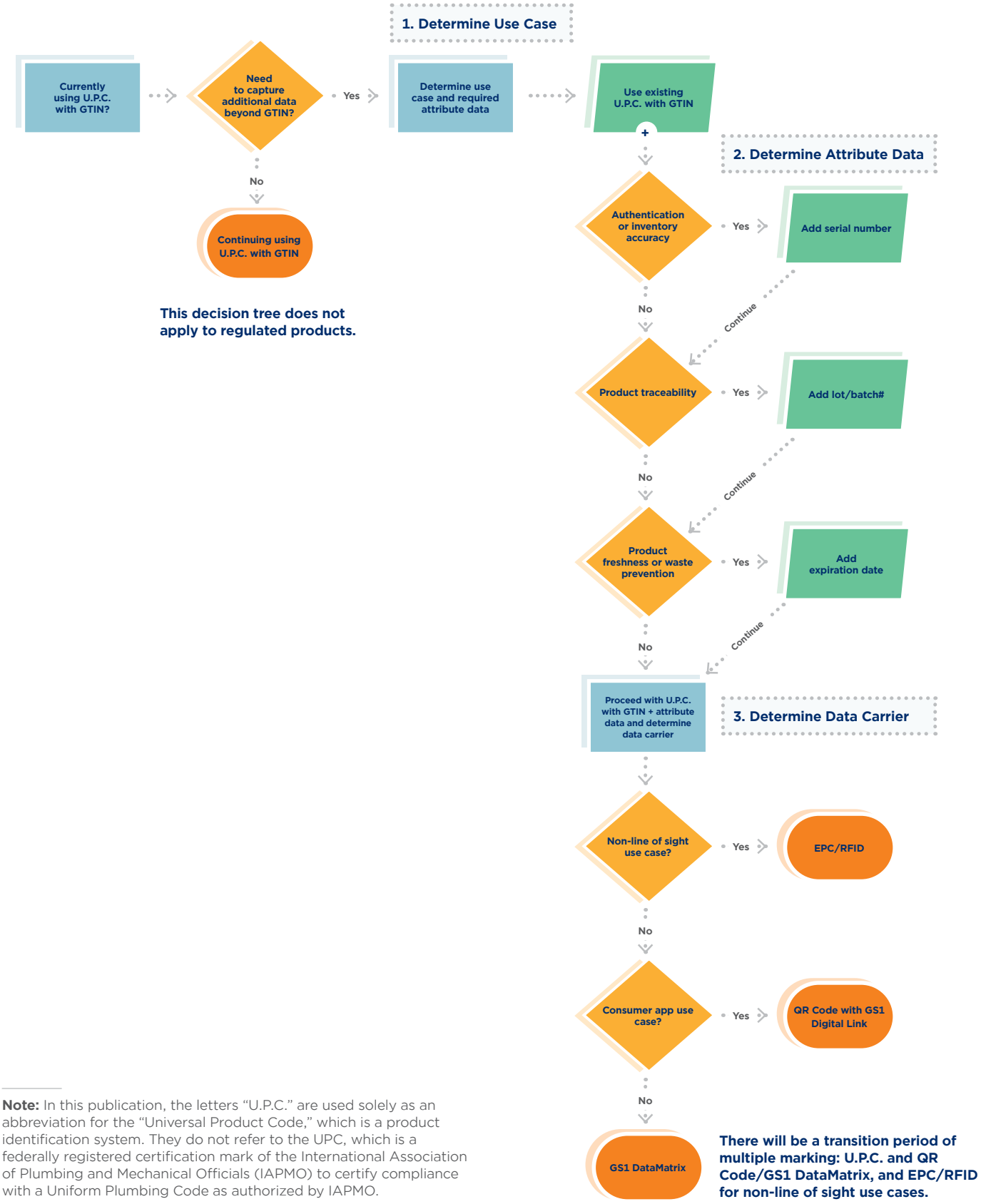

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Figure 15 Data Carrier Options Table

Data Carrier	Standards Organization	Capacity	Technology	Limitations	Status
U.P.C.	• GS1 • ISO	12 numeric digits	1D barcode	No capacity for additional data	North American (NA) standard for product identification for over 40 years.
EAN	• GS1 • ISO	13 numeric digits	1D barcode	No capacity for additional data	Unclear about full industry acceptance in NA despite Sunrise 2005 standard.
GS1 DataBar®	• GS1 • ISO	Up to 74 alphanumeric characters	1D barcode	Limited data capacity and ability to accommodate high-speed printing	Often used to label fresh food and manufacturer coupons.
GS1 DataMatrix	• GS1 • ISO	2,335 alphanumeric characters	2D barcode	Requires optical scanner (e.g., smartphone)	Very popular in barcode applications with small dimensions, as well as etched part marking. GS1 standard for regulated healthcare.
QR Code	• Open standard • GS1 standardization effort underway	2,953 alphanumeric characters	2D barcode	Requires optical scanner (e.g., smartphone)	Broad adoption by smartphone community and is the foundation symbology for the SmartLabel™ initiative.
EPC®/RFID	• GS1 • ISO	Storage capacity is only a limit of tag cost	UHF RFID Range >15m	Cost per tag	Although several successful POS pilots utilizing EPC/RFID have been conducted, it is probably not a short-term area of industry focus primarily due to the required transformation at POS.
GS1-128	• GS1 • ISO	48 alphanumeric characters	1D barcode	Probably not a good candidate for product identification	Used for logistical applications.
ITF-14	• GS1 • ISO	14 numeric digits	1D barcode	• No capacity for additional data • Probably not a good candidate for product identification	Used for logistical applications.

Continued on following page.

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Figure 15 Data Carrier Options Table *(continued)*

Data Carrier	Standards Classification	Capacity	Technology	Limitations	Status
NFC	IEEE		HF RFID Range ~10cm		• Used broadly in the payment industry. • May contain GS1 data.
ZigBee	IEEE		Range 10–100 meters line-of-sight	Probably not a good candidate for product identification	Used in mesh networks with low- powered devices.
Bluetooth	IEEE		Range 10 meters	Probably not a good candidate for product identification	Device to device communication protocol standards (e.g., phone to car, television to speaker).
DotCode	• ISO • GS1 standards for EU tobacco industry		2D barcode	Not read by all optical scanners	Prints at high speeds.
Digital Watermarking	Proprietary	150 bits	Steganography	• High-speed printing challenges • Challenges with certain colors on packages	Limited adoption due to required business process transformation.
Image Recognition	Proprietary	N/A	Camera	• Need for quality images • How to associate an identifier to an image? • How to differentiate organic versus non-organic?	Not currently viable for mainstream retail in near term.
Voice	Proprietary	N/A	Human voice		• Amazon Echo • Google Home • Apple HomePod

Appendix 1 Emerging Benefits of Alternative Barcode Symbology

Industry research indicated a number of key benefits that, to varying degrees, would be enabled by implementing alternative, data-rich barcode symbology:

1 Inventory Accuracy

Inventory accuracy and accuracy at POS are the two most frequently cited benefits of updating barcode symbology to more data-rich solutions. There is a perception that the U.P.C. is not designed, or suitable, for inventory management. The GS1 Electronic Product Code (EPC®)-enabled item level Radio Frequency Identification (RFID) technology is becoming a popular alternative to address this need in some retail sectors.

2 Improved Consumer Engagement

Updating barcode symbology to deliver more data-rich solutions will improve consumer engagement and deliver two primary benefits. It will provide:

- An opportunity to communicate more and better data to the consumer
- Richer consumer data: A more robust data carrier could provide consumers access to items such as nutritional and sustainability information as well as interactive video. This benefit was cited by more than 40 percent of retailers.

3 Product Authenticity

Both consumers and brand owners are concerned about product authenticity. Counterfeit goods cost the U.S. $29 to $41 billion annually.[6] Serialization of products (whereby every item contains a unique standard identifier and may include traceability information such as batch/lot, production date, and country of origin) can be used to verify that a product is genuine.

4 Traceability

Sharing richer product data across the retail value chain—data like place of purchase and product purchased—creates opportunities for improved consumer protection through faster and better targeted product recalls. For example, a single barcode symbology that contains information about batch/lot and country of origin would provide an incentive for every stakeholder along the supply chain to capture data to provide greater supply chain visibility. In fact, today, foodservice operators uniquely identify case-level information to provide track-and-trace visibility.

5 Freshness/Waste Prevention

Currently, one-fifth of all food waste is due to date confusion[7]—sell by vs. expiration dates. Improvements to sell by/expiration date management will enhance product rotation, increase freshness, and potentially eliminate sales of expired products. This benefit was cited by one-third of retailers.

6 Returns Management

There has been a 34 percent increase in retail returns over the last six years.[8] Seamless returns contribute significantly to positive consumer experiences and reduce operating cost, but retailers require more information than is available within the U.P.C. to effectively facilitate returns. Serialization would allow the retailer to tie the item back to a specific transaction to obtain the price and sales tax paid, method of payment, warranty, and other useful information.

6. Feb 2017, Inc Magazine. Retrieved on March 11, 2019 from https://www.inc.com/associated-press/counterfeiters-cost-600-billion-a-year.html
7. National Resources Defense Council, "Wasted: How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill," author Dana Gunders, NRDC, page 12, https://www.nrdc.org/sites/default/files/wasted-food-IP.pdf
8. Sidecar Discover, "The 4 Trickiest E-commerce Returns Challenges," post by Rishon Roberts, Senior Marketing Specialist, Optroro, https://discover.getsidecar.com/4-trickiest-ecommerce-returns-challenges

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