Microsoft

Resilience in volatility: modernizing the supply chain

How digital transformation enables industries to build connected supply-chain networks that can adapt to multiple disruptions
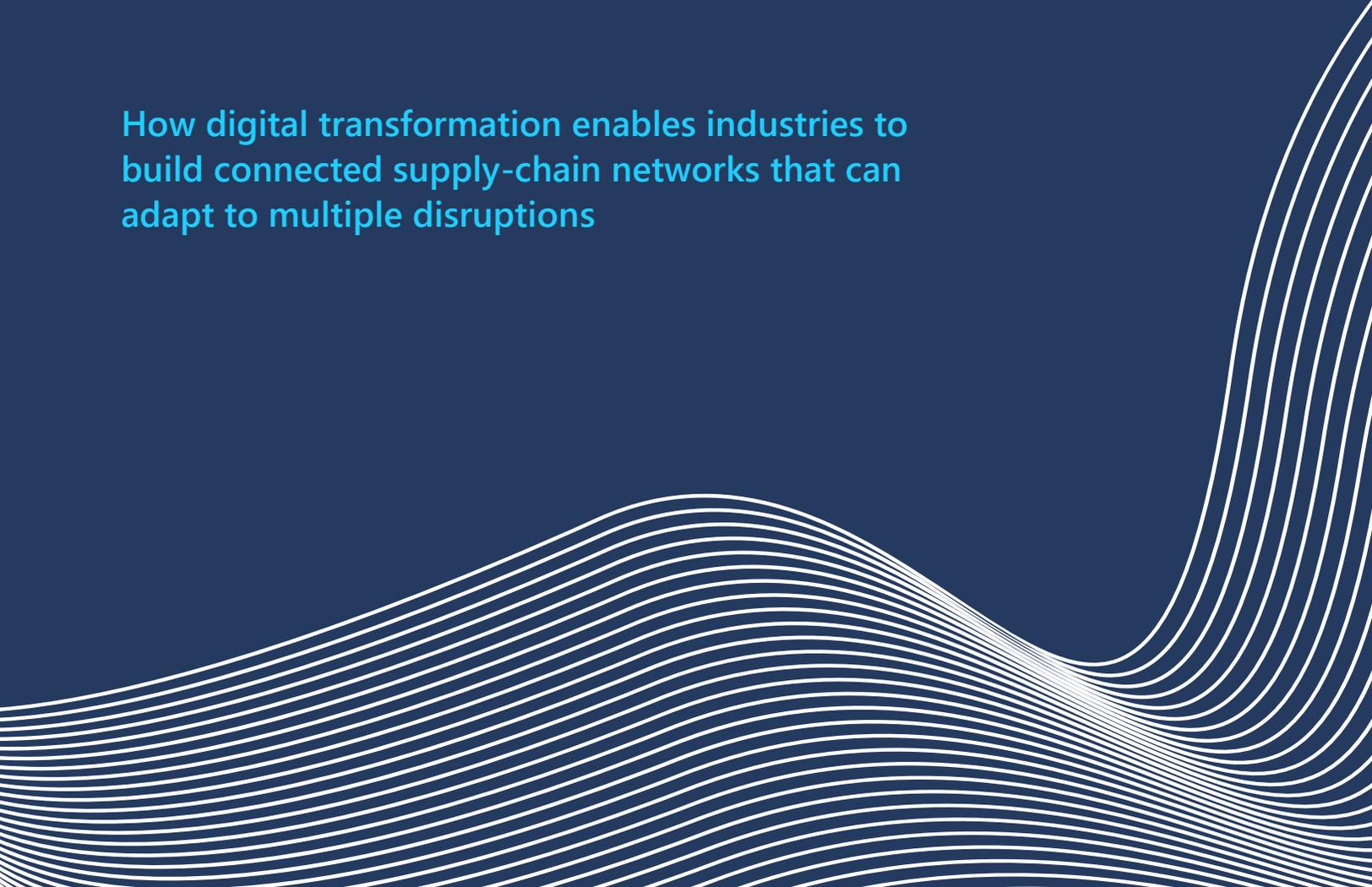
Supply-chain disruptions and shocks have upended industries around the world, and business leaders, especially Chief Supply Chain Officers (CSCOs), are considering new ways to keep operations steady under pressure. These disruptions have resulted in shortages and rising prices for products and services. In the past 18 months, we've seen limited amounts of semiconductors affecting car production, ports are experiencing a backlog of container ships full of imported products, and airports are running out of fuel because there aren't enough tank truck drivers.

The COVID-19 pandemic delivered the biggest shock to supply chains, but a perfect storm of geopolitical events and unforeseen issues exacerbated the problem: severe winter weather, natural disasters, a container ship wedged in the Suez Canal, and a ransomware attack on one of the United States' largest pipelines,[1] to name a few. Add to that the increased consumer demand for sustainable consumption, recyclability, and upcycling. These changes are forcing businesses to rethink the ways they design, make, source, and supply their products.

This confluence of challenges—and their impact to consumers—has thrust supply chains into the spotlight. Industries worldwide are reviewing their supply chains from end to end, and companies are looking for solutions that add more stability to the balance between efficiency and robustness.

Microsoft has spent months discussing the challenge of securing and modernizing the supply chain with companies in several industries, including automotive, semiconductors, pharmaceutical and healthcare, defense, and retail. We found, across Fortune 500 companies and mid-size businesses looking to grow, that there are three key areas to address to unlock the benefits of a modern supply chain. These include operational disruptions, lack of visibility, and insufficient forecasting. Once these areas are addressed, there are five key critical technology investments that CSCOs need to build an agile, flexible, and resilient supply chain. These vital capabilities include artificial intelligence (AI)/machine learning (ML), cloud, digital supply chain twins, Internet of Things (IoT) intelligence, and robotics.

Operational disruptions

A supply chain can be an incredibly complex ecosystem of players, from materials producers to manufacturers to end consumers. Nearly every decision along this chain comes down to a balance between cost, time, and service. These decisions also rely on a balance of quality, delivery, quantities, substitutions, and build plans. Manufacturers need to optimize operational costs, which can translate into better prices and access for consumers, in addition to higher profits. The acceleration of globalization over the past two decades has helped that optimization significantly, but the globalized economy depends on uninterrupted access to labor, multiple transportation modes, and below-capacity production. Those needs are not being met in the pandemic, which has caused unexpected disruptions in supply-chain operations.

Not enough supplier, customer, or market visibility

A manufacturer likely has a good sense of the operating conditions of its tier-1 suppliers—the ones it directly conducts business with. Visibility into the supply chain rapidly disappears as one looks further upstream. A lack of supplier visibility impacts the ability to forecast inventory, determine estimated time of arrival, and optimize production capacity. Better network mapping and supplier risk profiling allow companies to ingest, harmonize, and standardize data from different sources to reduce operational costs, get higher inventory turns, and improve fulfillment. While these challenges and concepts are not new, the

importance of addressing them has been magnified as a result of significant disruptions over the past two years.

A lack of external market signals, analytics, and usable customer data adds another layer of complexity, leaving leaders unable to adjust production and inventory levels according to real-time market needs. Finally, a need for end-to-end visibility, from the supplier to the customer, contributes to one of the biggest obstacles for supply chains: inventory replenishment. Companies must be able to predict their inventory demands. Visibility also deteriorates when companies don't have a firm grasp of supply-chain data. The problem isn't always a lack of data; sometimes it's a matter of too much data, scattered across systems and silos, with more coming in all the time.

Manufacturing companies often operate dozens of supply chains, each dealing with constant changes in demand and supply. That generates an incredible amount of data stored in different silos. Companies need more visibility into their supply chains, particularly as these systems grow increasingly complex, with more data and apps than ever before. These companies need to pinpoint—and even predict—the points of strain along a network, and they need to be able to react immediately.

Inadequate forecasting that is short on facts

Skillful forecasting of everything from raw materials to customer demand is a science. And trying to forecast during an unprecedented shock, such as the COVID-19 pandemic, is extremely difficult. Most companies have a forecasting process that relies on historical data but doesn't account for real-time market and environmental signals, which can lead to errors. Additionally, many companies also lack simulation capabilities that allow for the evaluation of multiple scenarios in the face of uncertainty.

Today, predicting demand and supply is becoming more complex, with more points of potential miscalculation and an increase in risk. Pre-pandemic forecasting methods are becoming outdated, and companies are realizing they need to up their game with advanced forecasting and planning solutions to improve demand-sensing capabilities.

Emerging technologies, such as advanced analytics, automation, IoT, AI/ML, and blockchain form an important foundation for these advanced solutions. The future of our supply chain is dependent on these technologies and capabilities because they address short-term needs and build out long-term models that create competitive advantage. As companies invest in these technologies and the platforms to support them, they can devise new, data-driven, AI-enabled forecasting models that can help decrease risk and increase transparency.

Designing supply chains for resilience

Business leaders and CSCOs are now designing supply chains to withstand any number of future shocks, investing in new technologies, and thinking creatively about automation and relocation. In a July 2021 IDC survey, 51 percent of companies said they will be making changes to their operational resiliency going forward.[2] The investments that industries are making today will set the course for growth for decades to come.

The pandemic was an eye-opener for many manufacturers and, as a result, three areas came into sharp focus. The first was the impact on the global workforce, particularly front-line workers that support the supply chain. The second was how to reconfigure a supply chain quickly to meet changing needs. The third area was how to synchronize demand and supply when both were going haywire in the pandemic.

Typically, manufacturers could tackle each of these areas on an ad-hoc basis, such as ramping up for seasonal sales events. But throwing them all together created a logistical nightmare. New priorities for manufacturers are now emerging, such as bringing in more automation to address workforce instability, the growing skills gap, and sustainability. They're looking to diversify sourcing and manufacturing to avoid potential bottlenecks with a single-source region and to better prepare for global

tariffs and geopolitical tensions. Lastly, companies are developing social and environmental policies for their suppliers, starting with first-tier partners.

Technology is playing a transformative role in modernizing supply chains, and digital transformation enables a more comprehensive view of supply-chain needs. Organizations of all sizes are looking at advanced solutions and capabilities to anticipate and solve challenges agilely. The critical technology solutions enabling companies with more flexibility and agility are AI/ML, cloud, digital twins, IoT intelligence, and robotics.

Improving the modern supply chain doesn't just increase business stability and resilience. A robust supply chain protects the workforce and gives companies and governments more control over their own orders, transportation, warehousing, and fulfillment. It offers more flexibility, agility, and scale, while enabling companies to maintain their central purpose, and it ultimately paves the way for growth, even in times of turbulence.
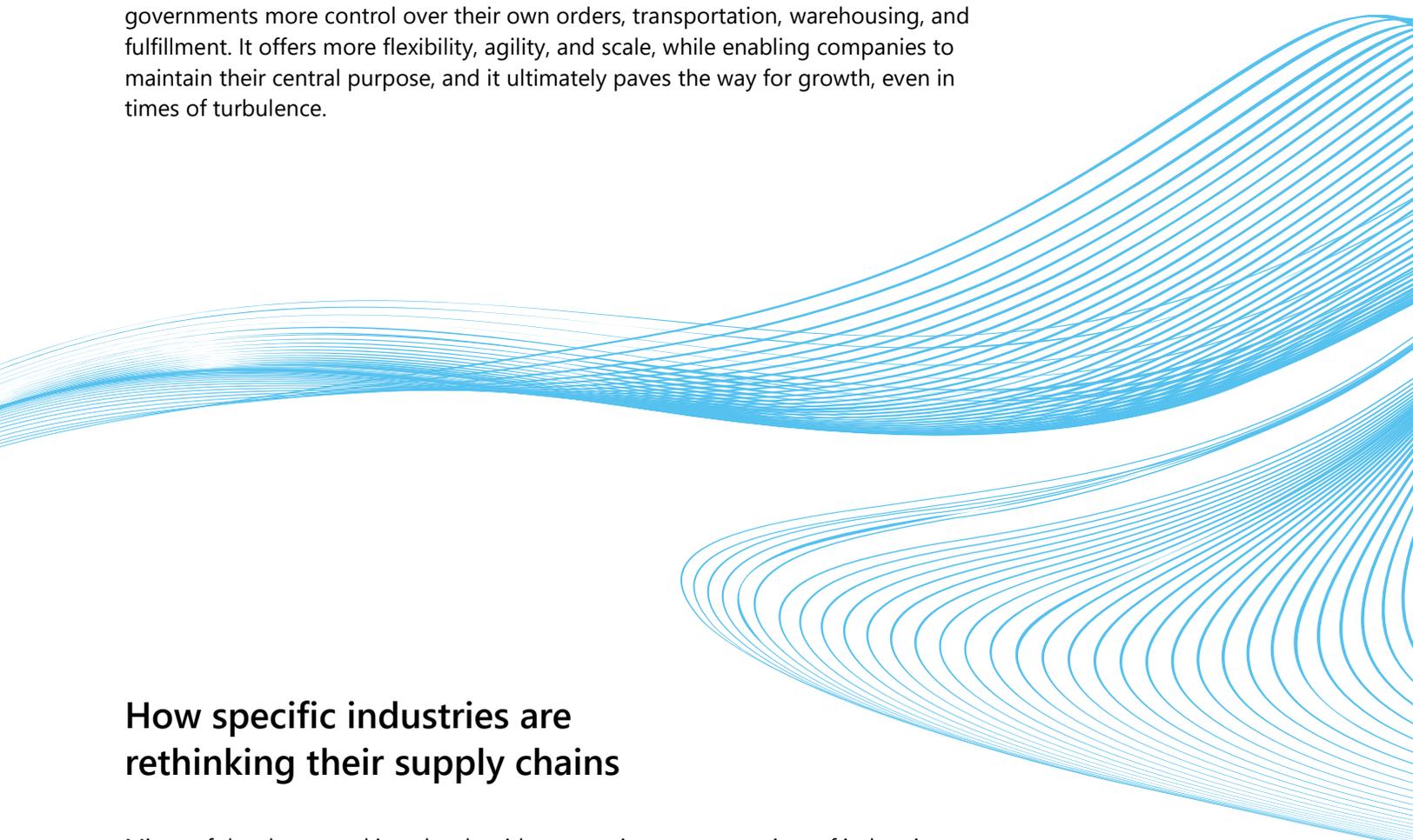
How specific industries are rethinking their supply chains

Microsoft has been working closely with companies across a variety of industries to analyze their supply-chain operations. Here are some of the responses Microsoft is seeing to the current landscape.

Automotive

Early last year, analysts and industry experts predicted that the pandemic would cause a major slowdown in auto and truck buying. As a result, many automakers pulled back their chip orders, and semiconductor manufacturers redirected their production for smartphones and other consumer electronics. When consumers started buying vehicles earlier than anticipated, semiconductor manufacturers placed orders from the automotive industry at the end of a long queue of requests from other industries. The consultancy IHS Markit estimates that supply interruptions caused nearly 1 million fewer light vehicles to be produced in the first three months of 2021 than previously anticipated.[3] The rental-car industry was also affected by the pandemic when demand dropped sharply, and operators sold off more than 770,000 vehicles in response. Now that the economy is recovering faster than expected and people are traveling again, there are not enough cars to meet demand, causing rates to spike.[4]

Even before the pandemic, the automotive industry was dealing with a shortage of lithium-ion batteries used in electric vehicles (EVs). Battery cells are largely manufactured in China, South Korea, and Japan, while the raw materials used are sourced from several countries around the world. A problem with one battery supplier can have an enormous impact.

Automakers want to diversify the locations of battery production, and some companies are taking production in-house. Analysts expect 22 percent compound annual growth rates (CAGRs) for global EV sales over the next five years.[5]

Going forward, automakers need both more insight on the production side and a better picture of the demand side. Most automakers don't sell directly to consumers Typically, dealerships own those relationships, and as a result, automakers might lose insight into consumer demand. For example, a customer visits a dealership looking to purchase a blue vehicle, but the dealership only has the vehicle in green, so the customer settles for the green model. Automakers register that a green model was sold and they assemble another one, not having received any insight into what the customer wants to purchase. New models that offer direct-to-consumer ordering can change that, while still delivering the vehicles to dealerships for final distribution.

As we embark into this new normal, automakers and CSCOs require technologies that give them more visibility into suppliers in outlying tiers and a better way to manage inventory risk. They want improved scenario modeling that can help anticipate future crises and better solutions to map consumer demand, considering economic fluctuations, climate changes, lifestyle needs, industry trends, and global events.

Semiconductors

Semiconductors are in nearly every electronics product and are so important to the human experience that when supply is crunched, entire industries are impacted. The automotive industry can certainly attest to that, based on its experiences during the COVID-19 pandemic. Everyone is feeling the pinch, and manufacturers are under intense pressure to increase production.

The semiconductor supply chain also includes chip design and fabrication, and this end-to-end focus is one of the reasons chipmaking is a slow and laborious process. It takes a year or more to design a chip and more than 14 weeks to fabricate it, with numerous packaging and assembly steps required before it reaches the customer. New manufacturing capacity requires equipment orders that can take a year or more. And manufacturing lines are highly specialized, typically able to fulfill just one of dozens of types of chips that might be required in a consumer market. The complexity and the slow response times to shifts in the market make better visibility and more accurate predictions that much more critical.

There are only a few major manufacturers supplying most of the world's chips, with 75 percent of the global capacity concentrated in East Asia. The global chip industry is heavily dependent on China, Taiwan, and South Korea for innovation, raw materials, labor, testing, and manufacturing.

Companies are interested in expanding the industry's geographic footprint to counter disruptions caused by future supply-chain shocks and geopolitical conflicts. There is growing interest, for example, in building more advanced semiconductor plants in the United States, and government policy will play an important role in determining whether this happens, and if so, how quickly.

Companies that use semiconductors are also increasingly concerned about not just cost and availability, but the security of their supply chains. They need to ensure that the complex supply network is not a cyber-vulnerability, and they need to protect against the use of counterfeit parts that might fail in the field. Simply arriving on time is no longer sufficient. Companies want a deeper look into how suppliers implement security, and they need more data to ensure that chips are authentic.

There often isn't much information flowing between chipmakers, suppliers, and end users. That was fine in the past, as buyers were less focused on visibility as long as the chips arrived as negotiated and on time. Now, they want a deeper look into suppliers, methods, planning, and allocation over a multi-year period.

All of these factors are leading CSCOs to reimagine the semiconductor supply chain and capacity as a more network-oriented ecosystem, one where multiple layers of suppliers and customers have a better sense of how they work together. Healthy collaboration and capacity awareness create more opportunities to optimize the supply chain in any environment.

Pharmaceutical and healthcare

The global supply chain for essential medicines and other treatments was fragile prior to the pandemic. COVID-19 revealed the real cost when a system breaks down. Manufacturers were unable to meet the world's imperative need for ventilators, personal protective equipment, and testing swabs. There were severe shortages of antibiotics, pain relievers, and sedatives to help place patients on ventilators or to facilitate critical surgical procedures. The American Medical Association called drug shortages an urgent public health crisis.[6]

There are four main causes for drug shortages. First, intense price competition and high investment requirements can lead to limited production decisions that impact availability. Second, there are no incentives for manufacturers to adhere to premium quality standards, so many of them simply comply with minimum requirements and use antiquated quality systems and processes that fail and cause disruptions. Third, a complex and lengthy regulatory environment across geographies inhibits the ability to qualify suppliers and quickly expand production across different contract manufacturers. Finally, special distribution requirements impact the availability of medicines. For example, vaccine distribution requires cold-chain distribution to hospitals, clinics, pharmacies, and other healthcare centers.

Fragmented systems mean more time and delays. If a company wants to increase production, it might have to get permission from multiple regional regulators, and it might have to source new ingredients. The risk to the supply chain is increased by the just-in-time method of holding slim inventories, which makes it more difficult to respond to new demands.

The sector saw some positive stories as healthcare companies reacted collectively to the pandemic. Various industries banded together to produce more ventilators.[7] Fuel ethanol refineries pivoted to produce hand-sanitizer ingredients, and competitors formed alliances to develop life-saving medicines.[8] These collaborations require new levels of trust, visibility, and supplier innovation.

Drug companies are working to expand the capacity of branded and generic manufacturers. These moves demand more intense attention to the quality, reliability, and financial metrics that validate sustainable operations and uninterrupted business continuity.

All these changes require advanced and intelligent methods of running operations. Manufacturers now more than ever want solutions that provide more end-to-end supplier visibility, demand sensing, forecasting accuracy, intelligent order fulfillment, and superior risk management.

The overall goal is to deliver care that is repeatable, predictable, and appropriate for individuals or populations—and to ensure that care will hold fast in future pandemics. Future-savvy CSCOs are innovating in new ways and embracing modern digital solutions. Pharmaceutical companies and the healthcare system will accelerate their mission toward delivering better healthcare for billions of patients around the world, especially at this critical point in time.

Defense

In this time of global uncertainty, defense supply chains are being reviewed as possible sources of risk for national security. A desperate search for critical supplies and medications gave some countries significant power over others during the pandemic, underscoring the need for manufacturers to have more control over where and how critical items are produced. The issue is so important that a congressional task force analyzed the US defense supply chain in early 2021 and found that there isn't enough visibility to understand its vulnerabilities, reduce risk, and know its surge capacity in the next crisis.[9]

The defense sector struggles with many of the same sourcing and manufacturing issues as other industries, but it has two additional concerns: supply-chain vulnerabilities could be weaponized in ways that endanger a region or even a country's security, and many defense supply chains rely on niche providers that require consistent, predictable defense orders to stay in business.

Transparency leads to security in a defense supply chain. Defense agencies and contractors need to know where parts are coming from, whether they are authentic, if they have been tampered with, and whether they're vulnerable to spying or other interference. Those questions can be answered at the tier-1 level that supplies directly to manufacturers, but not as far upstream as many manufacturers would like. The defense sector wants total visibility into all the underlying components of its products, which is almost impossible given the complexity of the materials used. Just as critical is the data surrounding the supply chain—and where to store it. Businesses are increasingly using cloud-based applications for communication, collaboration, networking, and storage, and now defense companies and government agencies are moving data to the cloud under strict security protocols.

Defense contractors and government agency CSCOs want a platform to easily manage data and adjust to incoming supply levels. They're interested in using AI to determine risk and uncover potential problems. They want a robust workforce of skilled workers that can handle sophisticated jobs.

Risk assessment is one of the top priorities of the defense industry. And it's important that any risks in supply chains can be readily identified at a moment's notice. Increasing visibility and transparency is critically important

Retail

The pandemic revealed how truly stretched retail supply chains had become, even as online and mobile commerce spiked. Warehouse and production job levels fell, slowing fulfillment. Stores struggled to forecast product demand and couldn't hire enough employees to fill orders. Retailers attempted to move operations online but found that suppliers had neither the sophisticated data to feed into their systems nor the processes in place to support a shipping methodology.

For many companies, that level of disruption is simply untenable going forward. Retail supply chains have historically centered around finding the lowest costs possible without impacting customer service, but now companies recognize that they need to be smarter and more agile.

The reality is that retail is never going to get less complex than it is today. Customers enjoyed the new innovations born out of necessity during the pandemic, such as curbside pickup, personal shopping, and virtual sampling. People will continue to want items delivered to their doorstep within hours. They want items to be in stock, they want delivery guarantees, and they want personalized communication and top-notch customer service (both in person and remote). Delivering on all these expectations is no easy task, and it involves a massive transformation that the retail industry has been trying to achieve for years.

Retailers are weighing a range of operational changes, including contracting with more backup suppliers, shifting more reserve inventory closer to last-mile customers, and using third-party shipping entities. They're searching for the right technologies for increased automation and optimization. Many are developing a three- to five-year vision for these initiatives. There is a sense of urgency because the innovations that retailers are developing on the front end of their businesses alongside their consumers could suffer if they don't have the right infrastructures, horsepower, and automation supporting those innovations on the back end.

Two of the biggest priorities are data transformation and automation that can remove the more mundane tasks for the workforce and provide significant savings down the road.

The old adage of "location, location, location" for retail success is giving way to something along the lines of "efficiency, responsiveness, and fulfillment." Forward-thinking companies and their CSCOs are already working out the tools to help them get there.
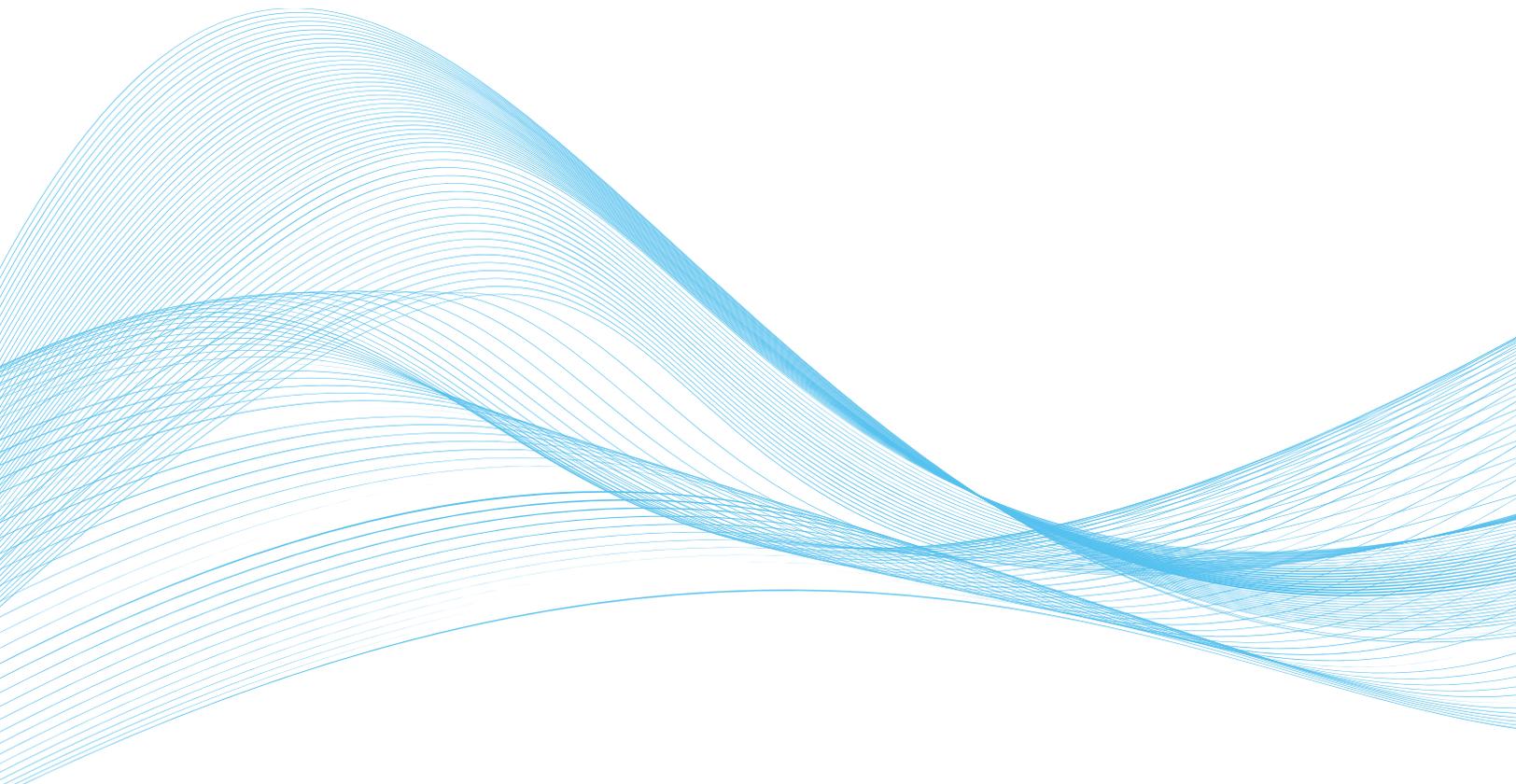
How technology is increasing adaptability of modern supply chains

The pandemic, coupled with unprecedented natural disasters, geopolitical events, and unforeseen issues, exposed the digital divide in manufacturing: those that had, and those that had not, invested in digital transformation. Technology is playing a critical role in the supply chains of digital leaders and will continue to have a transformative role in modernizing future supply chains. Digital transformation and implementing technology that enables a more comprehensive view of the supply chain need to reach far beyond the walls of a single factory, distribution center, customer, or supplier.

A high-powered digital network is the living, beating heart of future supply chains, creating an end-to-end value chain to deliver unparalleled customer experience. Microsoft is a platform company and offers multiple solutions that combine a secure public cloud, business applications, and enterprise resource planning (ERP) solutions with a robust partner ecosystem. Companies of all sizes need advanced solutions to predict disruptions and respond fast, while at the same time improving planning and making the right decisions for their customers.

Critical technology enablers for supply chains include:

AI and ML: Provide better market insights with analyses of different scenarios and automated decision making. AI and ML enable predefined alerts that are triggered upon notification of disruptions. They can boost customer support with chatbots and voice-activated assistance to provide delivery times and other information.

Cloud: End-to-end solutions can seamlessly connect people, assets, workflows, and business processes. Manufacturers can digitally empower a workforce and operate agile factories. They can create more visible supply chains and unlock innovation with digital feedback loops.

Digital supply chain twins: A virtual copy of a supply chain can absorb input data in real time to process customer orders, monitor performance, and identify the need for improvements.

IoT intelligence: Companies can gather real-time data and build applications that can send notifications for production delays, excess equipment downtime, and product quality.

Robotics: Mobile robots that can operate independently and move goods around are becoming a key part of warehouse and factory operations.

These are the tools for managing a resilient supply chain

We have seen our customers accelerate their investments in five key areas in response to COVID-19, and we expect these to continue into 2022 and beyond. Those areas are building more agile factories, transforming and developing skills in their workforces, engaging customers in new ways, creating more resilient supply chains, and unlocking innovation and delivering new services. These are areas where Microsoft and our partners can help connect experiences across operations, workforces, design and engineering processes, customer engagements, and the end-to-end value chain—which is why we've created Microsoft Cloud for Manufacturing.

Microsoft Industry Clouds provide an on-ramp to the broader portfolio of Microsoft cloud services, enabling customers to begin with the areas where the need for technology or business transformation is most urgent. Microsoft Cloud for Manufacturing is designed to deliver capabilities that support the core processes and requirements for the industry. These end-to-end solutions bring together new and existing capabilities across the Microsoft portfolio, along with partner solutions that help organizations and supply chains become more resilient.

What makes Microsoft Cloud for Manufacturing unique is our commitment to industry specific standards and communities, such as the Open Manufacturing Platform, the OPC Foundation, the Digital Twins Consortium, and our innovative partner ecosystem, coupled with composable and extensible solutions that seamlessly connect people, assets, workflows, and businesses processes. Our technology is giving businesses more intelligence and visibility than ever before and making operations more adaptable.

Here are some of the ways that Microsoft Cloud for Manufacturing can help improve supply chains:

Master planning platform: Allows companies to determine their future need for raw materials and capacity—gives the day-to-day picture of current orders and inventory, and forecasts gross requirements for long-term planning.

Intelligent order management: Helps companies coordinate orders that were captured in a mix of different channels and systems through a single point, optimizing delivery speed while helping reduce costs—enables greater inventory visibility so that orders can be fulfilled by the inventory closest to the customer.

Cost-management software: Works with the valuation and accounting of raw materials and semi-finished and finished goods—helps manage and report inventory accounting and manufacturing accounting.

Asset and inventory management software: Helps manage and serve equipment throughout the supply chain, including machines, production equipment, and vehicles—useful for managing inbound and outbound operations, quality assurance (QA), and inventory control.

Supply chain control tower: Can run "what if" scenarios to give a realistic sense of how supplier and inventory changes will land across all channels.

Supply chain management software and applications: Helps predict disruptions and informs product quality issues. Innovate with intelligent manufacturing operations and develop planning agility to fulfill customer demand. Optimize asset uptime, inventory, and logistics.

Multi-echelon planning optimization: Optimizes planning from a global perspective across all echelons of the supply chain. Creates a probability-based model of demand and inventory and then uses this model to understand the impact of demand forecasting on inventory.

Risk management and mitigation: Identifies, evaluates, and monitors ongoing risks, particularly as supply chains increasingly operate in a global environment.

Supply-chain security: Uses a risk-based framework to protect a company and help reduce threats across its supply-chain network, including for suppliers, who can often be the weakest link.

Track and trace: Know exactly where product inventory is and has been, based on data collected from sensors, which creates a detailed trail that provides at-a-glance information.

Setting the course for future growth

Microsoft has a vision for the future of supply chains—and solutions like Microsoft Cloud for Manufacturing—to make that innovation real. Enterprises can embrace new technologies that help improve digital operations while optimizing the value chain for customer outcomes. An enhanced infrastructure helps ensure better inventory management and cost savings, and it will help close the gap between demand and fulfillment. Transformative technologies can also help to shift business paradigms toward sustainability. They can help businesses better understand and minimize the impact of business operations on the planet. Furthermore, technology can enable companies to fulfill a responsibility to think sustainably and embrace and manage change as an opportunity for growth.

CSCOs looking to improve their supply chains can start with their data: how to map it, share it, collaborate on it, and use it to improve operations. Technology that was previously considered too costly or too difficult to implement is increasingly being adopted as foundational to a modern supply chain. At the same time, leaders can look at upskilling their employees to expand their capabilities across operations, which could also improve efficiency.

Industries can collaborate on benchmarking and innovation to understand what works, as supply chains revamp with an emphasis on digital transformation. Leaders can use this time to think creatively up and down the supply chain and make investments for the future. For many, technology will play a starring role. Businesses can rise out of this pandemic stronger than before, with renewed confidence in their operations and their ability to withstand future disruptions.

To find out more about supply-chain solutions and Microsoft Cloud for Manufacturing, please visit our website.

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