Innovation Insight for the Supply Chain Technology Heat Map

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By Analysts Christian Titze, William McNeill, Andrew Stevens, Pia Orup Lund, Simon Tunstall, Rick Franzosa, Bart De Muynck, Dwight Klappich

Initiatives: Technology and Solutions for Supply Chain and Operations

Technology capabilities have different maturity, adoption levels and benefits, and they also mean different things to different supply chain domains and participants. The supply chain heat map of key supply chain technology profiles helps CSCOs understand impacts and prioritize investments.

Overview

Key Findings

- The rise of innovative technology is challenging chief supply chain officers (CSCOs) to determine the implications on business and the supply chain transformation roadmap.
- Trends not only influence the end-to-end supply chain but are often initially adopted through application-specific and differentiated capabilities in supply chain domains.
- Finding credible information on the most relevant and valuable innovative technology options is especially challenging for organizations with unique lines of business or those pursuing new, nontraditional business models.

Recommendations

CSCOs responsible for transformation initiatives within technology and solutions for supply chain operations should:

- Solicit suggestions for using innovative technology to improve and transform by establishing an ideation process to engage different stakeholders and validate opportunities.
- Align supply chain technology capabilities with the company's business and IT strategy by creating a governance structure that includes executive guidance and bimodal practices.
- Evaluate how supply chain technologies optimize and transform capabilities within each supply chain domain — planning, sourcing and procurement, manufacturing, and supply chain execution (warehousing and logistics and transportation) as well as end-to-end capabilities.
Strategic Planning Assumptions

By 2025, over 50% of supply chain organizations will have a technology leadership role reporting directly to the CSCO.

Through 2024, 50% of supply chain organizations will invest in applications that support artificial intelligence and advanced analytics capabilities.

Introduction

Supply chain technology is a source of competitive advantage, and supply chain organizations are facing a range of technology options. These options range from emerging, growth, mainstream to legacy technologies (see Hype Cycle for Supply Chain Strategy, 2020). Yet the maturity level, adoption level and benefit implications, even the overall applicability of a certain technology capability, might differ per supply chain domain or even with supply chain's role in driving value in the organization. What could be a huge impact for supply chain execution could basically have no relevance in supply chain planning. Therefore, it is important for CSCOs to understand differentiated, domain-specific impacts of the most transformational technologies, processes, practices and trends, as well as to obtain background information for maturing technologies, practices and processes. This will lay the foundation for CSCOs, strategy and domain leaders to decide whether to explore and monitor them or invest and act on them within a specific supply chain domain. Additionally, there may be value and competitive advantage with evaluating these technologies and refining and tweaking existing functionality as part of the overall digital transformation strategy.

Figure 1 highlights the key technologies for CSCOs. The vertical axis represents the overall value of the technology they deliver, from low to transformational. The horizontal axis represents the technology’s level of maturity from embryonic to mainstream as tracked by Gartner within the annual Hype Cycles for supply chain:

- **Embryonic** — In labs; no products and vendors
- **Emerging** — Commercialization by vendors with pilots and deployments by industry leaders; first-generation products with much customization
- **Adolescent** — Maturing technology capabilities and process understanding, uptake beyond early adopters; second-generation products with less customization
- **Early mainstream** — Proven technology, vendors, technology and adaptation rapidly evolving; third-generation products, more out of the box
Suppload Chain Technology Value-Maturity Matrix

Figure 1: Supply Chain Technology Value-Maturity Matrix

Description

Supply chain technology capabilities have a significant impact on supply chain operations and are the source for competitive advantage. As a result, supply chain organizations must maintain a delicate balance between innovation for growth and operational excellence that addresses today’s goals alongside their already established technology infrastructure and systems. To balance growth and innovation with operational improvement, CSCOs and strategy leaders must understand these enablers’ maturity level, true business impact and readiness for adoption specific for each supply chain domain.

To better address unique business needs that may shift technology requirements, Gartner has assessed a collection of 12 supply chain technologies in 2020 that will act as a source for supply chain domain-specific analysis. (See Table 1 and The 2020 Strategic Supply Chain Technology Trends.)
Table 1: Key Supply Chain Technologies
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<thead>
<tr>
<th>Technology</th>
<th>Description</th>
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<tbody>
<tr>
<td>Hyperautomation</td>
<td>Hyperautomation is a combination of multiple ML, packaged software and automation tools to deliver work. A framework for delivering automation at scale to mix, match and optimize a vast array of technologies, including historic legacy platforms enterprise functionality, as well as recently deployed tools and planned investments.</td>
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<tr>
<td>Digital Supply Chain Twin</td>
<td>The DSCT is a digital representation of the physical (often multienterprise) supply chain. It is a dynamic, real-time and time-phased representation of the various associations between the data objects that ultimately make up how the physical supply chain operates. It is the basis for local and end-to-end decision making and is derived from all the relevant data across the supply chain and its operating environment.</td>
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<td>Continuous Intelligence</td>
<td>CI offers a way to extend AA applications into the realm of decision support and decision automation. By processing event-based and streaming data — no older than about 15 minutes — businesses can understand what's happening now and react rapidly. Running prescriptive analytics, ML and AI algorithms against streaming data can derive more actionable information.</td>
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<td>Supply Chain Governance and Security</td>
<td>An increasingly important macro technology trend which is a result of increased levels of public awareness of global risk events and security breaches impacting companies. Capabilities include next-generation track-and-trace and serialization, cybersecurity, dedicated IoT tools and functionality, smart and secure packaging and labeling or unique identification, fingerprinting and authentication</td>
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Source: Gartner (December 2020)

Benefits and Uses

Gartner segments the benefits of technologies into the following four categories:

- **Transformational** — Enables new ways of doing business across industries that will result in major shifts in industry dynamics
- **High** — Enables new ways of performing horizontal or vertical processes that will result in significantly increased revenue or cost savings for an enterprise
- **Moderate** — Provides incremental improvements to established processes that will result in increased revenue or cost savings for an enterprise
Now when actually looking into supply chain management (SCM) technology importance, combined with actual or planned investments by leading supply chain organizations, we recognize the following top five technologies:

- Advanced analytics (growth trend)
- Supply chain governance and security (emerging trend)
- IoT (growth trend)
- AI (growth trend)
- Immersive experience (growth trend)

Risks
Supply chain organizations with higher risk tolerance and willing to more aggressively approach new technologies (pioneering) will zoom in more on the middle to upper left of the matrix in Figure 1. Such organizations promote a culture of innovation, and are continually testing new, innovative approaches in a quest for competitive differentiation. They would weigh the business priorities of growth, innovation and new revenue sources as high priorities while placing a lower emphasis on cost savings and operational efficiency within their supply chain organization.

In contrast to a pioneer, a supply chain organization with an adapter profile will be much more risk-averse and has a heavy emphasis on continuous improvement, cost savings and efficiency. Innovation would be important, but it would be perused on a surgical basis where ROI could be clearly demonstrated. Using this set of higher and lower priorities, an adapter’s attention will be focused on the middle to upper right of the matrix in Figure 1.

Adoption Rate
In the following, we take a closer look into the relevancy (significance or importance) of key supply chain technologies per supply chain domain, plan, source and procure, manufacture, and execute and deliver. We build on the technology value matrix introduced above with its dimensions of level of maturity and overall benefits to:

- **Analyze** the individual technologies along factors such as business impact, risk, technology intensity, strategic policy change, organization change, culture change, process change or competitive value — all applicable to the individual supply chain domain

- **Grade** them using a classification schema or coloring, such as significant “XL” (strong dark blue), high “L” (dark blue), moderate “M” (medium blue), low “S” (light blue) and not applicable “N/A” (blue/white)
Drivers for change in supply chain planning fall into three main categories:

- Horizontal alignment of planning decisions for end-to-end supply chain planning including partners.
- Vertical alignment of planning decisions from respond planning in the short term to configure planning for more strategic decisions.
- Automation of planning decisions within this horizontal and vertical matrix.

To enable above, companies increasingly look for:

- Native cloud supply chain planning (SCP) solutions covering a broad range of capabilities to support data-driven planning decisions
- In-memory databases to speed up performance and improve scalability, especially within scenario planning capabilities
- Continued use of predictive and prescriptive analytics leveraging AI/ML
- Increasingly more multienterprise enablement to support co-planning efforts with trading partners

The next wave of change for SCP technologies will come from a subsection of the top key technologies. The journey to next-generation SCP solutions has been narrated in our SCP Hype Cycles over the last couple of years (see Hype Cycle for Supply Chain Strategy, 2020). Note that the impact of these top technologies is uneven when it comes to SCP because of business requirements.

Planning is about making decisions for the supply chain, such as how much will we sell, what should we manufacture and where should we put inventory. AI, especially the ML component of this, is making positive strides in SCP technologies to enable more automated planning decisions that are self-adaptive. But to make high-quality planning decisions, we also need to have visibility into our supply chain setup and be synchronized with what is happening in the real world. In other words; we need a DSCT. AI plays a role here as well as it enables the use of more data sources to enrich this DSCT. Consequently, artificial intelligence and the digital supply chain twin will have the highest impact on SCP (see Supply Chain Artificial Intelligence (AI) Use Case Collection and Innovation Insight for Digital Supply Chain Twin).

Slightly behind this will be the impact of edge computing and analytics, continuous intelligence and hyperautomation. Planning will become more granular in nature (an aspect of the vertical alignment driver) and will look to leverage lots of different data sources but not all data may impact planning. Edge computing and analytics will play a role in filtering out the data relevant for planning applications. Similarly, planning will also become less cyclic and move toward becoming continuous; the technologies
must assist humans in constantly monitoring and sensing, and alerting if a decision needs to be made. As written earlier, automation is important for planning but there will always be planning decisions that cannot be automated, thus hyperautomation — interpreted as extreme levels of automation — would also be considered as having only high and not significant impact.

The emerging technologies having little impact directly on planning are supply chain governance and security, 5G networks and immersive experience. These have a significant impact on executional processes (which indirectly impact planning as these two domains converge). For example, even though we use more data in our planning systems from the executional world, we assume that this data is secured beforehand in the executional environment.

See Figure 2 for supply chain technology’s relevance to planning.

Figure 2: Supply Chain Technology Relevance: Planning

Supply Chain Technology Relevance: Planning

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Source: Gartner
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Supply Chain Technology Relevancy: Sourcing and Procurement

Analysis by: William McNeill

Global events such as COVID-19 are forcing organizations to rethink how they work with internal and external stakeholders. Sourcing and procurement applications are well-positioned to make the vision of working from anywhere and with anyone into a reality.
Hyperautomation is not a technology. It is an approach in which organizations rapidly identify, vet and automate as many approved business and IT processes as possible through a disciplined approach. Hyperautomation involves the orchestrated use of multiple technologies, tools or platforms (inclusive of, but not limited to, AI, machine learning, event-driven software architecture, RPA, iPaaS, packaged software and other types of decision, process and/or task automation tools).

Sourcing and procurement is well-suited for the application of hyperautomation. Typically automation in sourcing and procurement begins with purchase orders and then extends naturally to invoices. However, our research shows that by 2025 almost half of practitioners believe that procurement automation will extend beyond routine tasks and processes. \(^2\) This could mean systems running entire parts of the sourcing process and freeing up capacity for staff to manage exceptions, such as handling more complex sourcing events or investigating subpar supplier performance. Ultimately, hyperautomation could lead to autonomous procurement driven by self-learning autonomous bots.

\textbf{AI and AA} are popular topics. AI is key to both automated/autonomous sourcing and AA. Although vendors have offered spend analytics capabilities for some time, these tools have represented historical data — in other words, offering descriptive analytics. AA uses machine learning, virtual assistants and other AI tools to offer more advanced analysis including diagnostic, predictive and prescriptive analytics to benchmark and improve both strategic and operational efforts (see Use Advanced Analytics to Make Better Procurement Decisions). Vendors are also trying to deliver solutions that incorporate cognitive and automated sourcing to gain an early-mover advantage (see Start Preparing Now for the Impact of AI on Procurement).

\textbf{Continuous intelligence}, the ability to apply real-time analytics to high-volume event data, has promise for certain procurement and sourcing activities. It holds the most applicability to situations in which real-time data from the last few seconds or minutes significantly improves the accuracy and effectiveness of business decisions. Examples would include supplier risk management and order fulfillment. It is not relevant where equally good decisions can be made solely with historical data that is hours, days, weeks or more old.

In the world of indirect procurement, typical information security protocols are often sufficient to safeguard account and payment information. But in the supply chain for direct materials, governance and security take on an enhanced need. Companies often share sensitive product information with suppliers and contract manufacturers that often require specialized applications. Software vendors often require industry-specific certifications before companies will procure their software and services.

There continues to be a lot of hype around blockchain (see Blockchain Fundamentals for Supply Chain: A Guide to the New Boardroom Buzzword). Gartner believes that blockchain has high potential to impact specific procurement and sourcing processes, such as procure-to-pay (P2P) and contract life cycle management. However, the technology remains immature and we do not see evidence of real-life, procurement-specific products or use cases available. As such, we have lowered its impact rating from the previous version of this research. One notable exception is IBM's Trust Your Supplier offering, which
is a blockchain-based supplier information management platform. We also see emerging use cases of blockchain in smart contracts, hence smart contracts have moved up in the Hype Cycle.

The concept of a DSCT has natural synergies with the concept of autonomous procurement. This is because you need the digital representation of the physical supply chain, especially the correlation between objects and partners, to understand implications (see Innovation Insight for Digital Supply Chain Twin). Despite this, we have found that the vast majority of companies are simply not ready to combine these two concepts and the vendors have not offered out-of-the-box, comprehensive solutions to support these initiatives. Sourcing and procurement vendors can help CSCOs identify supplier relationships (identifying suppliers they are doing business with), but it's still a far cry from fully mapping out the supply chain and then creating a digital representation. Perhaps the Coupa acquisition of Llamasoft will help make this fusion a reality.

Likewise, edge computing, 5G and IoT could play a supporting role in sourcing and procurement in the supply chain, especially as they underpin some of the other technologies featured in this research. But currently their direct impact is minimal as it pertains to the software market. As more product-focused companies become service-centric, the need for intelligent things will grow. Billions of devices are connected through IoT. Theoretically, an intelligent device could place replenishment orders on its own, but we've seen little evidence or appetite for this type of functionality. Few companies want to trust the machine to make these decisions.

**Immersive technologies** have shown little application for a sourcing and procurement environment. Early examples like Second Life, where companies opened virtual stores and let people shop, quickly disappeared. Additionally, we have not seen immersive technologies prominently displayed on vendor roadmaps.

See Figure 3 for supply chain technology’s relevance to sourcing and procurement.
Supply Chain Technology Relevancy: Manufacturing

*Analysis by: Rick Franzosa*

In manufacturing, the relevance of supply chain technology adoption is tied directly to efficiently and effectively getting products manufactured. Key considerations:

- Plants and factories operate on different technology roadmaps and budgets than other supply chain functions.

- Unlike other parts of the enterprise, manufacturing doesn’t update its technology or purchase with the same consistency as other functions, and has a legacy of do-it-yourself (DIY) and commercial off-the-shelf (COTS), which makes technology adoption complex.

- Goals, strategies, incentives and culture are tied to seamless, uninterrupted production. Technology decisions always weigh long-term benefit vs. the amount of disruption caused by implementing these technologies.

- There has never been a shortage of data and information in manufacturing operations, but the requirements for how data and information are accessed, processed and used are changing.
Major investments will continue in both the IoT and advanced analytics. IoT provides a low-cost method of providing additional intelligent sensor capability as an augmentation to manufacturers’ existing operational technology infrastructure, with relatively lower disruption to operations. This augmented and enhanced time-series and unstructured data collection capability drives the proven analytics use cases for advancing operational excellence. In turn, it provides the two-pronged benefits of insight into production performance, and early notification of possible production equipment issues. Taking a measured, surgical approach to implementing these capabilities reaps cost and time savings in production.

These two technology areas, combined with immersive experience and edge computing, are the four most relevant supply chain technologies for manufacturing. Building on IoT and analytics edge devices provides additional intelligence and analytics at the point of manufacture. Immersive experience enables the connected worker to perform with improved decision making and increased competency (see Optimizing Production Post-COVID-19 Swings the Pendulum From Managing Things to People).

Governance and security are a requirement for manufacturing in regulated industries. These capabilities are often the key driver/requirement in the selection of manufacturing operations technologies, from user validation to track and trace, product genealogy to electronic batch/device history record keeping.

In other domains, the relevancy of AI is growing as manufacturers develop use cases to leverage the data stores that they are building, but the speed of adoption will be predicated on development of these use cases. Adoption levels vary and there are point solutions leveraging AI (vision systems, ML, robotics, etc). Although lights out factories are still relatively unachievable, lights out at the individual process level has been successful. Hyperautomation is years away because it requires an established foundation of IoT, analytics, immersive experience, edge and AI/ML.

There are more pilots than scaled implementations of blockchain in manufacturing, virtually none outside of regulated industries. 5G networks, intelligent things or continuous intelligence systems are not often found in manufacturing. The argument could be raised, however, that it’s there but under a different name because neural networks, control logic and APC/APS systems had been in place prior to the resurgence of AI as a topic. Despite the hype and attention given to the digital twin, most manufacturers will find faster benefit pursuing the digital thread. A digital thread is a framework to provide an integrated view of a product and/or the processes and their evolution over its respective life cycle (see Innovation Insight for the Digital Thread). In addition, the most common uses of digital twin/digital thread in manufacturing are the discrete digital twin (about the product) and the hybrid digital twin (about the process and equipment). The organizational/process view of the DSCT has less relevance in the manufacturing facility (see What to Expect When You’re Expecting Digital Twins).

See Figure 4 for supply chain technology's relevance to manufacturing.
Although the warehouse management systems market is mature, innovation and more advanced technology adoption is gathering pace. We continue to see a bifurcation in the WMS market between the high-performance, complex and sophisticated end of the market, which is driving increased adoption of more advanced technologies, and the mass market where good-enough functionality is good enough. This is not because companies choose to sacrifice functionality. It’s because, globally, the bulk of warehouse operations are Level 3 or below in Gartner’s warehouse complexity model, with Level 1 being the most basic and Levels 4 and 5 being the most complex and automated. Warehouses at Level 3 and below do not require, nor would they normally use, the most advanced functionality. See Toolkit: Stratify Your Warehouse Operations to Determine the Right-Fit Warehouse Management System and Improvement Strategy for more insight on level setting warehouse operations.

This bifurcation highlights that there is a very clear market for high-end WMS solutions where feature/function and performance are critical and cost is less of an issue. This makes for a healthy, although smaller, market for high-end, functionally robust WMS solutions aimed at complex and sophisticated Level 4 and Level 5 operations. Conversely, there is another market where other factors, like ease of use, reliability, service and support, good-enough features, and lower total cost of ownership
(TCO), dominate. This is a very large WMS market for what Gartner’s stratification model would call Level 2 and Level 3 warehouse environments.

How are these technologies being used in warehousing and fulfillment?

Gartner has seen an increase in demand for and adoption of automated material handling equipment of many types in warehouse and distribution center environments. This includes incremental improvements in types of material handling equipment (MHE) automation that have been around for some time such as conveyors, sortation and ASRS but also intelligent autonomous things such as autonomous mobile robots and solutions focused on storage density. The growth in interest for MHE automation has been accelerated by impacts from COVID-19.

While historically not called digital twins, there are examples of the concepts behind digital twins being effectively exploited in warehousing and embedded within many warehouse management systems. For example, by being able to replicate the digital twin for individual warehouses, implementations and support for multisite operations can be accelerated and costs reduced. Additionally, to support highly complex and automated environments, specialist vendors are supporting the creation of 3D virtual representations of all the MHE in a warehouse to support simulation and virtual provisioning. See Innovation Insight for Digital Twins in Warehousing.

Additionally, we are seeing a growth in use of digital twin concepts in yard management by both WMS vendors and specialist yard management providers (see Yard Management Technology Trends and Selection Considerations and Market Guide for Yard Management).

In the more complex and automated environments there has been increased adoption of and experimentation with advanced analytics, AI and especially machine learning. This supports the constant prioritization, reprioritization and sequencing of combinations of tasks and activities for the workforce and interaction with automated equipment. See Select From the 8 Software Deployment Options to Support Warehouse Automation and Robotics and Revolutionize Automated Warehouse Operations With Rapidly Evolving Warehouse Execution Systems.

Immersive experience spans a number of technologies in the warehouse environment. Although transactional voice, especially voice picking, is very mature, conversational platforms or chatbots, while interesting to users, are nascent. Early indications are that AR is following an adoption pattern similar to transactional voice, so as the cost and performance of hardware improves, adoption will increase.

Also, we are seeing an increased number of cloud deployments at various levels of warehouse complexity and an adaptation of WMS application architecture to support this demand. This is combined with an increased drive for adaptability and ease of mobile usability in warehouse environments. See Magic Quadrant for Warehouse Management Systems and Critical Capabilities for Warehouse Management Systems for more information.

See Figure 5 for supply chain technology’s relevance to warehouse and fulfillment.
Supply Chain Technology Relevancy: Transportation

Analysis by: Bart DeMuynck

Although historically technology adoption in transportation has not been at the same pace as in other supply chain functions, in recent years transportation has increased its focus on the development and adoption of more advanced technologies. The recent crisis has highlighted the importance of the use of technology to automate and digitize transportation processes to increase efficiency, improve visibility and control costs.

As logistics organizations seek to exploit the benefits of greater levels of digitalization and networking, innovative technologies in transportation have the potential to change existing business models. Supply chain technology leaders should be and are examining the impact of the top strategic technologies for transportation on people, business objectives and IT systems. These leaders are assessing:

- What trends they need to know about and focus on
- Where they should begin investigations and experiments with technology solutions, immediate impacts and longer-term solutions available through the implementation of technology
- Key risks associated with new technology
How are these technologies being used in transportation?

Organizations will apply AA to support intelligent analytics that provide better, more prescriptive and more actionable insights. Advances in AI and ML provide new opportunities to automate processes and take specific actions based on transportation recorded events and past outcomes for:

- Transportation management systems (TMSs)
- Vehicle routing and scheduling (VRS) solutions
- Real-time transportation visibility platforms (RTTVP)
- Other transportation technologies

Autonomous vehicles (AVs) provide new alternatives for increased safety, added capacity and improved driver conditions for fleets, while delivery drones can provide solutions to face challenges such as the high volumes and costs of last-mile deliveries. Hyperautomation provides the application of both established and advanced technologies including AI and ML to increasingly automate processes and augment humans. Blockchain, although still immature in its application in transportation, will slowly continue to attract attention and new use cases might lead to eventual, larger opportunities. However, for the time being, we see limited developments from vendors together with a lack of standards to speed up adoption.

Advanced Analytics: The impact of AA on transportation is significant. Predictive analytics is undoubtedly a powerful competency that enables companies to be proactive and take advantage of a future opportunity. They may also mitigate or avoid a future adverse event, such as late arrival of a vehicle due to traffic congestion or weather. Prescriptive analytics can improve decision making in functional areas like transportation, fleet management and visibility. More importantly, prescriptive analytics can be deployed to improve end-to-end transportation performance because they are able to recommend a course of action that best manages the entire transportation process. Benefits of AA include better quality, cost savings and uninterrupted customer service through better asset planning and utilization. Processes that fully relied on human judgment can now be heavily powered with predictive and prescriptive analytics. This could have a significant impact on role definitions and job profiles that organizations look for in their transportation talent.

Artificial Intelligence: AI gives rise to a range of intelligent applications in transportation. These include physical devices (such as delivery robots or AVs) as well as apps and services (such as virtual chatbots and smart advisors). Although AI solutions can find patterns and probably predict future scenarios, they still lack decision-making abilities.

In transportation, AI capabilities are used to identify the potential risk exposure of a shipment or to get recommendations and make better decisions. Their goal is to offer the human user new insights, without being explicitly programmed, based on identified patterns in large datasets from the enterprise, customers, suppliers, carriers, or even external sources such as weather, traffic or news data. These
capabilities may also predict future risks. Furthermore, the AI solution might offer additional insights into how similar disruptive events were successfully resolved in the past. But AI systems still rely on traditional optimization techniques or expert systems and the quality of the data used to develop models and train the system to generate a recommendation to avoid or mitigate that risk. Combining pattern capabilities (predictive analytics) with more advanced prescriptive capabilities will be critical in supply chain adoption.

AI continues to carry a great opportunity to automate and digitize transportation processes. The ability to apply AI in transportation to enhance decision making (for example, automated route adjustments), reinvent business models and ecosystems (for example, digital freight networks), and remake the customer experience will drive the payoff for digital initiatives through 2025.

Intelligent Things: In the short term, autonomous trucks are likely to be used for repetitive short hauls, such as those from a factory to a nearby distribution center. Long-haul environments are harder to design and make safe. Although trials are underway, these will take longer to be widely adopted. Autonomous trucking will likely increase capacity by enabling trucks to make longer runs, and by attracting young workers who see trucking as a cool occupation in its autonomous format. For example, in the future, long-haul, cross-country runs are expected to be completed in two days, compared with the five days it takes today.

As the autonomous trucking sector continues to fine-tune its technology, it will continue to focus on harsh winter conditions. Harsh weather conditions are the primary reason why the technology has seen limited use in countries such as Canada, which, on the other hand, is ideal for autonomous trucks because of the country's largely rural geography and open highways. However, providers of autonomous trucks have yet to fully master how to safely navigate snowy and icy conditions.

The benefits of autonomous trucks are not just focused on automating the driver's role and filling the driver shortage gap, but also on complementing drivers. AVs in heavy-duty trucking will also increase safety and reduce transit times, which in turn will have a major impact on supply chains from a warehouse network and inventory perspective, reducing real estate and inventory levels.

Blockchain: Blockchain in supply chain, logistics and transportation innovation profiles are located in the Peak of Inflated Expectations on the *Hype Cycle for Blockchain Business, 2020*, with mainstream adoption anticipated in a range of five to 10 years. This projection is reflected in the current status of ongoing discovery together with the lack of standardization that is still taking place across many vendor-led initiatives, dedicated consortia groups, forums, pilots and proofs of concept (POCs).

For transportation, blockchain could reduce trade documentation and processing costs, and eliminate extra time and errors that result from manual paperwork to track goods. In addition, real-time visibility and the availability of information for risk analysis will improve accuracy, authenticity and accelerate shipping at ports. By securing information, blockchain will aid in mitigating the proliferation of counterfeit products.
See Figure 6 for supply chain technology's relevance to transportation.

**Figure 6: Supply Chain Technology Relevancy: Transportation**

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**Supply Chain Technology Relevancy: End-to-End Capabilities**

*Analysis by: Andrew Stevens*

Next to domain-specific processes and supporting technologies, companies also need to address a spectrum of applications delivering against end-to-end (E2E) requirements in their supply chain organization.

E2E concepts across organizations and technology solutions providers vary considerably, but have seen increased relevance in 2020. They are still highly contextual and open to much interpretation but market shaping is anticipated with more dedicated solutions emerging. As a macro trend, especially relating to risk, agility and resilience, there are increased demands and levels of interest in exploring E2E capabilities across different use cases and planning scenarios.

At a process and best-practice level, E2E increasingly is more closely correlated to initiatives such as networks and ecosystems as well as supply chain maturity, risk management and digitalization. Technology applications supporting E2E can be considered an emerging spectrum of applications (and services) that delivers scalable and progressive connectivity, visibility and governance across supply chain networks. These emerging capabilities may be augmented or extended across existing technology...
value propositions especially those that already work at a level of scale such as multienterprise visibility solutions.

E2E capabilities can be delivered at an internal business (enterprise) level either augmented as part of established solutions in specific functions or progressively in scaling across functions and domains. Existing solutions supporting platform- or process-centric workflows may also include elements or messaging for E2E capabilities, for example in transportation or manufacturing. Transitioning to more dedicated solutions may eventually become a reality.

E2E can be best positioned across the following four categories:

- **Enterprise — functional.** These existing and new technology solutions work specifically across functions that have network centricity enabling full visibility, interoperability and tracking across a network of stakeholders or ecosystems to map against process workflows, orders, transactions or at a product or asset level.

- **Enterprise — cross-functional.** These existing and new technology solutions work across functions within an individual business enterprise that has a defined extended network of stakeholders or ecosystems. Principal objectives for capabilities are to enable further or scaling connectivity beyond functions (and so remapping a progressive E2E footprint). These solutions align to shared value collaboration for tracking process and product workflow, supply chain governance and security, optimization and developing digitalization maturity. Solutions can enable economies of scale by offering broader connectivity to closely associated functions, for example, manufacturing, packaging, warehousing and early logistics phases.

- **Multienterprise — cross-functional.** Next to the well-known domain-specific processes, companies need to give increased attention to broader digital cross-functional processes so they become a matter of course. As part of transitioning to digital supply chains, they need to become increasingly embedded into domain-specific processes. Cross-functional processes are often referred to as internal enterprise cross-functions. If these processes expand outside the four walls of a supply chain organization and even into external business partners, they become multienterprise business processes E2E multienterprise capabilities need to map and align to expanding ecosystems and networks of participants.

- **Value chain — true E2E.** This is an aspirational goal that fully maps across the entire value chain assigned to a product, asset or service. Value chain extends beyond a traditional approach to the full E2E supply chain that may have approached scale by mapping closely to processes in line with the SCOR model. Value chains incorporate deep network mapping and visualization from the perspective of each incremental value phase (for example, in supply networks or across outsourced manufacturing steps). Value chains are mapped to an all-aspects approach to the life cycle (including origins and provenance of raw materials, component and phased intermediate stages of production and distributions). E2E capabilities will be deployed in conjunction with the latter phases of digitalization toward digital ecosystems. They will also align to the longer strategic goals across sectors including food and beverages or consumer products mapping to proposals tagged as “farm to
Emerging technologies will play a significant role in enabling such processes and future applications. They will include but are not limited to the following:

- Risk management
- Quality management
- Track-and-trace and serialization solution
- Industry 4.0 and industrial IoT application
- Smart factory, next-generation automation and optimization tools
- Digital platforms and services including digital twin
- Visibility spectrum of tools
- Traceability, transparency and sustainability
- Data management and modeling
- Security, governance and compliance
- Partner and customer collaboration tools
- Enterprise and private 5G data services (complementary to broader solutions, i.e., IoT or visibility)
- Blockchain as a service
- RFID-centric applications including asset tracking and QR codes

See Figure 7 for supply chain technology’s relevance to end-to-end capabilities.
Figure 7: Supply Chain Technology Relevancy: End-to-End Capabilities

Recommendations

Examine the key technology trends for supply chain with their impacts on each supply chain domain — plan, source and procure, manufacture, execute (store and deliver and/or return) and end to end — along people (employees and customers), business and IT. Adjust your business and IT strategies and operational models appropriately to account for these impacts.

Decide how these trends will affect the organization's business model and supply chain strategy, as well as the specific supply chain domain in correlation to the organization's maturity level. The findings may require a response to leverage or mitigate the trend's effect.

Assess your company's risk culture to determine your readiness to explore and possibly adopt offerings. Risk-tolerant or risk-exploiting firms should explore technologies highlighted in this research now, and risk avoiders should wait.

Evidence

1 Gartner 2019 Supply Chain Technology User Wants and Needs Survey

Results presented are based on Gartner's Supply Chain Technology User Wants and Needs Survey, conducted from November 2019 through December 2019. This survey explored the role technology plays in supply chain and how supply chain organizations leverage technology for competitive advantage, and
their views on exploiting as well as investing in supply chain technology. A sample of 350 respondents completed a web-based survey, with the organizations qualified according to their industry and annual revenue of their organization being $100 million and more. The sample mix by region was North America (40%), Western Europe (40%) and APAC (20%).

Respondents were required to be managers and above. Their involvement in decisions regarding supply chain management (SCM) processes, strategy, and supporting technology was needed.

The survey was developed collaboratively by a team of Gartner analysts who follow the IT market, and it was reviewed, tested and administered by Gartner's Research Data and Analytics (RDA) team.

Disclaimer: Results do not represent global findings or the market as a whole, but reflect sentiment of the respondents and companies surveyed.

2 The 2018 SCM World, A Gartner Community Future of Supply Chain Survey took place from August through October 2018 and included responses from 1,526 supply chain and other professionals.

Document Revision History

Innovation Technology Insight: The 2018 Supply Chain Technology Heat Map - 14 September 2018

Recommended by the Authors

The 2020 Strategic Supply Chain Technology Trends
Hype Cycle for Supply Chain Strategy, 2020
Predicts 2021: Supply Chain Technology