Trend Research 2020-2021

Navigating the next normal

Authored by the Innovation Board

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Navigating the next normal

Two years ago, the GS1 Innovation Board published its first edition of *Trend Research 2018-2019*, highlighting the business trends and technology enablers that impact the industries that GS1 serves.[1] As research for this second edition commenced in early 2020, the Innovation Board expected to see continued evolution towards the "digitalisation of everything" that headlined the first edition of this report. No one could have predicted the massive disruption and strain that the global COVID-19 pandemic would have on people, healthcare, businesses and the supply chain infrastructure.[2]

This second edition of the report focuses on the pandemic's impact on global commerce and on the sectors that GS1 serves, considering that they have endured the equivalent of several years of digital transformation over the span of just three months earlier in 2020. Massive behavioural shifts have accelerated societal adoption of digital technology – leading to huge growth in online marketplace and grocery businesses.[3] Many newly embraced behaviours, such as remote access to healthcare and remote work, are anticipated to persist past the pandemic.[4]

A different set of recommendations on "navigating the next normal" emerged, as the Innovation Board looked back at the trends and technologies presented in the 2018-2019 report and combined them with the lessons that have revealed themselves in this time of seismic societal, health and economic change. The following themes have emerged as foundational to guiding industry into a future where disruption and change will be both more frequent and more impactful.

Resilience and flexibility

Supply chain capacity was highly stressed in the early days of the pandemic, with companies challenged to manufacture, stock, warehouse and re-route goods to meet rapidly changing consumer fulfilment needs. Improving supply-chain resilience in the face of immense disruption requires visibility into all aspects of manufacturing, and the flexibility to adapt. Additionally, companies that digitalised their supply chains and invested in e-commerce capabilities were better able to serve the needs of their customers through 2020. During the coming years, it will be important for all companies to model and plan for disruption to ensure they have the agility to change and adapt.

Takeaway: Companies must develop contingency and continuity plans, stress testing their systems to identify opportunities to become more flexible and adaptable so that change can happen when it is needed most. GS1 continues to advance ways that digital identities can empower the next generation of data sharing to create the supply-chain visibility needed to ensure resilience in the face of disruption.

Collaboration and connectivity

Everything requires more data...more data to connect consumers to the things they need and more peer-to-peer data exchange to create operating efficiencies. And yet, the value of data can only be realised if companies break out of operational silos and engage in active collaboration with their trading partners, customers, consumers and patients. Working towards increased transparency and interoperability is only partly enabled by technology. The real value is unlocked when strong business practices are developed based on openness, collaboration and innovation.

Takeaway: Disruption is not the time to retreat and entrench into old ways of doing things. Connectivity and networked information is more powerful when partnered with strong collaboration across the ecosystem. Listening to employees, customers and trading partners will help companies identify and leverage new ways to collaborate and share information. GS1 is leading the way in creating communities where organisations can come together to solve problems and to show how data sharing can unlock new business value.

Innovation and diversification

Grocery stores rapidly shifted to enable pickup and delivery. Home hobbyists printed 3D parts for hospital face shields. Liquor and perfume companies repurposed to produce hand sanitiser. Food service companies leveraged their transportation infrastructure to shift from restaurant delivery to consumer delivery. Businesses of all kinds added "contactless" delivery and payment options to minimise physical contact.

1   GS1 Innovation Board. (7 February 2019). *Trend Research 2018-2019.* Retrieved from https://www.gs1.org/docs/innovation/GS1-Trend-Research-Paper-070219.pdf

2   Chopra, Sunil. (23 March 2020). The Coronavirus Has Upended Supply Chains. Here's How Companies Can Prepare for the Next Disruption. KelloggInsight. Retrieved from https://insight.kellogg.northwestern.edu/article/coronavirus-upended-supply-chains-how-companies-can-prepare-disruption

3   Kopka, Udo. (30 July 2020). What got us here won't get us there: A new model for the consumer goods industry. McKinsey Insights. Retrieved from https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/what-got-us-here-wont-get-us-there-a-new-model-for-the-consumer-goods-industry

4   Sawhney, Mohanbir. (15 April 2020). *The New Normal: 7 Behavorial Shifts that Will Persist Past the Pandemic.* LinkedIn. Retrieved from https://www.linkedin.com/pulse/new-normal-7-behavioral-shifts-persist-past-pandemic-mohanbir-sawhney/

These are all examples where companies and organisations acted quickly to flex and redeploy their capabilities, both to meet existing needs in new ways, and to adapt towards new diverse businesses and applications.

Takeaway: Companies need to think and act like start-ups, embracing ways to continuously innovate their business models in the face of ever-changing market and consumer needs. GS1's innovation activities are focused on enabling the digitalisation and sharing of product information in new ways to aid companies in solving new emerging business problems.

All of this points to ways that companies can be better prepared to survive through future changes and to emerge even stronger, more resilient and agile. At the heart is the simple truth that investing in innovation is the best way to prepare against the next disruption. Continue reading to learn how trends and technologies are continuing to evolve to support industry transformations.

Navigating disruption and planning for the future

The team responsible for the research reached out to GS1 Member Organisations and worked with the Innovation Board to confirm the relevance of the 7 business trends and 9 technology enablers that were highlighted in the 2018-2019 Trend Research report. In revisiting these trends and technologies, the team has highlighted new advances and changes to each and identified a new technology enabler: Verifiable credentials and decentralised identity. Additionally, the team worked with the GS1 Healthcare leadership team and GS1 Healthcare global members to learn about challenges and trends that are unique to healthcare.

Finally, these discussions surfaced additional trends and technologies that GS1 needs to watch in the coming years and assess the ways these will impact the industries that GS1 serves into the future.

"Since COVID-19, supply chains must be quickly transformed to enable diversity, flexibility and transparency. GS1 is helping businesses to build stronger supply chains that will withstand tomorrow's challenges."

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

Revisiting top business trends

The research team revisited the previous *Trend Research 2018-2019 report*[5] and confirmed that the business trends identified continue to be the top business trends impacting the industries that GS1 serves today.

Each business trend was then researched to explore how it had advanced or evolved. Additionally, the team noted that some trends are accelerating in importance faster than others.

Throughout the document, icons show the change in the trends and technologies that are:

Rapidly increasing in importance

Accelerating in importance

Making steady progress, but possibly not accelerating as fast as others

These current and near-term, top business trends include:

• Data security and privacy
• On-demand logistics and services
• Traceability
• Sustainability
• Smart everything and connected things
• Empowered consumers
• Mass customisation

Rapidly increasing in importance

Data security and privacy

Strong investment in data security and privacy continues, with over 70% of organisations seeing significant business benefits from these investments.[6] In addition to corporate, consumer and patient data security being a high priority, attention to privacy issues related to the pandemic have increased dramatically. Only a few months into the pandemic, mobile phone applications were being developed to facilitate contact tracing for exposure to COVID-19.[7] Yet consumer scepticism of these apps continue to show that data security and privacy continue to be top-of-mind for many consumers.[8]

Therefore, the Innovation Board believes that security and cyber security will only become more important post-pandemic and will continue to drive significant investment across the GS1 value networks, from upstream providers, through manufacturing and transport, and especially in retail and the use of products.

On-demand logistics and services

During the global pandemic, many companies have discovered vulnerabilities in their supply chains when responding to supply chain disruptions. The companies that invested more in the digital mapping of their supply chains have fared better, and have been able to adapt to meet the changing landscape more quickly.[9] Of particular note was how the experiences in China to meet the on-demand logistics capacity needs of Alibaba's "Single's Day" enabled supplies to flow into Wuhan, a city of 11 million people, within days of the first lockdown.[10] Such examples have shown that, while digital skills in managing on-demand logistics and services can be crucial in a crisis, flexibility is also key.

The Innovation Board believes that the continued work to ensure that all GS1 identifiers licensed around the world are in a global GS1 Registry Platform that is broadly accessible will be an important enabler in the digitalisation of supply chains. This is especially the case since these GS1 identifiers (which identify products, locations, parties, assets and things) are increasingly used to connect to additional sources of data relevant to everything, from provenance and logistics data to sustainability and ethical sourcing information.

5   GS1 Innovation Board. (7 February 2019). *Trends Research 2018-2019.* Retrieved from
    https://www.gs1.org/docs/innovation/GS1-Trend-Research-Paper-070219.pdf

6   Cisco. (January 2020). *From Privacy to Profit: Achieving Positive Returns on Privacy Investments.* Cisco Data Privacy Benchmark Study. Retrieved from
    https://www.cisco.com/c/dam/global/en_uk/products/collateral/security/2020-data-privacy-cybersecurity-series-jan-2020.pdf

7   Servick, Kelly. (21 May 2020). COVID-19 contact tracing apps are coming to a phone near you. How will we know whether they work? Science. Retrieved from https://www.sciencemag.org/news/2020/05/countries-around-world-are-rolling-out-contact-tracing-apps-contain-coronavirus-how

8   Hsu, Jeremy. (7 July 2020). Survey Finds Americans Skeptical of Contact Tracing Apps. IEEE Spectrum. Retrieved from
    https://spectrum.ieee.org/the-human-os/biomedical/devices/survey-finds-americans-skeptical-of-contact-tracing-apps

9   Choi, Thomas Y. (27 March 2020). Coronavirus Is a Wake-Up Call for Supply Chain Management. Harvard Business Review. Retrieved from https://hbr.org/2020/03/coronavirus-is-a-wake-up-call-for-supply-chain-management

10 Lin, Chengyi. (17 March 2020). Delivery Technology Is Keeping Chinese Cities Afloat Through Coronavirus. Harvard Business Review. Retrieved from https://hbr.org/2020/03/delivery-technology-is-keeping-chinese-cities-afloat-through-coronavirus

"COVID-19 has thrown on-demand logistics and services into high gear, particularly in the retail and food / foodservice industries, which raced to create new curbside pickup and delivery options."

Eric Ballot, Supply Chain and Logistics Professor, MINES ParisTech-PSL, Innovation Board Member

Traceability

Demand for true end-to-end traceability continues to gain momentum, being driven by consumer and patient demands for transparency and industry needs to increase security, accuracy, timely access to products and visibility across their supply chains. New guidelines from the US Food and Drug Administration (FDA) on food traceability[11] are driving opportunities to improve food safety and will be a powerful catalyst to improve consumer trust through transparency of product data. Efforts like these from government regulators will have a global impact as well, ensuring consumers and patients have access to authentic products. Additionally, more than half of consumers have placed a higher importance on locally sourced foods during the pandemic, reflecting a shift in behaviours to support local economies and authentic products. This "power of local" highlights the importance of corporate investment in traceability solutions to deliver trusted provenance information to consumers.[12]

Traceability is an even stronger enabler for trust and safety in the supply chain, both between consumers/patients and brands, but also between manufacturers and their suppliers. For these reasons, the Innovation Board reaffirms the broad impact that traceability has across the entire GS1 value chain and the importance of embracing the concept of mapping across known identification systems (for things like locations) to maximise the potential for GS1 identity and GS1 data sharing standards to serve industry.

Accelerating in importance

Sustainability

Social and environmental sustainability efforts are coming into sharper focus and gaining greater emphasis across all industries. On the environmental front, companies are placing increased emphasis on concepts such as circular economy, recycling and improved packaging sustainability.[13] Efforts in the EU are continuing to prioritise the European Green Deal to become climate neutral by 2050, even in the midst of the COVID-19 crisis.[14] From a societal perspective, companies are joining forces to address other human rights issues, as evidenced by the Consumer Goods Forum commitment to ending forced labour.[15] As companies begin to find ways to make their supply chains more flexible and resilient, social and environmental sustainability will continue to be important to consider in developing new solutions.

The Innovation Board believes this increased emphasis on sustainability by industry will be important as companies find new ways to make their supply chains more flexible, adaptable and humane, and GS1 must ensure their work supports these escalating drivers. The Innovation Board sees significant promise in the use of GS1 Digital Link, combined with authoritative GS1 "thin registries" and public Resolver services, to establish "primary nodes" of connection across myriad sources of data around the world. Such nodes of authoritative connection between sources of data will be critical into a future where social and environmental sustainability measures are increasingly representative of consumer trust.

11 Burke, Thomas. (23 September 2020). FDA's New Proposed Rule: What Does it Mean for Traceability and the Industry? Forbes. Retrieved from https://www.forbes.com/sites/thomasburke/2020/09/23/fdas-new-proposed-rule-what-does-it-mean-for-traceability-and-the-industry/

12 Demand for local food to last beyond Covid-19. Just Food. (12 August 2020). Retrieved from https://www.just-food.com/comment/demand-for-local-food-to-last-beyond-covid-19_id144185.aspx

13 Danigelis, Alyssa. (2 July 2020). Big Consumer Brands Invest $54 Million in the US Recycling Infrastructure. Environmental Leader. Retrieved from https://www.environmentalleader.com/2020/07/54-million-investment-recycling-infrastructure/

14 European Commission. (11 March 2020). Changing how we produce and consume: New Circular Economy Action Plan shows the way to a climate-neutral, competitive economy of empowered consumers. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ip_20_420

15 Consumer Goods Forum. Human Rights – Working to End Forced Labour – initiative webpage: https://www.theconsumergoodsforum.com/social-sustainability/human-rights-ending-forced-labour/

Smart everything and connected things

Advances in how to connect systems, devices and things continue to drive opportunities to make homes, factories and processes smarter. This creates opportunities to improve optimisation and visualisation of industrial and business operations. Additionally, smart automation solutions can enhance and improve the lives of consumers and workers. Although Smart Home investment by consumers is expected to drop in 2020 compared with 2019 due to economic slowdowns related to COVID-19, the market is expected to recover in 2021.[16] Some see a trend towards "hyperautomation" that leverages a range of tools (such as artificial intelligence, machine learning and robotics) to allow businesses to continuously monitor and improve connected devices and systems across their enterprise.[17]

The Innovation Board recommends continued research into ways that the identification of things can enable better digital connectivity to support the growth of smart systems, recognising that the future of interconnected devices will demand that "trust moves with data" in increasingly secure ways.

> "As companies start to restructure and fortify their supply chains, many are recognising that now is the time to take a stand on important issues like social and environmental sustainability."

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

Continued importance

Empowered consumers

Consumers remain the centre of the retail experience, controlling when, how and where they access products, goods and services. During the pandemic, over 60% of global consumers have changed their shopping behaviour – with huge growth in online shopping of food and grocery, a higher emphasis on value and convenience, and a greater willingness to try new brands and stores.[18] Many companies have seen returns on their e-commerce investments, and yet they will be challenged to find ever new ways to engage consumers with new experiences.

The Innovation Board continues to emphasise the importance of companies continuing their digital transformation to bridge physical and digital commerce. GS1 is committed to ensure that the products of tomorrow are linked directly to their "digital twins" and that these products are themselves capable of being sources of useful data to consumers, brands, retailers and marketplaces alike.

Mass customisation

Mass customisation is still a nascent trend that reflects consumers' desires to customise products to their wants and needs. Most of the recent examples are "limited edition" products (such as athletic footwear), which is still small batch production and does not yet deliver on the promise of mass customisation.[19] One positive example has been the many ways that 3D printing hobbyists jumped into action to manufacture personal protective equipment parts, such as face shields, to meet critical demands for front-line healthcare workers.[20] Yet while this helped meet the rapid prototyping needs of the pandemic, it is still a challenge to scale this capability while also providing the full traceability of components and raw materials.

The Innovation Board encourages GS1 to continue to look for ways that the GS1 Registry Platform can include the ability to register increasingly granular products (such as registering a serialised instance of a manufactured product) to support the future of mass customisation. It is believed that the time will soon come when prioritised business needs demand that critical information be accessible at a batch/lot or serialised level.

16 Business Wire. (15 July 2020). *Strategy Analytics: Post-COVID Smart Home Device Markets Set to Rebound in 2021.* Retrieved from https://www.businesswire.com/news/home/20200714005194/en/

17 Panetta, Kasey. (21 October 2019). *Gartner Top 10 Strategic Technology Trends for 2020*. Retrieved from https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2020/

18 *Consumer sentiment and behavior continue to reflect the uncertainty of the COVID-19 crisis*. (8 July 2020). McKinsey. Retrieved from https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/a-global-view-of-how-consumer-behavior-is-changing-amid-covid-19

19 Petro, Greg. (3 January 2020). 7 Predictions For Retail This Year. Forbes. Retrieved from: https://www.forbes.com/sites/gregpetro/2020/01/03/7-predictions-for-retail-this-year/

20 Best, Jo. (26 March 2020). Coronavirus and 3D printing: How makers are stepping up to supply vital medical kit. ZDNet. Retrieved from: https://www.zdnet.com/article/coronavirus-and-3d-printing-how-makers-are-stepping-up-to-supply-vital-medical-kit/

Trends in healthcare

While digital transformation happened across many industries in an accelerated way, the healthcare industry was pushed to its limits more than any other. The need for supply chain visibility of personal protective equipment, COVID-19 tests, crucial medicines for ventilated patients, and aggressive global demands to ramp-up vaccine research and development have all been at the forefront of the media. As a result, the healthcare industry is seeing greater disruption, and coupled with that greater innovation, than in the past few decades, including:

- Increased willingness of organisations to collaborate to solve critical supply chain issues and share learnings in the race to develop treatments. These will become enabled by **artificial intelligence** and machine learning to navigate the massive amounts of big data available.

- Flexibility and diversification from companies able to redeploy their expertise in new ways, such as clothing companies making masks and automotive companies making ventilators.

- 3D printing capabilities of companies and hobbyists showed the positive impact of rapid prototyping to support on-demand manufacturing in new ways that supports the trend of **mass customisation**.

- Digital and e-health trends have provided remote healthcare access via web and telemedicine technology supporting **empowered consumers and patients**.

- Interoperability has become a crucial global issue to ensure that identification and traceability systems can be connected, even between countries, enabled by **open, structured and linked data**.

What's on the horizon for healthcare? Prioritised trends and activities parallel those from other industries, such as:

- Patient privacy regulations will continue to make **data security and privacy** a high priority for organisations.

- Digitalisation of medical care **(on-demand services)** through e-health/telemedicine platforms which will accelerate opportunities for remote care.

- **Smart everything** leveraging home IoT and sensor systems to enable remote diagnostics.

- Increased personalised healthcare which leverages technology advances to remotely connect with patients **(Smart everything, IoT, sensors)** as well as future opportunities for personalised medicine and 3D printing of specialised medical devices (**mass customisation**).

"The saying 'Out of adversity comes opportunity' has never been truer for healthcare. The adversity of COVID has fast-tracked the healthcare industry's opportunity to innovate across business and clinical processes, and already those healthcare organisations leveraging GS1 standards are reporting benefits."

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

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.
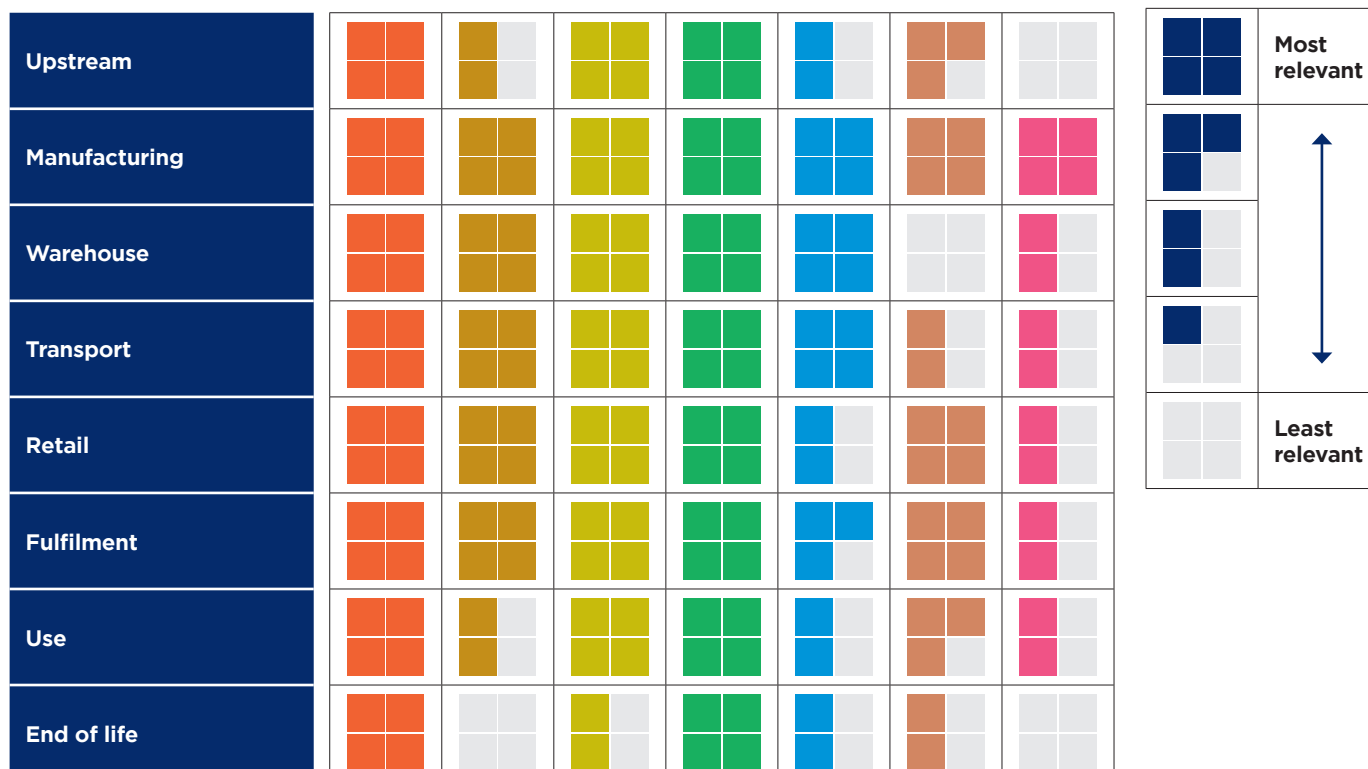
Each element across the GS1 value chain is defined below:

- **Upstream –** including the origin of raw materials or ingredient sources.

- **Manufacturing –** is the production of raw materials to a finished product, or final assembly of a product from individual subcomponents.

- **Warehouse and Transport –** describes both the ways that products and goods are moved from place to place and how they are stored or kept before distribution to the retail store or hospital.

- **Retail –** typically describes the physical store environment where a consumer shops and purchases products.

- **Fulfilment –** describes delivery of orders directly to the customer, which could be direct fulfilment of products to consumers (through e-commerce, for example), 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.

Business trends

Relevant across the value chain

	Data security & privacy	On-demand logistics & services	Traceability	Sustainability	Smart everything & connected things	Empowered consumers	Mass customisation
Upstream	Most relevant	High	Most relevant	Most relevant	Medium	High	Least relevant
Manufacturing	Most relevant	Most relevant	Most relevant	Most relevant	Most relevant	Most relevant	Most relevant
Warehouse	Most relevant	Most relevant	Most relevant	Most relevant	Most relevant	Least relevant	Medium
Transport	Most relevant	Most relevant	Most relevant	Most relevant	Most relevant	Medium	Medium
Retail	Most relevant	Most relevant	Most relevant	Most relevant	Medium	Most relevant	Medium
Fulfilment	Most relevant	Most relevant	Most relevant	Most relevant	Medium	Medium	Medium
Use	Most relevant	Medium	Most relevant	Most relevant	Medium	High	Medium
End of life	Most relevant	Least relevant	Medium	Most relevant	Medium	Medium	Least relevant

Legend: Most relevant → Least relevant

Technologies enabling business trends

Revisiting the key enabling technologies that were analysed in the first edition of this report has reinforced the fact that no single enabling technology can solve every problem. Companies and organisations continue to need to investigate a variety of approaches to identify potential solution alternatives to increasingly complex business problems. As seen throughout the pandemic, many of the technologies that the Innovation Board looked at in 2018-2019 are being accelerated or are being deployed in new ways to counteract the disruptive challenges faced by industry.

Each of these enabling technologies continue to support the prioritised business trends in important ways. GS1 will need to investigate each of these in reference to GS1 solutions and applications.

As the Innovation Board researched the landscape in late 2019 and into 2020, one new technology enabler, "verifiable credentials and decentralised identity," emerged as essential to enabling the concept of "trust moving with data" into the future. This technology enabler is highlighted as the only new entry to the list below.

As with the business trends discussed, each technology disruptor was evaluated to determine if it is rapidly increasing in importance, accelerating or making steady progress. The technology disruptors include:

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

Rapidly increasing in importance

IoT, sensors and biometrics

Key to advances in this area are the rapid development and deployment of contactless systems enabled by rapid shifts in business needs during the pandemic. Industries have leveraged everything from temperature sensors to people counting systems to biometric sensors to quickly innovate around contact tracing systems and identification of people and places.[21] In the supply chain, IoT-enabled cold chain monitoring systems are gaining in interest to meet increased online consumer shopping of perishable goods.[22]

We expect that IoT, sensors and biometrics investment and deployment will continue to increase at a rapid pace to meet the growing needs of many business trends, such as smart everything, on-demand logistics and services, and traceability.

Artificial intelligence (A.I.)

A.I. and machine learning continue to be powerful smart computing tools that help enable new systems and capabilities, from autonomous robotics to biometrics and computer vision. As facial recognition systems are increasingly used to facilitate mobile payments, especially in China, A.I. algorithms are helping systems adapt to a world where more consumers are wearing face masks.[23] Additionally, A.I. ethical concerns have come to the forefront, driven by increased consumer interest in data security and privacy.

As spending on A.I. is expected to double in the next four years to over $100 billion globally, these technologies will continue to advance and support a wide variety of smart everything and connected things trends.[24]

Autonomous logistics

Autonomous logistics solutions are optimising aspects of logistics automation in ways that are particularly relevant to the recent pandemic. From drone delivery to self-driving trucks, there are a surge of technologies that are taking advantage of autonomous systems for logistics optimisation, as well as safety enhancements

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21 Daley, Beth. (30 July 2020). Thermal cameras aren't perfect, but they can help control the coronavirus pandemic. The Conversation. Retrieved from
https://theconversation.com/thermal-cameras-arent-perfect-but-they-can-help-control-the-coronavirus-pandemic-141701

22 Cold chain monitoring on the rise; can SMEs benefit? (10 September 2020). Business Matters. Retrieved from
https://www.bmmagazine.co.uk/business/cold-chain-monitoring-on-the-rise-can-smes-benefit/

23 Simonite, Tom. (5 May 2020). How well can algorithms recognize your masked face? Wired. Retrieved from
https://wired.me/business/algorithms-recognize-masked-face/

24 McCormick, John. (27 August 2020). World-Wide AI Spending Expected to Double in Next Four Years. The Wall Street Journal. Retrieved from https://www.wsj.com/articles/world-wide-ai-spending-expected-to-double-in-next-four-years-11598520600

and operational efficiencies.[25] Additionally, automation adoption in warehouses and fulfilment centres is growing at a rapid pace, with automated pallet loading and solutions for picking, packing and moving of goods.[26]

Robotics and A.I. are other technologies that are contributing to the advancement of autonomous logistics, which is a key enabler for the on-demand logistics trend.

Verifiable credentials and decentralised identity

Over 50% of Gen Z and Millennial consumers will pay more for sustainable products and will increasingly buy from companies with values that match their own.[27] Yet, when a company claims that its products are fair trade, organic, kosher, or sustainably sourced, how will consumers verify these claims, especially when they want to seek authoritative sources beyond the brand?

Additionally, when a brand makes these claims to a retailer, the retailer must also verify these claims, which is often a cumbersome paper-based process. Bridging the physical to the digital requires new techniques in managing "identity," verifying claims and requiring trust that is scalable for increasingly distributed data. This is where verifiable credentials and decentralised identity come into play as important, rapidly emerging technology enablers.

Verifiable credentials and decentralised identifiers (DIDs) provide key features that can benefit an increasingly globally distributed supply chain. Verifiable credentials allow for any number of claims to be declared to by any number of data sources. DIDs provide for a decentralised method of cryptographic trust in those claims by enabling proof that the entity providing the data is the trusted source of that data (in the same way that a web browser can verify that a website destination is the one that the user is seeking).[28]

As an example, imagine a product listing on a marketplace from an unknown seller. The product's identifier and certain aspects of the data can be presented as "verified" with credentials indicating the data is brand authorised, the Global Trade Item Number® (GTIN®) is legitimate and the product is certified organic. The source of this data can therefore be validated

directly from each authoritative organisation – the brand, GS1 and the organic certification body. Each of these sources then become a "trust anchor" for the respective data that they verify, ensuring that trust moves with data.

The Innovation Board sees verifiable credentials and decentralised identity as critical tools that offer future capabilities that bring additive trust to programmes like Verified by GS1 and the GS1 Resolver work. Pilots underway should continue to explore the role for GS1, understand how to leverage expertise and partnerships in this space, and pilot potential use cases to explore a future framework where "trust moves with data."

> "Regardless of how data exchange methods evolve, it is clear that we must unlock a future where 'trust moves with data'…by leveraging new capabilities offered by tools such as verifiable credentials and decentralised identity."

Robert Beideman, Chief Product Officer, GS1 Global Office, Innovation Board member

Accelerating in importance

Open, structured and linked data

Access to real-time data at every point in the supply chain has never been more important than during the pandemic.[29] A key consumer example is how linked data between restaurants and mobile phone mapping apps have helped consumers quickly find take-out and delivery options. Yet, without abilities to link, structure and share the data, companies will suffer from having too much data and not enough information. Emerging concepts to optimise business processes, such as digital twins and smart factories, rely on the sharing of structured data, highlighting that open data best practices continue to be foundational to interoperability.

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25 Ghaffarzadeh, Khasha. (17 August 2020). The evolving relationship between drones, mobile robots, autonomous vehicles and logistics. Global Trade Magazine. Retrieved from: https://www.globaltrademag.com/the-evolving-relationship-between-drones-mobile-robots-autonomous-vehicles-and-logistics/

26 Reiser, Clint. (8 July 2020). Investing in Warehouse Automation? Who Isn't. Logistics Viewpoints. Retrieved from https://logisticsviewpoints.com/2020/07/08/warehouse-automation-investment/

27 Petro, Greg. (31 January 2020). Sustainable Retail: How Gen Z Is Leading The Pack. Forbes. Retrieved from: https://www.forbes.com/sites/gregpetro/2020/01/31/sustainable-retail-how-gen-z-is-leading-the-pack/#34e219672ca3

28 W3C Working Cases. Verifiable Credentials Use Cases. Retrieved from: https://www.w3.org/TR/vc-use-cases/

29 Bowman, Robert. (29 July 2020). Data, Not Digitalization, Transforms the Post-Pandemic Supply Chain. MIT Sloan Management Review. Retrieved from http://sloanreview.mit.edu/article/data-not-digitalization-transforms-the-post-pandemic-supply-chain/amp

The Innovation Board believes that the continued development of the GS1 Web Vocabulary and migration toward a single semantic representation of the GS1 System are important contributions in this area. Additionally, progress toward increased adoption of the Global Data Model will be essential.

Robotics

Robots continue to advance, with businesses investing in capabilities to both automate routine tasks and enable new applications. With continued growth of e-commerce, robots are commonplace in warehouses and fulfilment centres. In grocery and retail stores, robots are helping to automate scanning and stocking of shelves, cleaning floors, and assisting with fulfilment for deliveries and order pickups.[30] In hospitals, robots have been deployed to automatically sanitise rooms and hallways to improve safety for patients and front-line workers.[31]

Robotics and other automation tools will continue to be key enablers in the on-demand logistics and smart everything trends.

Computer vision

Computer vision continues to impact a wide range of applications, helping observe environments to speed up business processes throughout the value chain. At the origin of an item, computer vision is useful to verify the accurate dimensions of products and cases for optimal supply chain transport. In the warehouse, it can help identify misplaced pallets. In the store, it can scan shelves to identify pricing inaccuracies and find products that need to be replenished.[32] A high-profile way that computer vision is transforming retail can be seen in the increased pilots of "grab and go" checkout-free in store experiences.[33]

Additionally, computer vision is a key technology that complements developments in both robotics and autonomous logistics, and is an enabler of many business trends, notably automation and smart everything as well as on-demand logistics and services.

Continued importance

Blockchain and distributed data

Blockchain continues to be highly hyped as a technology that can be a tool to strengthen trust in data sharing. However, while many companies continue to test viability of this technology enabler in pilots, most are recognising that distributed ledger technology is only one potential layer of more intricate solutions that are needed to truly solve industry business challenges.[34]

And, while blockchain offers new capabilities, such as smart contracts to aid in business efficiency and automation, such capabilities have not yet managed to find traction in significant business solutions in ways that have disrupted the status quo.

Blockchain technology continues to be a potential technology enabler for decentralised identifiers and in traceability, especially in food safety and pharmaceutical traceability applications.

Voice recognition

Voice recognition and natural language processing continue to evolve, with applications expanding beyond smart speakers to include voice transcription for online "work from home" meetings. And while voice assistant use in both smart speakers and mobile phones has seen an increase in daily use during the pandemic, requests are still primary limited to simple tasks like playing music, setting an alarm and answering general questions.[35]

Voice commerce, while still being an interesting application to enable more product research and purchase, is growing slower than anticipated.[36] Still, it will be important to continue to track advancements in how "conversational commerce" will be enabled by smart speakers and devices. GS1 continues to be involved with the Open Voice Network[37] to explore how standards can/should be developed in this important space.

30 Meyersohn, Nathaniel. (7 April 2020). Grocery stores turn to robots during the coronavirus. CNN Business. Retrieved from https://www.cnn.com/2020/04/07/business/grocery-stores-robots-automation/index.html

31 Morrissey, Janet. (16 June 2020). Fighting the Coronavirus With Innovative Tech. New York Times. Retrieved from https://www.nytimes.com/2020/06/16/business/fighting-covid-19-innovative-tech.html

32 Kumar, Vivek. (20 January 2020). Making Disruption in Retail With Computer Vision. IndustryWired. Retrieved from https://industrywired.com/making-disruption-in-retail-with-computer-vision/

33 Adams, John. (9 September 2020). Checkout-free tech's ambitions gets larger as opportunities multiply. PaymentsSource. Retrieved from https://www.paymentssource.com/news/checkout-free-techs-ambitions-gets-larger-as-opportunities-multiply

34 Bowman, Robert. (27 April 2020). When Will Blockchain Be Ready for the Supply Chain? Supply Chain Brain. Retrieved from https://www.supplychainbrain.com/blogs/1-think-tank/post/31219-when-will-blockchain-be-ready-for-the-supply-chain

35 The Smart Audio Report. (April 2020). NPR and Edison Research. Retrieved from https://www.nationalpublicmedia.com/uploads/2020/04/The-Smart-Audio-Report_Spring-2020.pdf

36 Walk-Morris, Tatiana. (5 February 2020). Smart speaker shopping falls short of projections. RetailDive. Retrieved from https://www.retaildive.com/news/smart-speaker-shopping-falls-short-of-projections/571748/

37 Open Voice Network website. https://openvoicenetwork.org/

This technology enabler will have the biggest impact on the trends: empowered consumers, smart everything and connected things.

Augmented, virtual (AR/VR) and mixed reality ➡

Wearable headsets used to create immersive experiences for consumers still capture our imagination, and augmented reality features in smartphone apps create new ways for consumers to interact with the real world. Yet, the promises for rapid growth of applications and hardware for AR/VR have not lived up to these lofty expectations.[38] On the horizon, the rapid rise of work-from-home and video conferencing as well as telemedicine may offer new opportunities to restart interest in AR/VR technologies, especially to aid in connected and smart systems.

Other emerging trends to watch

The team identified additional emerging trends that may capture our attention in the coming years, such as:

- Digital Informatics (and ways that the "digitalisation of everything" will impact other sectors and government institutions)

- Contactless systems to drive automation and create flexible environments that provide for employee safety

- 5G networks, cloud and edge computing will be enablers to watch as they impact opportunities for IoT/sensors, smart everything and connected things

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"Data interoperability and visibility is key to ensuring that all trading partners can benefit from leveraging new technologies to solve their most crucial business challenges."
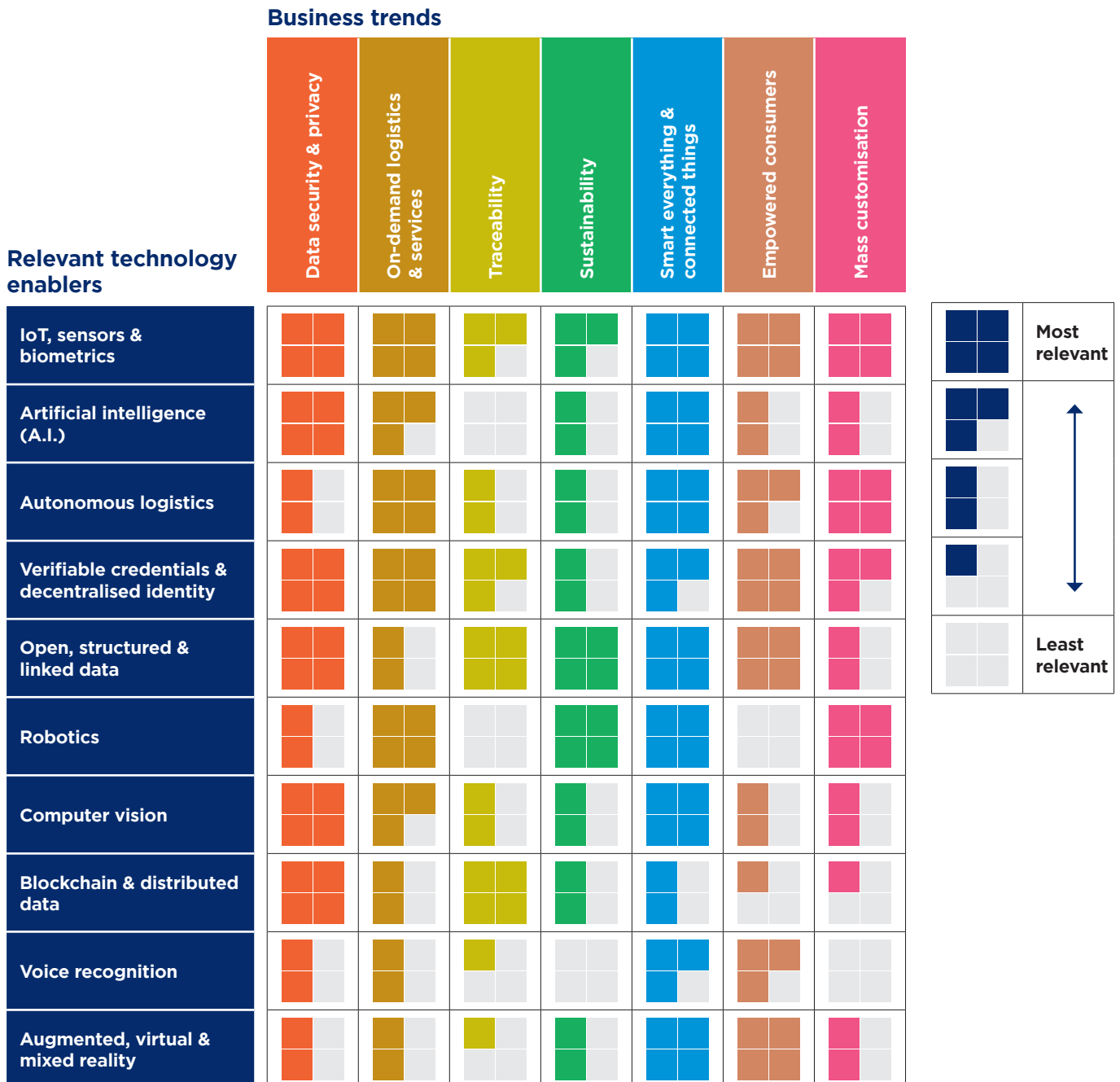
Mouhammad Takieddin, Sr. Director IT, Master Data Services & Solutions, Procter & Gamble, Innovation Board member

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38 Fried, Ina. (13 May 2020). VR misses its pandemic moment. Axios. Retrieved from
  https://www.axios.com/vr-misses-coronavirus-pandemic-moment-487a914e-6057-48cd-8360-ff264ef6d4e7.html

Business trends and technology enablers

Because today's business challenges are so complex, solving those challenges is only possible through the investment and integration of a variety of techniques and technologies. And while the actual impact from any specific technology will be different depending on the business sector and the application, the chart below maps the general relevance of each technology enabler against the prioritised business trends highlighted in this report.

Business trends

Relevant technology enablers	Data security & privacy	On-demand logistics & services	Traceability	Sustainability	Smart everything & connected things	Empowered consumers	Mass customisation
IoT, sensors & biometrics	Most relevant	Most relevant	3/4	3/4	Most relevant	Most relevant	Most relevant
Artificial intelligence (A.I.)	Most relevant	3/4	Least	3/4	Most relevant	2/4	2/4
Autonomous logistics	2/4	Most relevant	3/4	3/4	Most relevant	3/4	Most relevant
Verifiable credentials & decentralised identity	Most relevant	3/4	Most relevant	2/4	2/4	Most relevant	Most relevant
Open, structured & linked data	Most relevant	2/4	Most relevant	Most relevant	Most relevant	Most relevant	2/4
Robotics	2/4	Most relevant	Least	Most relevant	Most relevant	Least	Most relevant
Computer vision	Most relevant	3/4	2/4	Most relevant	Least	2/4	2/4
Blockchain & distributed data	Most relevant	2/4	Most relevant	3/4	3/4	2/4	2/4
Voice recognition	2/4	2/4	2/4	Least	Most relevant	3/4	Least
Augmented, virtual & mixed reality	2/4	2/4	2/4	2/4	Most relevant	Most relevant	2/4

Legend:
- Most relevant (4/4)
- (3/4)
- (2/4 — vertical)
- (2/4 — diagonal)
- Least relevant (0/4)

Recommendations

As described in this second edition of the GS1 Innovation Board's *Trend Research 2020-2021* report, the disruptions of the past year have forced the acceleration of many digital transformation elements. A cornerstone of any digital transformation includes the concepts that are core to the GS1 system: globally unique identification, a common data language, a commitment to interoperability and a firm belief that business value achieved through data sharing is amplified through the use of standards.

The Innovation Board continues to emphasise the power of leveraging these standards to enable access to data about products, locations, services and things, and believes that many of these trends and technologies will advance successfully only when companies and partners adhere to a standards mindset.

The Innovation Board recommendations highlighted throughout this report are summarised below.

1. Further development of the GS1 Registry Platform is crucial to allow for broad accessibility to data about all GS1 identifiers.

Recommendation to industry: Explore how the GS1 Registry Platform can become an important enabler in the digitalisation of your supply chains...connecting users to additional sources of data relevant to everything, from provenance and logistics data to sustainability and ethical sourcing information.

Recommendation to GS1: Continue the strong work to ensure that all of the GS1 identifiers licensed around the world are in the global GS1 Registry Platform to identify products, locations, parties, assets and things.

2. Access to new sources of data about products will greatly extend the power and relevance of GS1 standards...and it is essential to do this in a way that enhances consumer trust.

Recommendation to industry: Needs for information about products will continue to increase, and the concept of "linked, open data" will ensure that many more organisations are able to provide their own data about these products. Yet, consumer trust is so hard to win...and so easy to lose. New concepts and techniques such as verifiable credentials will further help to enable a future where "trust moves with data."

Recommendation to GS1: Ensure that the work on the GS1 Registry Platform and on standards-compliant GS1 Resolver services unlocks the ability to establish "primary nodes" of connection across myriad sources of data around the world. Continue work to understand how technology enablers such as verifiable credentials can help increase trust in identity and data.

3. Being flexible and adaptable will ensure more robust and resilient supply chains.

Recommendation to industry: Continuously innovate and test new approaches to strengthen your processes and ability to adapt quickly.

Recommendation to GS1: Continue advancements in the digital identifier space. This will empower next-generation data sharing and will be an important enabler in ensuring adaptability and flexibility.

4. Collaboration is crucial to ensure we all plan for the future. Nearly every organisation is challenged to find new ways to engage in active collaboration with many internal and external stakeholders.

Recommendation to industry and GS1: Leverage the global, neutral communities that GS1 convenes and work together to create collaborative relationships that believe in the power of data sharing to unlock new business value.

5. Continued exploration of trends and technologies from GS1's global innovation teams is vital to understand how GS1 must evolve and change in an increasingly disruptive and uncertain world.

Recommendation to GS1: GS1 must continue to leverage innovation-based learnings from its members and from other organisations around the world to help expand and extend GS1's system of standards to serve global commerce in new and meaningful ways.

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

"Technology alone rarely leads to breakthroughs ... breakthroughs happen when technology is applied to solve real-world business problems that create value for companies and their partners in the ecosystem."

Bernhard Schindlholzer, Ph.D., Senior Product Manager, Google, Innovation Board member

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 115 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.