



The Global Language of Business

Trend Research 2018-2019

Identifying opportunities for GS1 to
address today's industry challenges



Authored by the Innovation Board

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Navigating the changing world

Twenty years into the “internet revolution” and the pace of change in business shows no sign of slowing. Advances in technology continue at breakneck speed, and industries are challenged to adapt, grow and thrive by leveraging new developments in digital connectivity, automation, artificial intelligence, miniaturisation and personalisation. In fact, the disruptive impact of technology is accelerating.

Millennials are now replacing baby boomers as the generation with the greatest buying power.¹ Social and behavioural changes are empowering consumers, who expect increased transparency, connectivity and integration of their services and products—all at lower costs, with increased speed and a greater focus on sustainability practices.

Other social influences impacting the global community of consumers include the aging population, the growing middle class and accelerating urbanisation where vast numbers of people are moving to cities around the world. The World Economic Forum projects that by 2050, approximately 66 percent of the population will live in cities, urbanised metropolitan areas and mega-cities.²

Businesses of all types are seeking greater opportunities to capture their share of consumer and corporate spending and are leveraging technologies to optimise their operations. They are also collecting and analysing more and more information—turning data into actionable intelligence.

“More data means more opportunities to create new feedback loops with consumers.”

Sanjay Sarma, Professor of Mechanical Engineering, Massachusetts Institute of Technology, Innovation Board Chair

Manufacturing companies are rapidly evolving to Industry 4.0 environments. They are looking for new ways to integrate information about equipment, components and subsystems for optimal throughput, cost savings, predictive maintenance and overall improvements in asset productivity.

In the healthcare industry, manufacturers are striving to make the global supply chain secure and highly efficient, while hospitals continue to seek new ways to improve patient care and safety via tools and processes to minimise errors and deliver better outcomes.

Additionally, better data is helping to create a massive shift to outcome-based payments.

It is clear that businesses and organisations can no longer afford to operate in silos. Instead, they need to actively collaborate with their trading partners, customers, consumers and patients—and work toward increased transparency and interoperability across their respective systems and processes.

The Innovation Board has been chartered to help GS1 navigate today’s challenging landscapes by identifying opportunities to evolve GS1’s core foundation of standards, systems and services to support industry transformations. This group of technology experts and industry leaders has provided initial guidance by identifying business trends and emerging technologies that are expected to have an impact on stakeholders across the supply chain.

This paper summarises the team’s research findings and insights. It is hoped that these insights will help guide GS1 as it prepares for—and delivers—solutions for today and into the future.

Innovation Board recommendations to GS1

1. Develop and extend the foundational GS1 Registry Platform to include all GS1 identifiers, to accommodate all levels of identity granularity, to include links to authoritative sources of data and to enable the capability to verify credentials for digital identity.
2. Make all products and things into sources of data for the companies that manufacture and sell them.
3. Leverage “linked, open data” to position the GS1 Registry Platform as a “primary node” of authoritative data about all GS1 identifiers on the web.
4. Embrace the mapping of other identification systems and data to GS1 identifiers.
5. Leverage innovation team resources to more deeply explore GS1’s potential relevance in voice/image recognition related to e-commerce.

1 Schroeder, Jules. (31 October 2017). *How To Tap Into The Millennial \$200 Billion Buying Power with Social Media*. Forbes. Retrieved from <https://www.forbes.com/sites/juleschroeder/2017/10/31/how-to-tap-into-the-millennial-200-billion-buying-power-with-social-media/#2566b3ea1161>

2 *Future of Urban Development and Services*. (25 October 2017). World Economic Forum. Retrieved at <https://www.weforum.org/projects/future-of-urban-development-services>



Exploring the future today

The team responsible for the research reached out to GS1 Member Organisations, connecting with over 400 people in 80 countries, through various user groups. The team received input from all GS1 core sectors, including retail, healthcare, transport & logistics, and technical industries. Additionally, input was gathered from other functional areas of the organisation such as Innovation, Public Policy and Automatic Identification and Data Capture (AIDC).

Additional external input was received from the Innovation Board and other industry experts. These responses resulted in the identification of more than 50 business trends and 75 technology enablers.

Top business trends in multiple industry sectors were collected, organised and prioritised and the relevance of these trends was mapped across the entire GS1 value chain. This approach was taken in order to provide direction when prioritising investments while continuing to support the current and future needs of industry.

Through this research, the team found that there are many emerging business trends that are being explored today or are being actively investigated by companies. Therefore, the focus of the research was relatively short-term—addressing topics that are “hot” today, and will be the focus of industry investigation and investment through the year 2020.

Identifying top business trends

By analysing business trends that span a variety of industry sectors, and investigating other sources of “mega-trend” and sector-specific trend research, the team identified the following current and near-term top business trends:

- Data security and privacy
- Traceability
- Sustainability
- On-demand logistics and services
- Automation and “Smart Everything”
- Empowered consumers
- Mass customisation

Data security and privacy

With the proliferation of connected devices on track to reach as many as 500 connected devices in the average home, the security of information is more important than ever.³ The cyber security market already exceeds US \$100 billion and is expected to exceed US \$200 billion by 2021.⁴

Consumer privacy concerns from recent data breaches have helped push security to the forefront for many industries. In the supply chain, as more systems become digitised, up-to-date security strategies and practices are critical to protect company data.

In healthcare, an important area of interest for patient safety is detecting falsified or counterfeit products that enter the legitimate supply chain. Therefore, the Innovation Board believes that security and cyber security are important underlying business trends that are driving significant investment across the GS1 value chain, from upstream providers, through manufacturing and transport, and especially in retail and the use of products.

Traceability

While the promise of end-to-end supply chain traceability has been possible with GS1 standards for some time, companies are now looking for greater opportunities to improve automated visibility across their supply chains.

They need to increase supply chain efficiency and improve product safety, value and integrity, while also meeting regulatory requirements to track and trace the movement of pharmaceuticals—and these regulatory requirements are increasing around the world. In addition, increased consumer interest about the foods they buy is driving more brands and retailers to explore ways to share information about the origin and source of foods and ingredients. More than ever, the need for traceability in food recalls is required to quickly and efficiently identify contaminated food and remove it from shelves.

Approximately one in ten people worldwide get sick every year from eating contaminated foods, according to the World Health Organisation. As a result, detection equipment is becoming more sophisticated and food safety regulators are recalling about twice as many products as a decade ago. And as the number of recalls rises, so do questions about food safety.⁵

Traceability has become a key enabler for trust and safety in the supply chain, both between consumers and brands, but also between manufacturers and their suppliers. For these reasons, the Innovation Board considers traceability to have broad impact across the entire GS1 value chain.

“Sustainability is ‘for real’ now ... More and more companies are taking this seriously and understand that their reputation on environmental and social sustainability issues is increasingly important to consumers.”

Pallaw Sharma, Vice President, JJSC Digital & Analytics, Johnson & Johnson, Innovation Board member

Sustainability

Sustainability is a global mega trend that encompasses both environmental and social issues such as reducing waste, new ways of optimising the use of resources, finding new opportunities to recycle and reuse packaging and products at end of life, and ensuring the fair trade of products.

³ Gartner Says a Typical Family Home Could Contain More Than 500 Smart Devices by 2022. (8 September 2014). Gartner. Retrieved from <https://www.gartner.com/en/newsroom/press-releases/2014-09-08-gartner-says-a-typical-family-home-could-contain-more-than-500-smart-devices-by-2022>

⁴ Size of the cyber security market worldwide, from 2017 to 2022 (in billion U.S. dollars). Statista. Retrieved from <https://www.statista.com/statistics/595182/worldwide-security-as-a-service-market-size>

⁵ World Health Organisation. (3 December 2015). WHO estimates of the global burden of foodborne diseases. Retrieved from https://www.who.int/foodsafety/publications/foodborne_disease/fergreport/en/

While “sustainability” has been an identified concern over the past decade, public perception and interest appears to be making sustainable social and business practices a real consumer priority that companies, brands and retailers need to embrace.

Continued efforts to reduce plastic waste, food waste and improve fuel efficiency in transportation, as well as ensuring fair labour practices, are at the forefront of business strategies. An increasing number of initiatives strive to define and measure sustainability metrics and how they change over time.⁶ Because the business drivers for such sustainability initiatives are closely related to GS1’s core sectors, the Innovation Board believes that this area is important for GS1 to maintain awareness and relevance.

On-demand logistics and services

With almost two-thirds of the population living in urban centres by 2050, consumers’ expectations for on-demand services and delivery are escalating.⁷ Additionally, business-to-business (B2B) companies are looking to reduce inventory and streamline their processes to serve their end customers better. All this calls for more and more automation throughout transport and logistics processes for increased efficiencies when making on-demand deliveries.

Location-based services, geolocation apps like What3Words and global positioning system (GPS) chips in smartphones and cars make it easy to find others anywhere and everywhere, creating new opportunities for on-demand delivery of products and services.

This not only allows consumers to get products delivered to any location at any time, but creates new opportunities for the agile management of warehouse and manufacturing facilities. This trend is expected to have great impact across the GS1 value chain for manufacturing, warehouse, transport, retail and fulfilment.

The Innovation Board believes that there is significant work to do to better enable the GS1 system to be used across the logistics and services landscape of tomorrow, specifically in the area of openly mapping location-based information to GS1 identifiers within a GS1 Registry Platform that is broadly accessible.

6 *Sustainable products: Guidelines for creating more sustainable products and product ranges.* (Version 1.2, January 2019). Sustainable Supply Chain for Food in Sweden. Retrieved from https://hallbarlivsmedelskedja.se/wp-content/uploads/2019/01/WWF_Sustainable-Products-v-1.2.pdf

7 *In a fast-changing world, can cities be built with long-term perspective?* (n.d.) EY. Retrieved from <https://www.ey.com/gl/en/issues/business-environment/ey-megatrends-urban-world>

8 Bernardi, Linda; Sarma, Sanjay; Traub, Kenneth. (6 October 2017). *The Inversion Factor: How to Thrive in the IoT Economy.*

9 Castellanos, Sara. (23 January 2019). Budweiser Maker Uses Machine Learning to Keep Beverages Flowing. *The Wall Street Journal*. Retrieved from <https://www.wsj.com/articles/beer-maker-uses-machine-learning-to-keep-beverages-flowing-11548239401>

10 *What intelligence will we need to create a smart future?* (n.d.) EY. Retrieved from <https://www.ey.com/gl/en/issues/business-environment/ey-megatrends-future-of-smart>

“With urbanisation comes heightened shopper expectations for delivery services, convenience and trusted providers.”

Milan Turk, Jr., Managing Director, Go-To-Market Strategy & Innovation, Procter & Gamble, Innovation Board member

Automation and Smart Everything

Everything that can be connected, will be connected. IoT technologies and devices along with high-bandwidth wireless communication and data transfer are all becoming cheaper and easier to implement.⁸

Today, these technologies are making a huge impact in the automation of existing processes—estimated to save over \$1 trillion per year for asset operators.⁹ For example, sensor-enabled systems are improving manufacturing efficiency, enabling new opportunities for adaptive process control and predictive maintenance.

Additionally, this “connection of everything” is opening up large, new industries related to Industrial IoT (Smart Factories) and Consumer IoT, enabling the automated replenishment of goods (Smart Homes), remote patient monitoring in healthcare (Smart Health) and Smart Cities. These IoT concepts encompass a diverse collection of energy, transportation, logistics and services optimisation.¹⁰

In the supply chain, new sensor-enabled systems are helping to monitor the cold chain to better manage and control freshness of perishable foods and provide temperature control for pharmaceuticals.

Automation and Smart Everything will have a substantial impact on the entire enterprise. This business trend will change the ways that consumers and customers interact with and use products.

In order to support new intelligence creation opportunities, the Innovation Board recommends continuing existing research into expansion and enhancement of the GS1 system to enable the identification of “things” more broadly and more permanently.

Empowered consumers

Retail is significantly transforming due to the rise of e-commerce and immersive mobile interactions.

Mobile retail sales are growing at an ever faster rate, and are projected to exceed \$1 trillion in China in 2018.¹¹ This, along with the proliferation of social media sharing, means that consumers are more powerful than ever before.

Consumers are demanding a greater variety of ways to shop, whether in the home, on the go or comparing prices in a physical store with an e-commerce site. Additionally, consumers are increasing their engagement, both by using connected devices and health monitoring devices and apps to manage their health and fitness goals, but also to share user-generated content through social media. In fact, 69 percent of shoppers are willing to trade their personal information for more personalised services.¹²

Companies are now shifting from the old way of looking to consumers for insights that aid in product development, and are now considering consumers as co-collaborators for developing products and services, which are also becoming more customisable to each consumer.¹³

Retailers around the world are also redefining the in-store experience. Consider that unstaffed retail stores without checkout lines are emerging from Amazon (US), Tesco (UK), Wheelys (Sweden and China), 7-Eleven (US and South Korea) and Alibaba (China).¹⁴

While the mobile device is a key enabling platform for the empowered consumer, other major technologies include IoT, augmented and virtual reality, and autonomous logistics.

The Innovation Board recommends that GS1 work with urgency to ensure that the products of tomorrow are generators of useful data providing insights to business leaders, by leveraging new work to bridge physical and digital commerce.

Mass customisation

Mass customisation of products and services—whether uniquely made for each customer or extensively configurable to meet their needs—requires success in two areas.

“Companies are asking how to make it possible to get more value from personalisation.”

Marina Kotsianas, CEO, Artia Strategies, Innovation Board member

The first is identifying opportunities for customisation that create value for the customer and are supported by smooth, swift and inexpensive transactions for both consumers and producers. The second is achieving a manageable cost structure and cost level for the producer even as manufacturing complexity increases.¹⁵

Customisation is possible in many industries, including personalised apparel, food, consumer electronics, beauty care and automotive. Across healthcare, individualised medicine and treatment are personalising patient care in new ways.

In manufacturing, new systems, software and processes are boosting equipment effectiveness. They can “think” multiple moves ahead to find new ways of maximising production throughput while creating new opportunities to create personalised products.

These systems are opening the door to extreme customisation called “order of one” and “batch size 1,” enabling factories to ship orders of one directly to customers.¹⁶ Enabling technologies that most impact mass customisation include autonomous logistics, robotics, A.I., and the Internet of Things and sensors.

The Innovation Board sees opportunity in this space around the extension of the foundational GS1 Registry Platform to include the ability to register increasingly granular products (such as registering a serialised instance of a manufactured product, which could be unique for every consumer).

11 Yu, Eileen (15 November 2018). *Alibaba Crosses 1 Billion Orders on 11.11 Singles Day Shopping Festival*. RetailTechNews. Retrieved at <https://www.retailtechnews.com/2018/11/15/alibaba-crosses-1-billion-orders-on-11-11-singles-day-shopping-festival/>

12 *How will you change buyers into stakeholders?* (n.d.) EY. Retrieved from <https://www.ey.com/gl/en/issues/business-environment/ey-megatrends-empowered-customer>

13 Bernardi, Linda; Sarma, Sanjay; Traub, Kenneth. (6 October 2017). *The Inversion Factor: How to Thrive in the IoT Economy*.

14 Huner, Julian. (10 April 2017). *Amazon Go vs. Wheelys 247- The Race for the Future of Retail has Begun*. Retrieved at <https://www.linkedin.com/pulse/amazon-go-vs-wheelys-247-race-future-retail-julian-huner>

15 Gandhi, Anshuk; Magar, Carmen; Roberts, Roger. (2013). *How technology can drive the next wave of mass customization*. McKinsey. Retrieved at https://www.mckinsey.com/-/media/mckinsey/dotcom/client_service/bto/pdf/mobt32_02-09_masscustom_r4.ashx

16 Queen, Karen Haywood. (30 March 2018). *To Each His Own: Batch Size 1 Arrives*. Advanced Manufacturing. Retrieved at <https://advancedmanufacturing.org/to-each-his-own/>

Business trends and the GS1 value chain

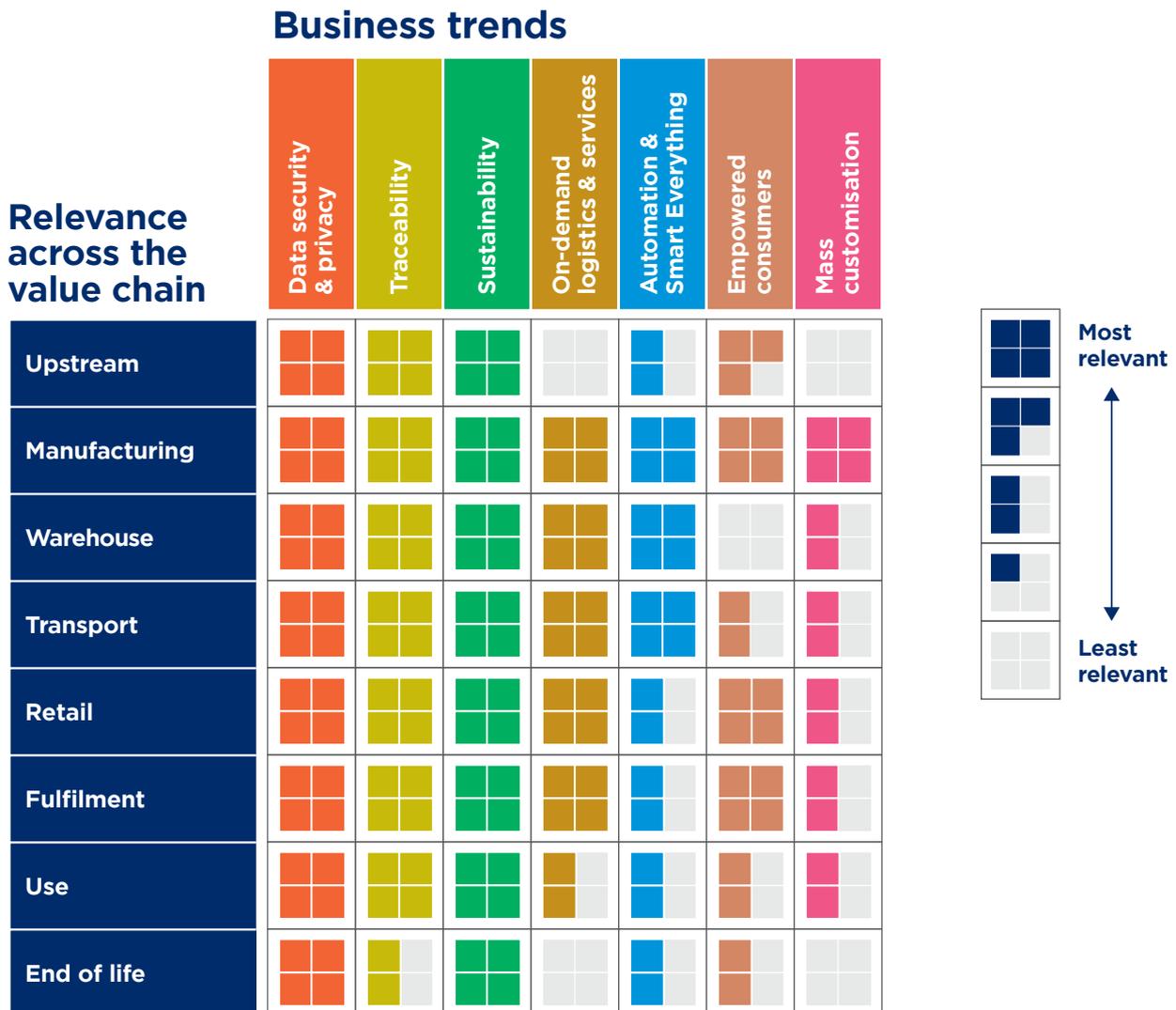
To help show their relevance to the industries that GS1 serves, business trends were mapped to the different parts of the GS1 value chain, based on anticipated impact.

The Innovation Board decided it was important to extend its exploration beyond the traditional supply chain to include the entire “value chain” and its processes, including:

- **Upstream** – raw materials or ingredient sources
- **Downstream** – the fulfilment of products direct to consumers, hospitals or other end users

- **Use** – any and all ways that products are used, such as consumers connecting products to their Smart Home system or a hospital using pharmaceuticals and medical devices in patient care
- **End of life** – includes a variety of scenarios; for example, products that are being disposed of, disassembled, recycled, and even industrial components that are refurbished to re-enter the value chain

The figure below illustrates the degree of relevancy of business trends on the steps of the GS1 value chain.



Technologies enabling business trends

Internet, blockchain, artificial intelligence and robotics are all new or emerging technologies that capture people's attention and imagination. In our Trend Research, technologies have been investigated separately from business trends, because such technologies are potential enablers of the business trends.

In fact, through the Trend Research, it became clear that no one enabling technology can solve every problem, but that a combination of enabling technologies and capabilities are required to address each of the prioritised business trends of today.

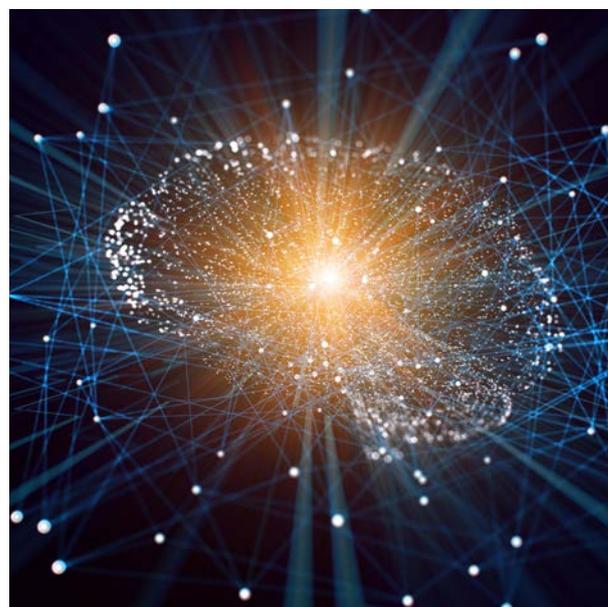
The top technology disruptors that are expected to impact GS1 industries and be relevant to the prioritised business trends are:

- IoT, sensors and biometrics
- Artificial intelligence (A.I.)
- Open, structured and linked data
- Autonomous logistics
- Blockchain and distributed data
- Computer vision
- Voice recognition
- Robotics
- Augmented, virtual and mixed reality

IoT, sensors and biometrics

The impact of IoT on how we live, play and work is enormous and wide-reaching—from Smart Homes to Smart Hospitals, and Smart Factories to Smart Cities. IoT (along with sensors, biometrics and the data that is generated by these devices) is creating a “design platform” that enables the development of a variety of applications in every industry—connecting devices that aid in fitness tracking, connecting patients with their doctors and caregivers, and smart industrial applications that better optimise equipment and resources.¹⁷ Across the value chain, IoT promises to improve cold-chain monitoring for food and pharmaceuticals, and create radically new consumer experiences by connecting home devices to each other.

Key business trends impacted are: automation and Smart Everything, empowered consumers, on-demand logistics and services, traceability and sustainability.



Artificial intelligence (A.I.)

A.I. describes advanced, smart computing techniques used to analyse complex problems and data, helping to define patterns in the data as well as provide advanced predictive analytics.

Machine learning is an A.I. application that provides systems the ability to automatically learn and improve from experience, without being explicitly programmed. Machine learning further focuses on the development of computer programmes that can access data and use it to learn for themselves.¹⁸

However, having too much data, too little data or inaccurate data creates challenges for companies that want to solve new business problems. In a recent study, McKinsey notes that only one percent of data collected is ever analysed for use in powerful business outcomes and decisions such as predictive analytics or optimisation.¹⁹

Artificial intelligence is, therefore, a powerful set of data technologies that supports the accelerated growth of other enabling technologies, such as improving voice recognition for digital assistants, enabling computer vision for self-checkout systems, supporting autonomous logistics and self-driving cars.

17 Bernardi, Linda; Sarma, Sanjay; Traub, Kenneth. (6 October 2017). *The Inversion Factor: How to Thrive in the IoT Economy*.

18 What is Machine Learning? Expert System. Retrieved from <https://www.expertsystem.com/machine-learning-definition/>

19 Manyika, James; Chui, Michael; Bisson, Peter; Woetzel, Jonathan; Dobbs, Richard; Bughin, Jacques; Aharon, Dan. McKinsey Global Institute. (June 2015). *Unlocking the Potential of the Internet of Things*. Retrieved from <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/the-internet-of-things-the-value-of-digitizing-the-physical-world>

These technologies enable new applications and approaches for autonomous robotics in support of the automation and Smart Everything trend, create new ways of engaging with empowered consumers, and help solve new problems in real-time for on-demand logistics and services as well as data security and privacy.

Open, structured and linked data

Transport applications need data from transport operators and mapping agencies. Entertainment websites need data from promoters, venues and ticket agencies. Healthcare apps need epidemiological and clinical data.

Almost any useful business-to-business or business-to-consumer application needs data from multiple sources. Integrating this data is extremely difficult, especially if it's unstructured, uses different identifiers for the same things and doesn't follow recognised standards.

Linked data²⁰ uses the concepts, standards and technologies of the internet to connect objects, people, places, products and documents. If this connected data is made available using a well-defined structure and under an open licence, it becomes easy to integrate, enabling the rapid development of applications that actively put products and services in front of consumers.

Classic examples of open, structured data include the global positioning system that underpins so much of modern life; census data and government statistics that guide business decisions and more; the U.S. Food and Drug Administration's Global Unique Device Identification Database of all medical devices.²¹

Baseline information for products, locations, services and things that carry GS1 identifiers, made available in ways that leverage linked, open data best practices, is a necessary foundation for the development of applications that serve retail, healthcare and many other industries. This will have a strong impact in all the business trends that rely on interoperable data, especially empowered consumers, traceability, and automation and Smart Everything.

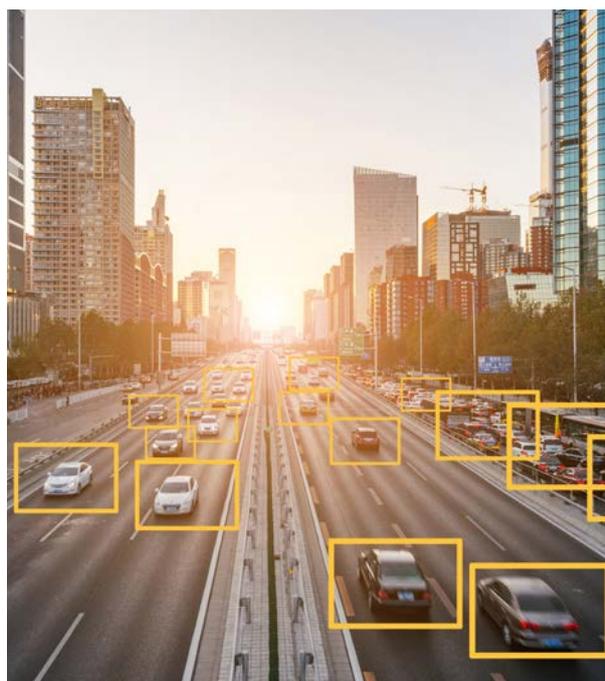
Autonomous logistics

In the same way that self-driving cars are disrupting personal transportation, there is a surge of applications that are taking advantage of autonomous systems for logistics.

These technologies are impacting baggage-handling systems at airports, drones assisting in last-mile delivery, automated ways to optimise pallet loading, and a multitude of picking, packing, and moving of goods throughout warehouses and fulfilment centres.²²

While autonomous vehicles can help address challenges in "last mile" implementations, larger, autonomous heavy trucks are also being tested today for the transport of goods over long distances.²³

Robotics and A.I. are other technologies that are contributing to the advancement of autonomous logistics, which is a key enabler for the business trends: on-demand logistics, and automation and Smart Everything.



20 Berners-Lee, Tim. (27 July 2006). [w3.org](https://www.w3.org/DesignIssues/LinkedData). Retrieved from <https://www.w3.org/DesignIssues/LinkedData>

21 Access GUDID. (n.d.) U.S. National Library of Medicine. Retrieved from <https://accessgudid.nlm.nih.gov>

22 Singh, Sarwant. (22 September 2016). Future of Logistics: Five Technologies That Will Self-Orchestrate The Supply Chain. Forbes. Retrieved from <https://www.forbes.com/sites/sarwantsingh/2016/09/22/future-of-logistics-5-technologies-that-will-self-orchestrate-the-supply-chain/#5fae68fd5a63>

23 Davis, Ally. (1 May 2018). Are Autonomous Vehicles The Future of Logistics? AI Business. Retrieved from <https://aibusiness.com/autonomous-vehicles-realistic-add-expect-logistics-industry-near-future>

Blockchain and distributed data

Blockchain is one of the most talked-about new technologies, gaining popularity as the enabling distributed ledger technology behind cryptocurrencies. The interest has expanded to a variety of industries as a means to share data and information across a large number of participants, such as the stakeholders in a supply chain, and offers potentially greater security to prevent the altering of data or transactions.

Blockchain offers new capabilities, such as Smart Contracts to aid in business efficiency and automation. These capabilities are helping to re-ignite interest in other approaches to managing distributed data, such as edge computing and distributed data warehouses.

Blockchain technology has emerged as a potential enabler for traceability, especially in food safety applications.²⁴

Computer vision

While early advances in computer vision have been focused exclusively on image recognition, the field has expanded to consider the ways that vision systems can observe environments and make decisions and conclusions about the physical environment to support a variety of applications.

For example, computer vision is aiding quality control inspection steps in food production, improving manufacturing efficiency and helping the navigation capabilities of autonomous cars. It is also a key component in helping advanced robotic systems that automate the movement of goods in a warehouse.

Computer vision is gaining attention in its role to help identify products and consumers in new self-checkout retail environments.²⁵

Computer vision is an enabler of many business trends, notably automation and Smart Everything as well as on-demand logistics and services.

Voice recognition

Voice recognition and natural language processing have progressed significantly in the past few years, and are driving the adoption of personal assistant devices. This has not only transformed the ways that consumers interact with their devices and access information, but is also beginning to impact commerce.

One example is how (in combination with A.I.), new voice chatbots are helping companies automate customer service. Yet, the greatest area of interest today is how “conversational commerce” will be enabled by smart speakers and other personal assistant devices. Brands, companies and marketplaces will increasingly look for opportunities to connect with consumers through apps and create new voice conversations to improve product research, answer questions about use of products and simplify purchases.²⁶

This technology enabler will have the biggest impact on the trends: empowered consumer, and automation and Smart Everything.

Robotics

Robots have advanced dramatically from the stationary, single purpose robotic “arms” that have traditionally automated automotive and industrial assembly. Today’s robotic systems take on many forms, whether carrying out a series of actions autonomously or semi-autonomously (e.g., performing stock picking or assembly and movement of palettes in warehouse and logistics operations), or acting in concert with other robots or people for more complex tasks.²⁷

A key emerging trend is “collaborative robots” (also referred to as cobots or co-robots) in which robots are interacting with people in warehouses and manufacturing settings. One area that is experiencing huge growth in robotic systems is in fulfilment and distribution centres, where robotic-enabled bins or entire racks are moved throughout the facility to the pick-and-pack workers.

Robotics is a key enabler in the automation and Smart Everything trend; it is also assisting in the scaling of mass customisation.

24 Mearian, Lucas. (1 October 2018). Q&A: Walmart’s Frank Yiannas on the blockchain for food safety. Computerworld. Retrieved from <https://www.computerworld.com/article/3309656/emerging-technology/qa-walmarts-frank-yiannas-on-the-use-of-blockchain-for-food-safety.html>

25 Agarwala, Badru. (8 October 2018). The Rapid Rise of Computer Vision. Electronic Design. Retrieved from <https://www.electronicdesign.com/industrial-automation/rapid-rise-computer-vision>

26 Taylor, Mark; Jacobs, Kees; Warner, Shannon; Graman, Gwendolyn; Sarma, Prof. Sanjay; Subirana, Prof. Brian; Cantwell, Richard; Stine, Jon; Hunt, Chris. (14 January 2018). *Time to talk*. Capgemini. Retrieved from <https://www.capgemini.com/resources/time-to-talk/>

27 3 Tech Trends Shaping the Future of Global Logistics. (25 August 2016). SupplyChain247. Retrieved from http://www.supplychain247.com/article/3_tech_trends_shaping_the_future_of_global_logistics



Augmented, virtual (AR/VR) and mixed reality

The ability to super-impose digital images and information into the real world using mobile phones, displays and wearable headsets is not only creating new immersive ways for consumers to interact with the real world, but is also helping to improve accuracy and efficiency in industrial and commercial settings.

New AR apps help consumers translate written signs and menus in real-time, and scan a barcode on a package to identify the product inside. Within manufacturing and logistics, AR/VR systems are

combined with computer vision to enable workers to see the digital picking list in their smart glasses, or to identify where a product is located or find products that have been misplaced.²⁸

And who can forget ways that these “mixed reality” systems can enhance maps for improved gaming or service location. While the cost of wearable AR/VR systems is still a barrier to more widescale adoption, we anticipate that these systems will have a big impact in driving new advances in the automation and Smart Everything and empowered consumer business trends.²⁹

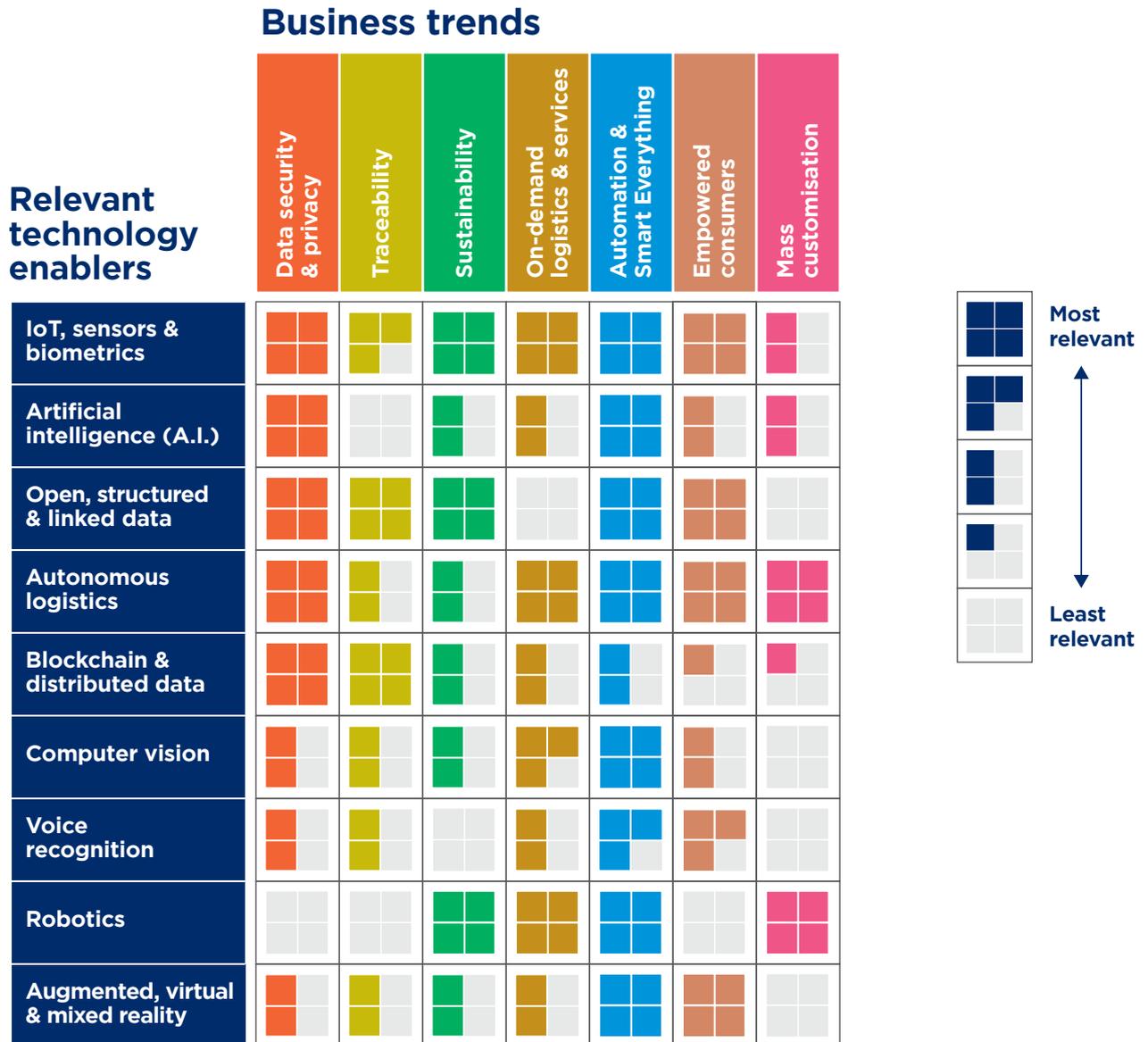
“Technology is moving fast, which means that companies need to be agile so that they can pilot things quickly.”

Sanjay Sarma, Professor of Mechanical Engineering, Massachusetts Institute of Technology, Innovation Board Chair

28 3 Tech Trends Shaping the Future of Global Logistics. (25 August 2016). SupplyChain247. Retrieved from http://www.supplychain247.com/article/3_tech_trends_shaping_the_future_of_global_logistics

29 Park, Michael. (9 November 2017). 3 ways AR is transforming manufacturing and logistics. Venture Beat. Retrieved from <https://venturebeat.com/2017/11/09/3-ways-ar-will-revolutionize-manufacturing-and-logistics/>

Business trends and technology enablers



“No silver bullet technology will solve everything ... Today’s business challenges are really complex, and require a portfolio of capabilities.”

Chris Resweber, Senior Vice President, Industry Affairs, The J.M. Smucker Company, Innovation Board member

Recommendations

With so many technologies developing rapidly, it's challenging for any organisation to decide what to invest in. This report highlights the idea that technologies can be enablers to help industry adapt to real-world business trends.

At the core of the GS1 system is the concept of globally unique identification. Built around this core is a standards ecosystem that enables the exchange of three types of data about the products, locations, services and things that are identified using the GS1 system: master data, transactional data and event data.

Beyond continuing current investigations into both IoT and blockchain, the Innovation Board has identified five recommendations for GS1.

1. Develop and extend a foundational GS1 Registry Platform for all GS1 identifiers. Enable this GS1 Registry Platform to store (and make available) basic, foundational and authoritative data about each registered identifier. Then, enable this platform to allow registration of identifiers at increasing levels of granularity. Next, enable any registered identifier to have associated "links" to sources of data about them. Then, enable the GS1 Registry Platform to be able to verify credentials for digital identity.

Further developing and extending a GS1 Registry Platform to be relevant to more granular levels of identity will serve to enable industry to develop and adapt solutions to address the business trends of traceability and sustainability. Additionally, enabling the registration of GS1 keys for locations and assets will enable industry to develop enhanced, on-demand logistics and services solutions. And, once scaled, such a GS1 Registry Platform will serve to enable solution providers, content service providers and data pools to build advanced solutions around it and to further enable the empowered consumers of tomorrow.

2. Make all products and things into sources of data for the companies that manufacture and sell them. Set a path to the future of on-pack labelling that makes sense to CEOs, by ensuring that each and every product or machine that they produce can leverage its GS1 identification as the foundation of a growing ecosystem of inbound data. Be a guidestar for industry's evolution by enabling industry to accelerate toward a clearer future.

Once industry embraces their products...even traditional consumer packaged goods and fast-moving consumer goods products...as "data generators," a revolution that leverages machine learning and A.I. to generate insights for brands and manufacturers will begin. Serving ever-more-empowered consumers will get easier and mass customisation will see significant growth, both enabled by the insights and deep knowledge that industry will be able to gather about the use and post-sale lives of its products.

3. Leverage "linked, open data" to position the GS1 Registry Platform as a "primary node" of authoritative data about all GS1 identifiers on the web. Make the GS1 Registry Platform open and accessible to the world, so that the relevance of GS1 identification can (and will) scale dramatically.

The world is hungry for sources of authoritative data, with millions of app and solution providers looking to build value on top of such data sources. Opening access to foundational, authoritative data about products, locations, services and things, while maintaining security around the platform, will trigger a step-change in the value of GS1 identity around the world. This, in turn, will fuel significant growth in use of GS1 identification to solve industry challenges around traceability, sustainability, on-demand logistics and services, automation and Smart Everything.

4. Embrace the mapping of other identification systems and data to GS1 identifiers. For example, enable mapping of GPS, What3Words and/or other location data to the Global Location Number, for the purpose of removing friction and enabling more interoperable delivery and logistics offerings that are based on the GS1 system. Similarly, embrace the mapping of Global Product Classification (GPC) to other classification systems and the mapping of GS1 attributes to those of other known, common schemas. Continue to monitor other emerging product identification technologies, which may play a role in identity in the future.

5. Leverage innovation team resources to more deeply explore GS1's potential relevance in voice/image recognition related to e-commerce. As the GS1 system of standards is foundational to commerce around the world, it's timely and important for GS1 to more deeply understand the technologies that are starting to drive changes in purchase behaviours. Voice and image recognition need to be monitored as potentially rapidly growing paths to purchase, and are areas that may be in need of foundational standards so that siloed ecosystems do not become the only alternatives.

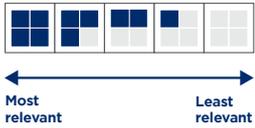
Relevancy: business trends, technologies and the GS1 value chain

Relevance of business trends across the value chain

Upstream	Manufacturing	Warehouse	Transport	Retail	Fulfillment	Use	End of Life
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Prioritised business trends

4	4	4	4	4	4	4	4	Data security & privacy	4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	Traceability	3	3	3	3	3	3	3	3	3	3
3	3	3	3	3	3	3	3	Sustainability	3	3	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2	On-demand logistics & services	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	Automation & Smart Everything	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	Empowered consumers	2	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	Mass customisation	2	2	2	2	2	2	2	2	2	2



4	4	4	4	4	4	4	4	4	4	4	4	4	4
3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	2	2	2	2	2	2	2	2	2	2	2	2	2
1	1	1	1	1	1	1	1	1	1	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0

Technology enablers relevant to business trends

Take the journey

Many of the business trends and technology enablers presented in this paper are still emerging. The Innovation Board believes they will continue to impact multiple industries for years to come.

As a result, the team intends to continue to track these business trends and technologies, while working with GS1 to expand the role of GS1 standards, solutions and services to support their advancement.

Our work is less about predicting the far-off future and more about identifying opportunities that GS1 can continue to support through these evolutionary, yet disruptive times. There is much more work ahead. Join us on this journey.

For more information about the GS1 trend research and GS1 innovation, contact GS1 at innovation@gs1.org.

About GS1

GS1 is a neutral, not-for-profit organisation that develops and maintains the most widely used global standards for efficient business communication. We are best known for the barcode, named by the BBC as one of “the 50 things that made the world economy”. GS1 standards improve the efficiency, safety and visibility of supply chains across physical and digital channels in 25 sectors. Our scale and reach – local Member Organisations in 112 countries, 1.5 million user companies and 6 billion transactions every day – help ensure that GS1 standards create a common language that supports systems and processes across the globe. Find out more at www.gs1.org.

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