

2019 MHI ANNUAL INDUSTRY REPORT

ELEVATING SUPPLY CHAIN
DIGITAL CONSCIOUSNESS

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Elevating Supply Chain Digital Consciousness

2019 MHI Annual Industry Report Key Survey Findings

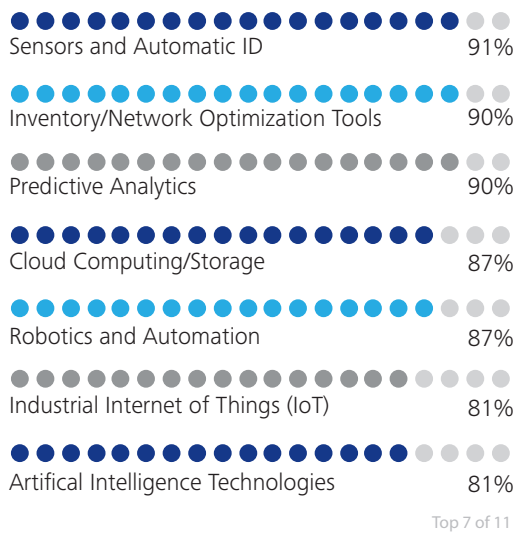
COMPANY CHALLENGES

The top 5 company challenges - rated extremely or very challenging



TOP IMPACTS

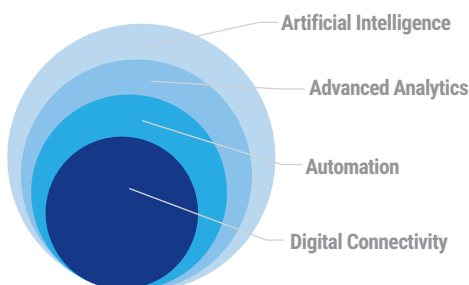
Technologies that will have an impact on the supply chain in the next 10 years



ARTIFICIAL INTELLIGENCE

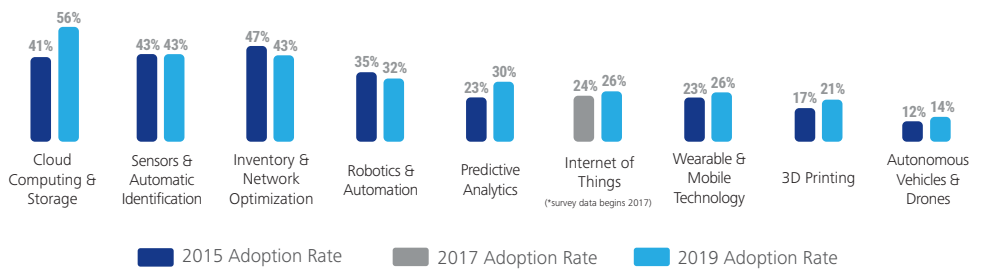


STATES OF DIGITAL ADOPTION



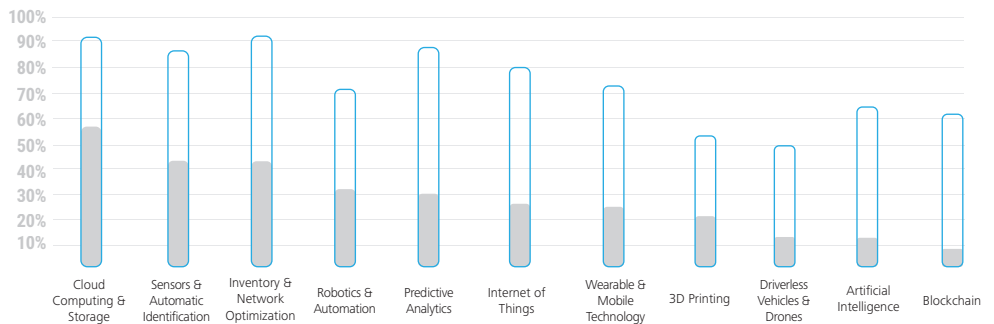
ADOPTION TRENDS - CURRENT USE

Answer rate for "in use today" from the given years



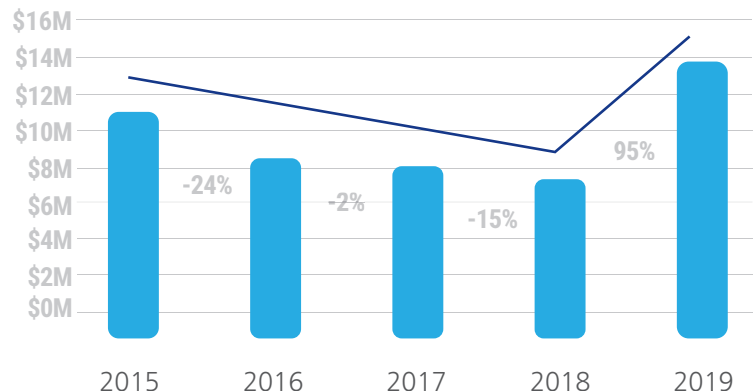
ADOPTION TRENDS - PREDICTED USE

Technologies that are in-use today vs. their predicted use in 5 years



PLANNED INVESTMENT

Weighted Average Spend Projections Over the Next 2 Years



Introduction



“The pace of supply chain innovation over the six years of our survey is truly astounding, creating real and measurable competitive advantage for early adopters. With supply chain complexity showing no signs of slowing, the risk of inaction is only growing. Leading manufacturing and supply chain executives agree that technology is the key to future success.”

- George Prest, CEO of MHI

In the six years we have been conducting this survey on ground-breaking supply chain innovations, one thing has become abundantly clear — the age of the digital supply chain is here. Digital technologies and innovations continue to fuel escalating customer expectations for service that is better and faster, creating relentless pressure for supply chains to perform flawlessly, efficiently and transparently. Only a digital supply chain that is agile, fully automated and self-learning will likely be able to meet these demands and compete/thrive in the future.

One common issue over the years has been the supply chain workforce shortage and rising need for digital skill sets. Companies continue to be severely hampered in their ability to implement digital technologies due to the shortage of workers with the necessary skills to run them.

By focusing on talent development and leveraging tools such as automation, robotics, cloud computing, Internet of Things (IoT), analytics, machine learning and augmented reality, an end-to-end supply chain solution can be created that is adaptable, transparent and more intelligent than ever before. Leading companies are not only recognizing and accepting this new digital reality, they are elevating their mindset

from a state of simple “awareness” to a state of keen “consciousness” — a mindset that helps them identify and implement the fundamental changes necessary to harness digital-driven opportunities for reducing costs, anticipating and managing risk, and creating a more customer-focused experience.

Embracing a digital supply chain mindset can open the door to greater performance and success by helping an organization leverage the latest digital technologies to inspire and drive experimentation, ingenuity and innovation.

[Fresh insights from the latest survey and roadmap](#)

In this year’s survey report, MHI and Deloitte Consulting are once again collaborating to generate clarity and insight about supply chain innovations — and how to adopt them. The findings in this report focus on themes that are top of mind for the 1,000+ industry leaders surveyed. Survey respondents hail from a wide range of manufacturing and supply chain industries, with half holding executive-level positions such as CEO, Vice President, General Manager or Department Head. Participating companies range in size from small to large, with 47% indicating annual sales in excess of \$100 million, and 10% indicating annual sales of \$10 billion or more.

The upcoming third edition of the U.S. Roadmap on Material Handling & Logistics, which is targeted for release in Spring 2020, will take a futuristic view of the economic and technological trends that are expected to impact supply chain over the next 15 years. This report focuses on the 3-5 year outlook for the following key technologies from the current Roadmap – technologies that are driving next-generation (NextGen) supply chains:

- Inventory and network optimization tools
- Sensors and automatic identification
- Cloud computing and storage
- Robotics and automation
- Predictive analytics
- Wearable and mobile technology
- 3D printing
- Driverless vehicles and drones
- Internet of Things (added in 2017)
- Blockchain (added in 2018)
- Artificial Intelligence (added in 2018)

The rise of supply chain digital consciousness

This year we are introducing the concept of “Supply Chain Digital Consciousness” to describe the escalating levels of digital awareness and maturity in supply chain operations (Figure 1). Our goal is to help companies identify where they are on the digital supply chain journey and then chart a clearer path to where they need to go.

The Supply Chain Digital Consciousness framework enables companies to assess themselves across five

digital categories and four levels of awareness that will be covered in this report.

According to this year’s survey findings, progress and interest in NextGen supply chain innovations has never been higher, nor more promising. In particular, artificial intelligence, which depends on many of the survey technologies as a foundation, saw a huge leap in potential impact.

Adopting these important innovations and elevating supply chain digital consciousness is essential for competing effectively in an increasingly digital economy. However, the challenge is highly complex and may require significant organizational change, along with increased investment.

Today, even the most successful companies are still struggling to understand how and when to adopt digital supply chain innovations. Falling behind on digital innovation in supply chain can have disastrous consequences in this increasingly digital world, so it’s important to start small, act quickly, learn from setbacks and rapidly build on successes.

This report provides practical insights about how and where to start. It also offers a framework to help companies identify where they are on the journey to digital adoption in supply chain and provides tips and real-world examples to help them move forward more effectively.

DIGITAL CATEGORIES

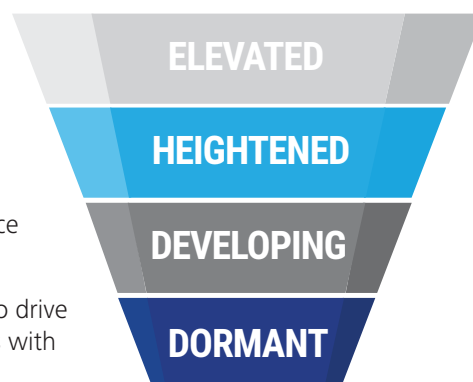
Leadership - focused alignment

Talent - attracting, retaining, and growing

Customer Engagement - connecting with customers

Workplace Environment - cultural embrace of technology

Innovation/Technology - experimenting to drive digital advancement and pairing innovations with core business



- 04** | Intelligent analytics to support decision making
- 03** | Innovation to collect/analyze digital information
- 02** | Low levels of automation or connections
- 01** | Waiting for adoption

Figure 1: Supply Chain Digital Consciousness Overview

The background of the slide is a photograph of an industrial setting, likely a factory or warehouse. It features rows of tall, grey metal shelving units or racks. Some of the shelves are filled with yellow plastic bins. In the background, the blurred faces of several people can be seen, suggesting a busy work environment. A solid blue rectangular overlay is positioned in the upper half of the image, containing the title text.

Survey Highlights

Impact of Supply Chain Innovation

Expectations remain high that the digital innovations we have been tracking for the past six years will have significant impacts on supply chain. This year's survey results show that the vast majority of respondents expect these technologies to have a substantial impact on their supply chains over the next 10 years (Figure 2).

What's more, respondents generally believe that most of these innovations have the potential to disrupt supply chain practices and create lasting competitive advantage for companies that embrace them (Figure 3).

Adoption Rates

Cloud computing and storage has the highest current adoption rate, 56%, and adoption of this technology

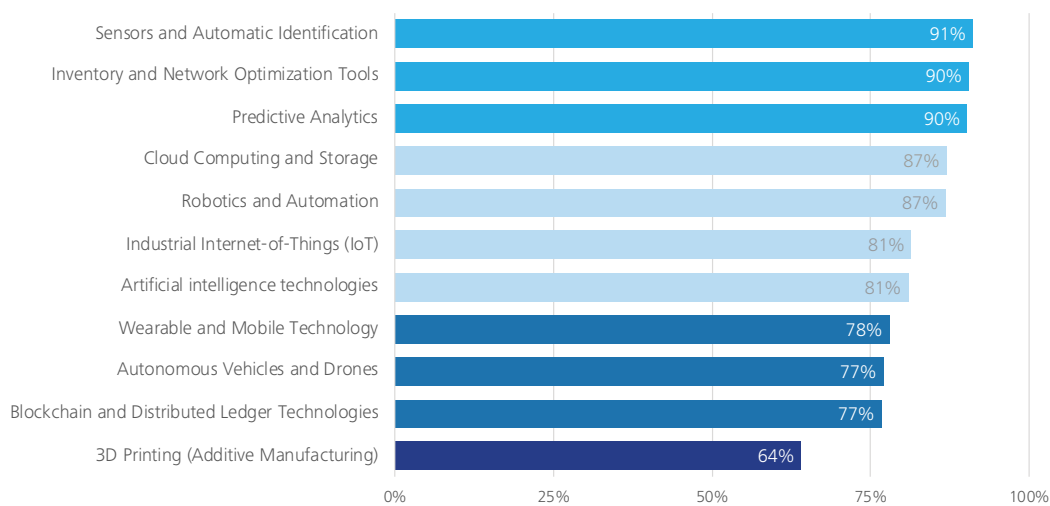


Figure 2: Predicted 10-year Impact on Supply Chains

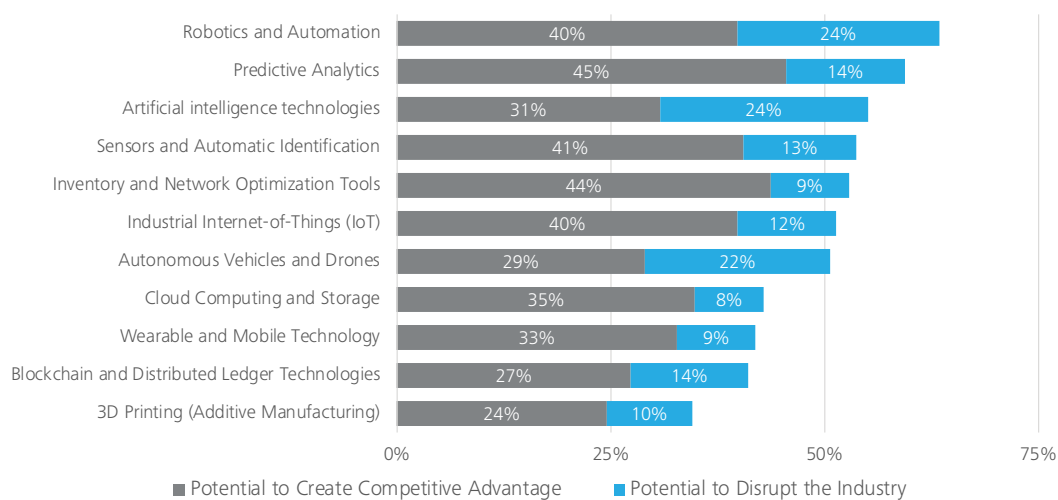


Figure 3: Competitive Advantage/Potential to Disrupt Supply Chains

is expected to grow to 79% over the next two years, and to 91% over the next five years. Inventory and network optimization is forecast to reach a 75% adoption rate in two years, and 90% in the next five (Figure 4).

Over the next five years, predictive analytics is expected to reach an adoption rate of 87%, followed by Sensors at 86%, IoT at 80% and Wearables at 73%. Blockchain and Artificial Intelligence, which are currently only at 10% and 13%, respectively, are both expected to reach 62% in five years.

Workforce & Customer Demands Remain Key Challenges

In this year's survey, hiring qualified workers is seen as the single biggest challenge, with 65% of respondents rating it as extremely or very challenging and 91% rating it as at least somewhat challenging (Figure 5). The importance of the supply chain workforce shortage has been a consistent result over the past five years of the survey and has been analyzed extensively in our previous reports. Finding, hiring, and retaining talent will likely continue to be top of mind for supply chain leaders.

Another continuing theme from past reports is that the collective challenges related to customer demands on the supply chain remain a top concern (Figure 6).

The frameworks and digital adoption approaches highlighted throughout this report can help companies address these rising customer expectations for service that is better, faster and more efficient.

Increasing Investment in Supply Chain Innovation

Manufacturing and supply chain operations continue to invest heavily in innovation. 57% of respondents are planning new technology investments totaling more than \$1 million over the next two years — that is a 10% increase over the 2018 report. 34% plan to spend more than \$5 million and 22% plan to spend more than \$10 million. According to the survey, the highest funding will be for Robotics and Automation, an area where companies plan to spend an average of \$20 million over the next two years. At the other end of the spectrum, companies only expect to invest an average of \$10 million on 3D printing over the next two years. Planned investment levels for the other technologies range from \$10 million to \$14 million (Figure 7).

The survey results suggest that investment in supply chain innovation is at a critical inflection point, with a trend of declining investment from 2015 to 2018 being more than countered by a 95% increase in projected spending for 2019 (Figure 8).

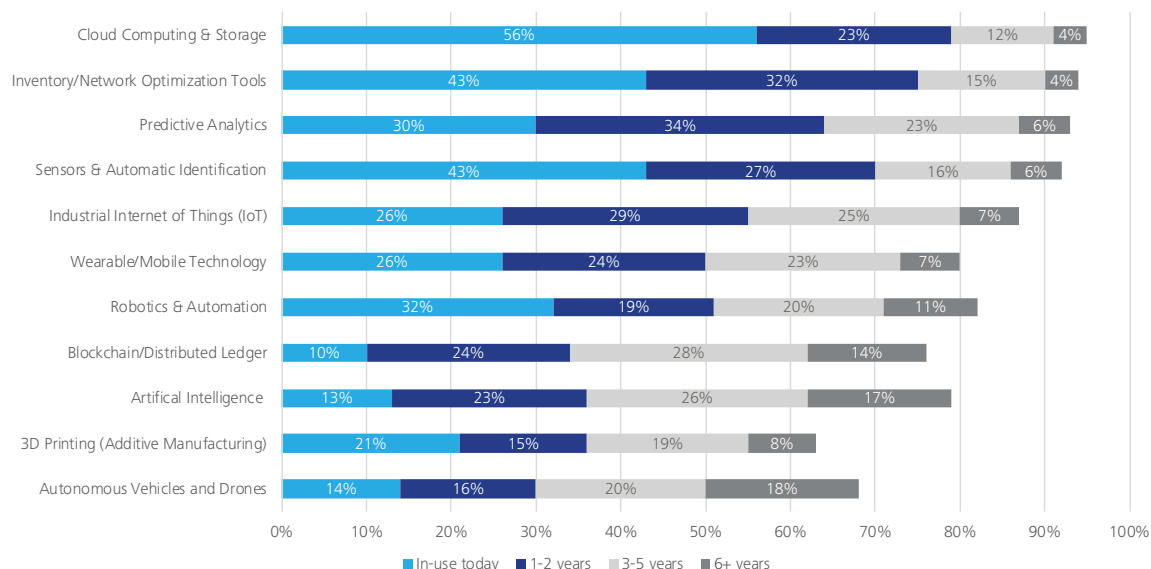


Figure 4: Adoption Rates

COMPANY CHALLENGES

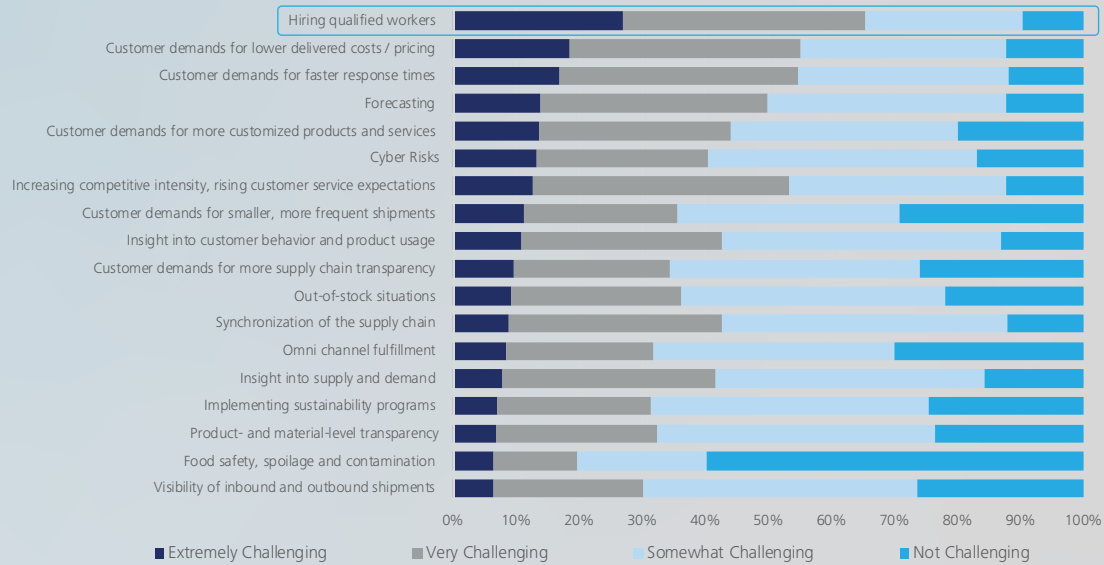


Figure 5 - Company Challenges

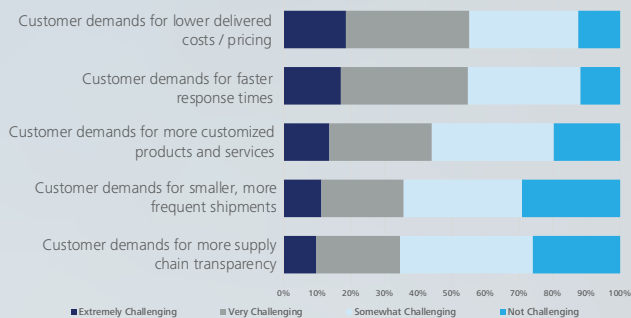


Figure 6 - Company Challenges Related to Customer Demands

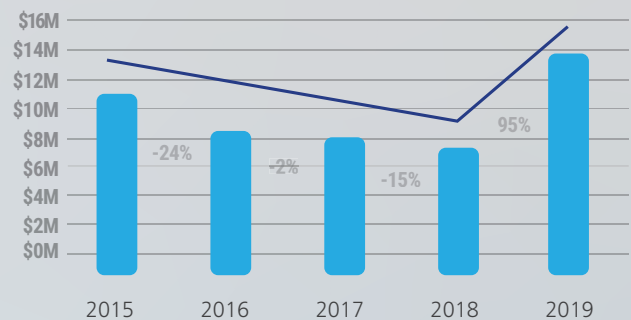


Figure 8 - Weighted Average Investment in Next Two Years (2015-2019)

PLANNED INVESTMENT

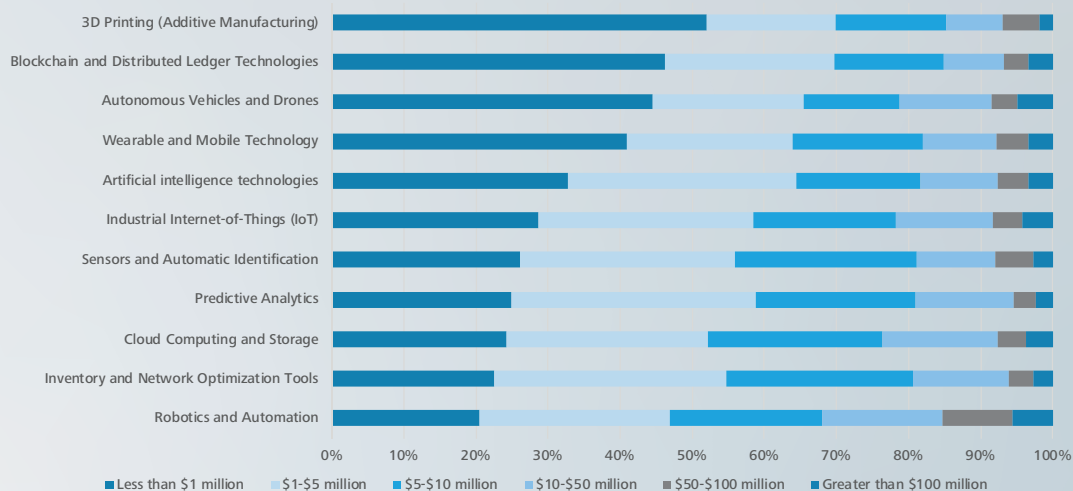


Figure 7 - Investment in Next Two Years

Security

Pressures on Supply Chains

Driving the Need for Digitization

ZAPP2PHOTO/SHUTTERSTOCK.COM

“As digital capability fuels customer expectations to unprecedented heights, NextGen supply chains must be proactive, predictive and prescriptive, with all of its links interconnected and synchronized to the same drum beat of consumer demand.”

- Scott Sopher, Deloitte Consulting LLP

Digitization and the “always on” supply chain

Many of today’s consumers are demanding more from businesses in terms of shorter service cycles, lower costs, greater transparency and increased corporate responsibility. Over time, consumers have come to expect unprecedented levels of service, ranging from same-day delivery and free shipping to real-time alerts on the status and location of items they have purchased. These expectations are rippling across the entire supply chain ecosystem. Consumer-facing organizations themselves are increasingly demanding speed, visibility and transparency from their own upstream supply chain partners to meet the end-customer’s rising expectations.

In response, leading companies are adopting a more digital approach to business. Using digital innovation to improve supply chain efficiency, transparency and sustainability has become a necessity for continuing to grow the customer base and maintain a competitive standing.

Digital technology is now an integral part of every step in the supply chain, and it is virtually impossible to find a company not in the midst of modifying its technical architecture to be more digital.

“Free” shipping

The concept of free shipping is now so ubiquitous that it has become a basic expectation for many consumers. Of course, nothing is ever truly free. To make “free” shipping economically viable companies are constantly looking for new but effective methods and technologies to reduce costs.

Large direct-ship providers with low overhead costs are becoming increasingly nimble, enabling them to fail fast and innovate until they have successfully developed and fortified a niche market offering. Implementing supply chain innovations and piloting new technologies in a smaller scale environment can take much longer, cost more, and may not deliver the same level of benefits a large direct-ship provider can achieve.

One area where direct ship providers excel is their ability to quickly adjust to modified orders and returns. Many online customers have come to expect product returns to be straightforward and painless. As such, companies today must have a robust infrastructure and demonstrated logistics both for purchasing and returning products. This complex and demanding environment makes the promise of free shipping a heavy burden for companies to bear.

Social & environmental awareness

Increased societal concern and awareness about where products are sourced from — and where they end up — is driving consumers to demand more corporate responsibility. Socially and environmentally conscious consumers are changing their purchasing habits, steering away from companies that do not offer a sustainable and transparent supply chain.

Sourcing materials that are recycled, reused, or environmentally considerate — from locations that consumers consider acceptable — has become critically important for attracting and retaining consumers. As the sustainability bar rises, end-to-end supply chain visibility becomes increasingly necessary. Creating a supply chain that can satisfy these requirements will require significant effort.

In addition, the overall demands of corporate social responsibility create the need for companies to ensure that ethical sourcing decisions are not only made internally, but also communicated externally.

Skilled worker shortage

To achieve innovation and growth, supply chains need to address the challenge of the shrinking skilled workforce. Today, the number of people with the required technical skills to effectively fill supply chain roles is dwindling. As such, the ability to identify, retain and develop superior talent has become critical to success. The digital talent gap is particularly challenging for supply chain organizations, many of which are still in a relatively early stage of maturity. According to a study by MIT Sloan and Deloitte¹, organizations in the early stages of digital maturity face a chicken-and-egg problem where they have a tremendous need for digital talent, yet their hesitancy to embrace a digital culture makes them less attractive to such talent. (Figure 9).

Innovative technology is often viewed as a threat to existing jobs. However, while it is true that some of

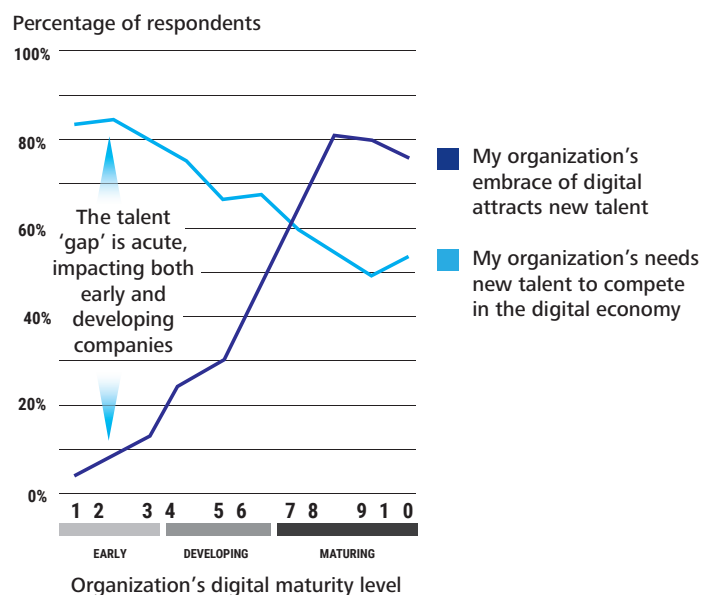


Figure 9: Digital Talent Needs vs Ability to Attract¹

the new supply chain technologies — such as automation and bots — have the potential to replace workers for monotonous and repetitive tasks, the broader goal is to enable increasingly scarce supply chain workers to focus their efforts on activities and decisions that are more valuable and complex. That said, a company must be extra careful when communicating with its existing workforce about technology innovations in order to avoid sending the wrong message.

The adoption of NextGen supply chain technologies will require a greater need for skilled workers. Whether that requires bringing in new talent or offering additional training to the existing workforce, expanding the company's skill base will remain a top priority for the foreseeable future.

Once new knowledge and technical skills have been acquired, companies must make a conscious effort to retain and fully utilize their talent. Today's workers expect more options for work-life balance,

including flexible schedules and work locations. They also expect a work environment that offers compelling career trajectories and continuous learning and development.

Encouraging employees to train cross-functionally and connect² with other departments can help them sharpen their critical thinking and further develop their technical and business acumen, producing benefits both for the company and its employees.

Another digital supply chain trend on the rise is “reverse mentoring.” Some companies are beginning to couple younger supply chain talent with more seasoned supply chain talent. According to Randy Bradley, Assistant Professor of Supply Chain Management, University of Tennessee, seasoned supply chain professionals, especially those in key leadership roles, benefit from the younger professionals who have grown up with using digital technologies. Bradley notes that “regardless of whether they are tech-savvy or merely tech-dependent, the digital natives are able to help ensure the seasoned leaders are up to speed on the latest tech developments, consumer engagement expectations of digital natives and immigrants, and the limitations of how best to apply emerging technology.”

Deciding which technologies to adopt/implement

The dizzying pace of innovation, combined with rising market pressures, is creating a sense of anxiety about which technologies to pursue (and when). In trying to determine the optimal implementation sequence and

timeline, decision makers are equally worried about missing the mark and missing the boat. Ultimately, every company is unique, and its path will be strongly influenced by a variety of factors, including budget, customer demands, competitive insights and available talent¹.

Overcoming barriers to technology adoption is fundamental to success and must be effectively addressed

“The current generation wants the opportunity to be creative and solve challenging problems. They are not infatuated with the mundane. They want the flexibility to leverage their unique understanding of NextGen supply chains.”

Randy Bradley, Assistant Professor of Supply Chain Management,
University of Tennessee

in order to achieve the expected benefits of digital supply chains. These include not only workforce and business case/ROI considerations but also cultural barriers, drawn-out timelines and competing business priorities. Additionally technical barriers such as incompatible systems that require new interfaces and time-consuming data consolidation/cleansing, which can slow the implementation to a crawl.

One key to success is establishing a technical architecture that is flexible and agile enough to proactively adapt as the company’s supply chain needs mature and evolve.

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The Four Stages of **Digital Adoption**

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001 345 662 993
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code process /// fixing /// password xxxx xxx xxxx xxxxx
done
done /// final pass /// password denied
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“As the pace of supply chain innovation escalates, so does the price of inaction. Leaders will outpace their competitors faster than ever.”

- George Prest, CEO of MHI

Digital adoption is an evolutionary process of implementing digital technologies and capabilities from the ground up, building on a foundation of data that can be analyzed and leveraged to drive business decisions. This evolution occurs naturally as a supply chain organization adopts new digital technologies into its operations.

The pyramid of digital adoption (Figure 10) has four technology stages, starting with the collection of data through digital connectivity, and then moving up the pyramid to generate increasing supply chain value and insights from that base data through automation, advanced analytics, and ultimately artificial intelligence.

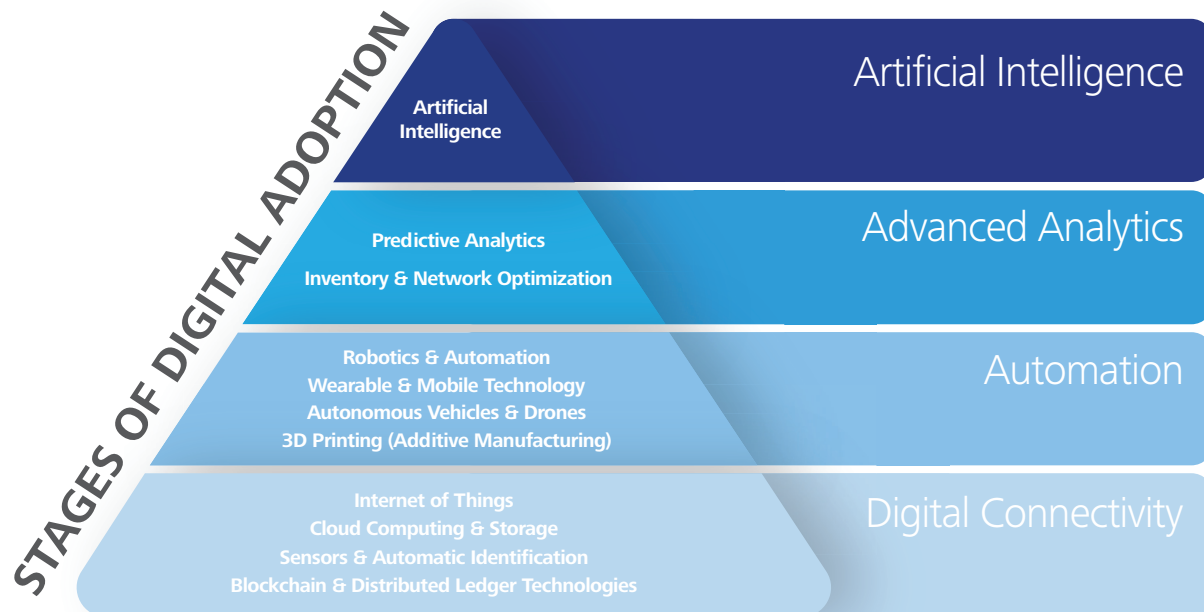


Figure 10: Digital Adoption Technology Pyramid
(technologies pulled from survey)

Stage 1: Digital Connectivity

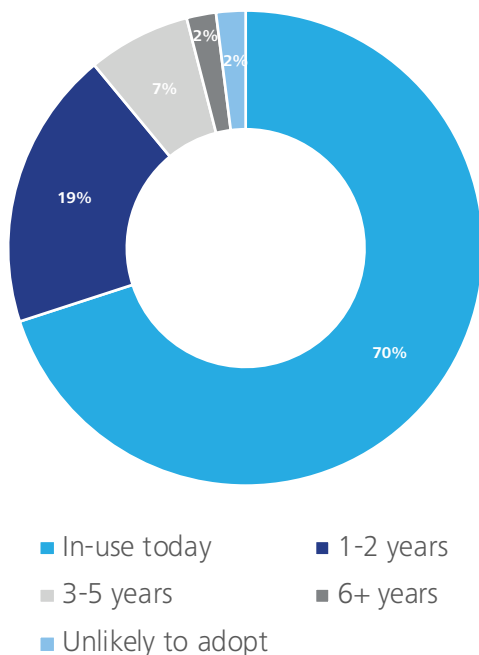
The first stage of the digital adoption technology pyramid is digital connectivity: the process of collecting, cleansing, and organizing data from multiple points and sources throughout the supply chain — including supplier and other partner data that helps enable real-time, end-to-end visibility. This stage can provide a strong foundation for the digital supply chain, priming the pump by taking the digital information that is now so readily available and converting it into a more usable form.

Digital connectivity of supply chain operations involves collecting data from the following four innovations:

- Cloud computing and storage
- Sensors and automatic identification
- Industrial Internet of Things
- Blockchain and distributed ledger technologies

Before implementing AI, firms need to get their data house in order. Without this foundation, AI will not be successful.

George Prest, CEO of MHI



According to this year's survey, 70% of participating organizations are already using at least one of these four connectivity-related innovations in their operations (Figure 11).

Figure 11: Adoption of Digital Connectivity Innovations



PHOTO COURTESY OF DELOITTE

FUTURE OF FRESH FOOD, CONNECTED SUPPLY CHAIN

CASE STUDY



Situation

A nationwide grocery chain wanted a technology to monitor the freshness of a product as it moves through the supply chain, from the time it is harvested, packaged in pack houses and transported through the company's distribution network. The company's existing supply chain provided limited visibility into the quality of food at each node, which led to poor product freshness and significant food waste.



Actions

The company tested a solution that used a combination of sensors, and cloud analytics to reduce retail food waste. The sensors continuously monitored and reported the products' location and the elapsed time since it left the field, while also measuring the temperature and humidity that the product was exposed to on its journey through the supply chain. Using the temperature, humidity, and elapsed time information, a cloud-based analytics solution could apply multiple algorithms to predict product freshness.

The powerful data provided the company opportunities to develop analytical and enterprise solutions that reduces food waste either by monitoring cold chain compliance or dynamically routing the products based on their remaining freshness or enhance the quality programs by providing near real-time data on product quality across the supply chain.



Results

Through the use of the connectivity technologies, the company was able to increase visibility of its cold chain and significantly improve operational performance including reduced logistics and inventory carry costs from reduction of food waste, as well as increased service levels. The company developed a roadmap for adoption and scaling of the technology for different use cases for perishable produce.

Stage 2: Automation

The next stage of digital adoption is automation — using automated systems, robotics, and augmented technologies to perform repetitive, resource-intensive supply chain tasks with a goal of streamlining operations and making them safer, quicker, and more reliable.

Supply chain automation involves the following five innovations surveyed:

- Robotics and automation
- Autonomous vehicles and drones
- Wearable and mobile technology
- 3D Printing (additive manufacturing)

Automation is both a consumer and source of digital data; as such, it expands on the first-stage connectivity innovations by providing additional valuable data about the automated supply chain activities. But it is not just about finding ways to work faster in old ways. It's also about inventing new ways to accomplish objectives.

According to the survey results, more than 53% of respondents are already using at least one of the above automation innovations in their operations (Figure 12). This majority adoption rate of automation-related technologies reflects a slow but steady increase over

“Like the rise of industrial robots in car manufacturing, automation is helping the supply chain industry respond to consumer pressures for faster service, more choices, and greater customization. Businesses that best leverage advanced automation and technology will become new market leaders.”

Joel Reed, CEO of IAM Robotics

the past six years as supply chains have positioned themselves to address constant cost pressures and the chronic workforce shortage.

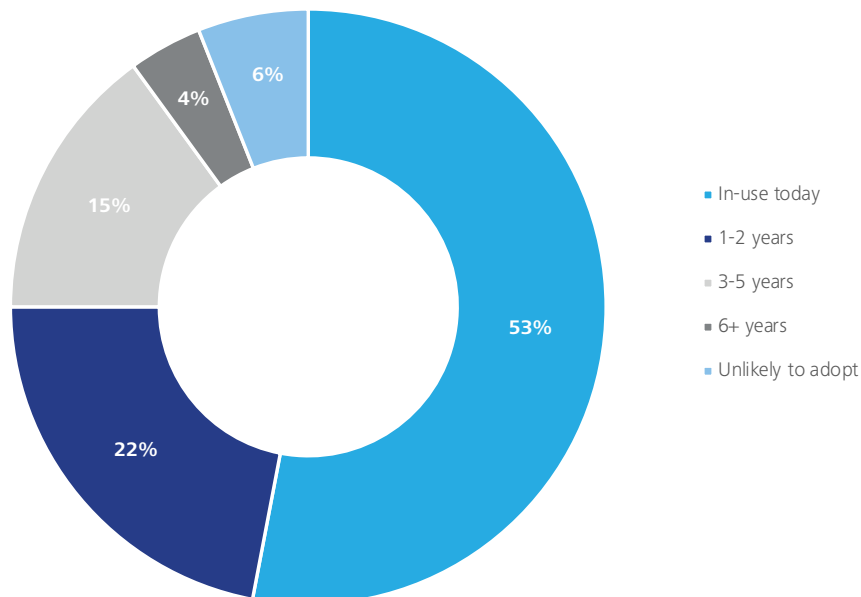


Figure 12: Adoption of Automation Innovations

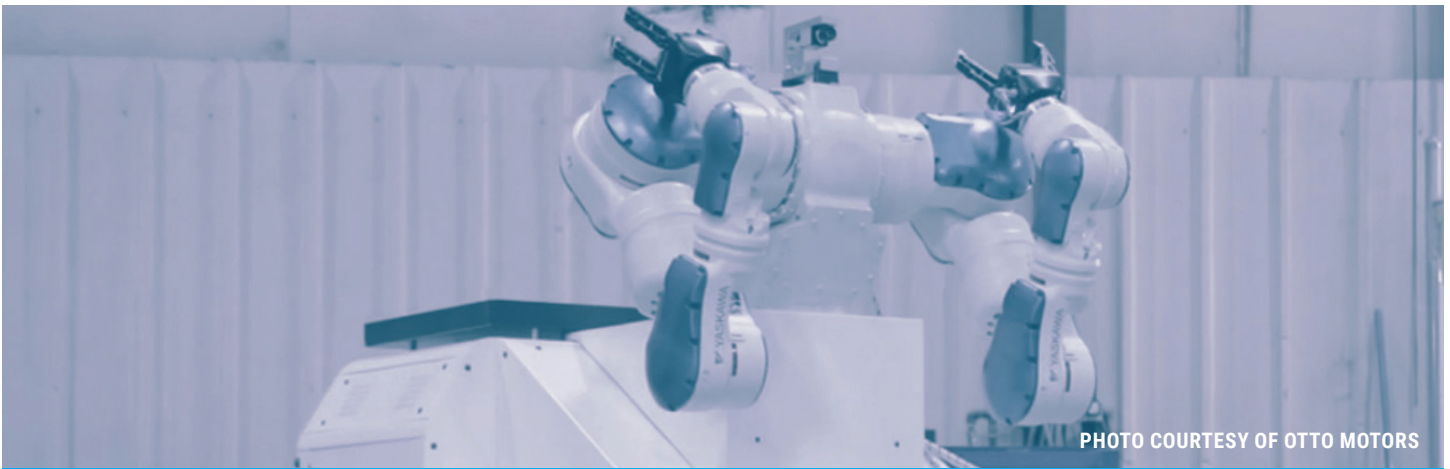


PHOTO COURTESY OF OTTO MOTORS

AUTOMATED INNOVATION: MOBILE AUTONOMOUS ROBOTICS

CASE STUDY



Situation

When adopting new automation technology in its facilities, an automotive supplier worked toward the goal of operating as a 24/7 fully automated (“lights-out”) manufacturing operation. The company’s spare parts process was found to be ideal for automation, as it involved several menial, repeatable steps that took up operators’ valuable time. Automation would improve quality control and consistency while enabling workers to be repurposed to more value-adding tasks.



Actions

Through internal research the company determined that one of its spare parts coating processes was among the least efficient. The process involved transferring parts between various buckets at fixed time intervals, requiring operators to interrupt their other tasks to ensure proper timing. This caused severe inefficiency in the interrupted processes.

Full automation of the process required mobility between work stations, so the company chose to implement autonomous driving platforms with dual-arm robots that could move between workstations and handle parts the way a human operator could. These mobile robots have sensors that allow it to navigate around humans and other equipment, eliminating interruptions to other processes in the facility. And because they are mobile, the robot platforms function without taking up dedicated space in the facility, helping the company to avoid the need to invest in additional infrastructure.



Results

Implementing autonomous mobile robots produced immediate positive results. The robots took over the coating process entirely within one week, allowing the previous human operators to focus on value-adding tasks. Overall quality increased due to the robotic precision of completing the time-sensitive tasks. The error rate dropped to near 0%. And after eliminating human error, the process no longer required multiple iterations. After successful implementation in the North American facility, the company’s Japanese facility set up identical mobile robots to take over similar repeatable processes.

Stage 3: Advanced Analytics

The third stage of digital adoption is advanced analytics. This stage is a primary consumer of digital information, converting mountains of data into valuable nuggets of insight.

Advanced analytics in supply chain involves the following three innovations from the roadmap:

- Inventory and network optimization tools
- Predictive Analytics
- Prescriptive Analytics

As noted earlier, big data without analytics can actually be a hindrance — yet, unfortunately, many supply chain operations end their digital adoption journey before the analytics stage. Specifically, only 30% of survey respondents say they are currently using predictive or prescriptive analytics in their operations. (Figure 13).

The good news is that while adoption rates for this stage are not currently as high as for the first two stages, Figure 13 shows that supply chain executives do value advanced analytics and 87% plan to put it into practice within the next five years.

According to the survey, the biggest barriers to faster, more widespread adoption of advanced analytics are:

1. lack of understanding of the technology landscape and business effects, and
2. lack of adequate talent to effectively implement and utilize the technology (Figure 14).

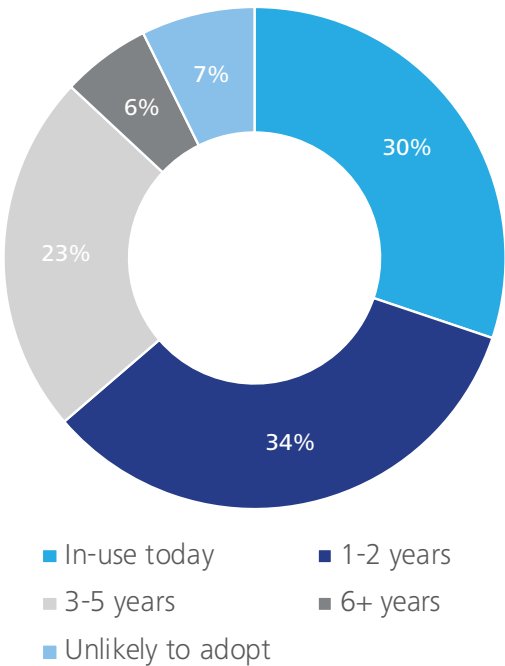


Figure 13: Adoption of Predictive/Prescriptive Analytics Innovations

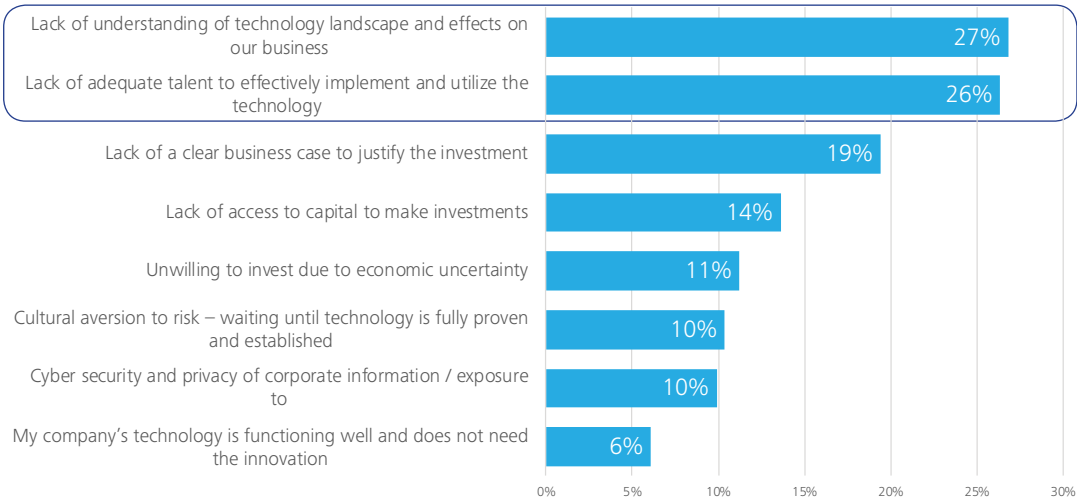


Figure 14: Barriers to Adoption of Predictive/Prescriptive Analytics Innovations



PHOTO COURTESY OF DELOITTE

PROACTIVE ANALYTICS TO OPTIMIZE INVENTORY

CASE STUDY



Situation

An airline was looking to transform its supply chain into a world-class operation. A key objective of its overall efforts was to dramatically reduce inventory across its network while maintaining high service levels. A significant enabler was implementation of an analytics solution across all functions to promote understanding of the complex network of technical operations and maintenance activities and to measure and sustain operational performance.



Actions

The company turned to analytics to identify excess inventory that existed throughout the network. Using a network and inventory optimization technology suite, the airline re-defined their network strategy for stocking inventory globally. This led to identification of possible reductions in safety stock across the network. The company also previously had no clear segmentation of parts across the network, leading to over ordering of non-critical parts. The company was able to optimize this inventory by developing differentiated stocking policies based on part segmentation, e.g., centralizing non-critical slow-moving parts in one DC rather than distributing them across the network. Analysis of historical data using advanced analytics helped inform the correct segmentation of every part and its appropriate stocking policies. For example, they used previous out of service data to identify parts which had previously caused delays and stocking these parts across the network with appropriate safety stock to prevent future events.

In addition, the company implemented an analytics-based control tower which worked across previously silo'd functional units, combining multiple disparate data sources and incorporating predictive analytics. The solution enabled real-time insights into operations, provided actionable root-causing capabilities, and informed decision-making for everyone from executive leadership to shop floor employees.

PROACTIVE ANALYTICS TO OPTIMIZE INVENTORY (CON'T)

CASE STUDY

The solution combined data sources which included: Repair vendor data, flight schedules, financial data, parts movement data, on-hand inventory, procurement data, parts usage data, and historical causes of flight delays.

One of the important aspects of the solution was proactive positioning of parts required for maintenance. Previously delays would be caused due to the right-parts not being available for maintenance at the right-locations. Real-time alerts driven by predictive analytics theorems provided insight into where parts will be needed based on stock out risk and unplanned maintenance events, giving the inventory planners time to position parts correctly. This was widely possible due to combination of multiple data sources, ability to perform analytics on unstructured data, and using predictive algorithms.



Results

The inventory and network optimization efforts, powered by analytics, led to the identification of nearly \$1B of inventory reduction opportunities.

The analytics solution also helped the airline gain broader visibility over their technical operations, better predict service part requirements, proactively manage workload and resourcing and reduce flight delays. The solution also helped the airline avoid an estimated 9,000 labor hours previously needed to expedite mis-aligned parts.

Stage 4: Artificial Intelligence

The highest stage of digital adoption is artificial intelligence (AI), which the Deloitte Analytics Academy defines as decision-making enabled by machine learning³ (computers learning on-the-fly from data, rather than being pre-programmed to follow a fixed set of rules).

AI takes the digital information from other stages and generates smart insights, while at the same time getting smarter itself by learning from patterns, behaviors, and feedback from various digital and human interfaces. As such, AI can be thought of as the ultimate evolution of business intelligence and analytics. (Figure 15).

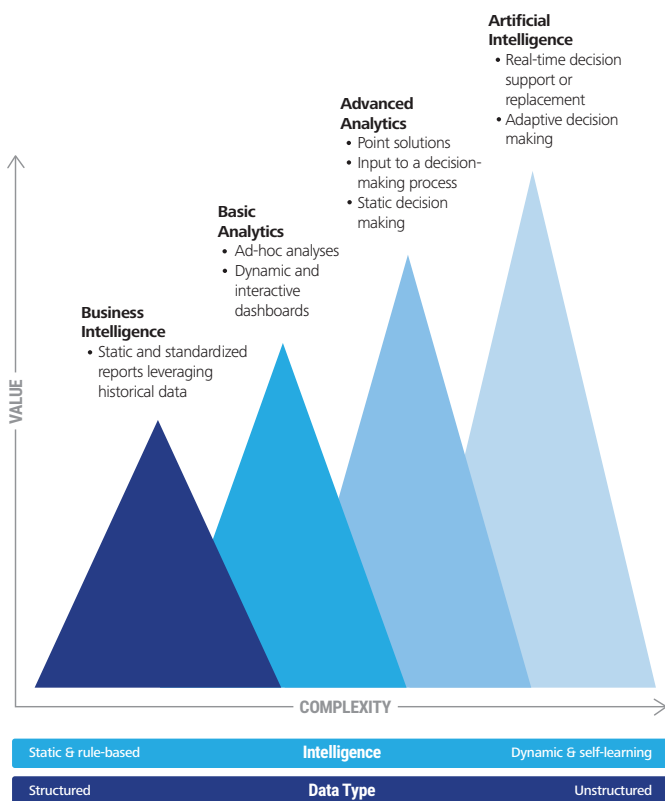


Figure 15: Evolution of Decision-making Using Technology³

AI uses a broad array of technologies to mimic or extend human functions, enabling it to reason and intelligently interact with the environment (Figure 16).

For AI to work, it requires the effective implementation of many systems and technologies from earlier stages of the digital adoption pyramid. Conversely, the tremendous potential of AI can be a useful catalyst for accelerating adoption of many other technologies. This catalyst effect will only continue to grow as AI becomes a standard requirement for the future of supply chain operations – a future that might be closer than many think.

Reason

(Pattern matching and optimizing)

- Generate insights
- Predict
- Recommend
- Optimize

Interact with

(Communicating and sensing)

- Text
- Sound and voice
- Image and video
- Humans

Figure 16: Examples of AI Capabilities³

According to the survey, 79% of companies believe AI will be a core business competency in less than three years. Also, 88% believe AI will be instrumental in managing risks and improving predictability (Figure 17).

“AI empowers human resources and frees them up to focus on the strategic and creative work of planning and running supply chains.”

Scott Sopher, Deloitte Consulting LLP

With AI gaining widespread acceptance as integral to the future of business, the next logical question is how AI will be used in supply chain operations. Supply chain executives initially plan to use AI in three key areas:

1. demand forecasting and supply chain planning / warehouse management
2. inventory management
3. logistics, shipping and transportation (Figure 18).

The survey results closely align with the digital adoption pyramid, underscoring the need for supply chains to fully capitalize on the digital technologies at every stage.

ARTIFICIAL INTELLIGENCE

THE PRESENT

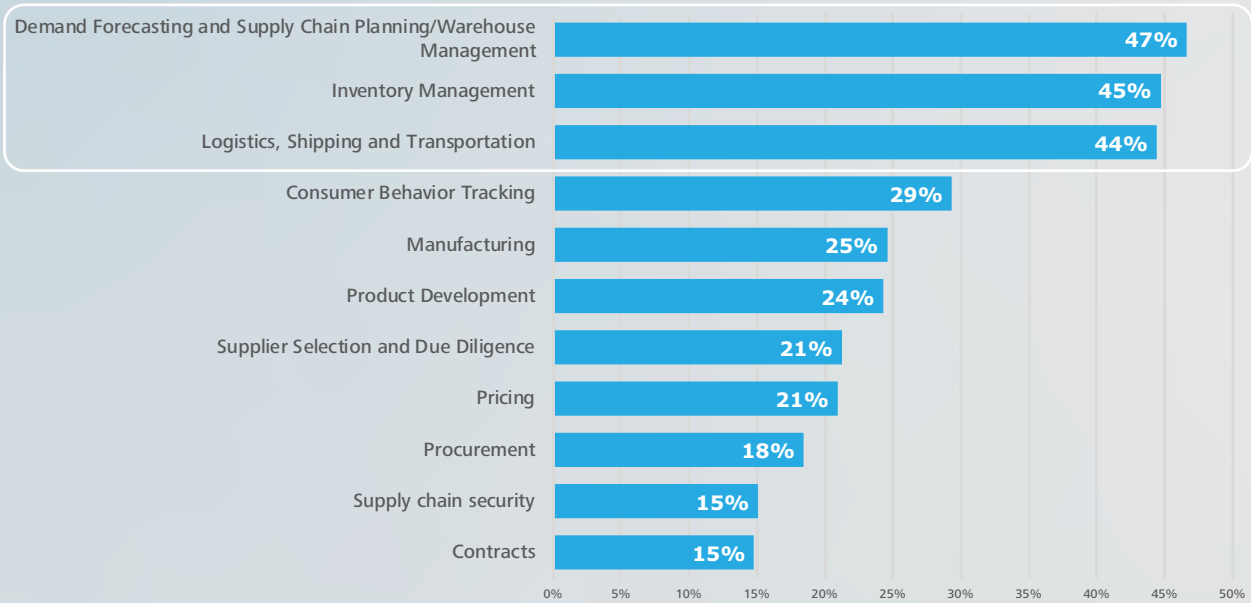
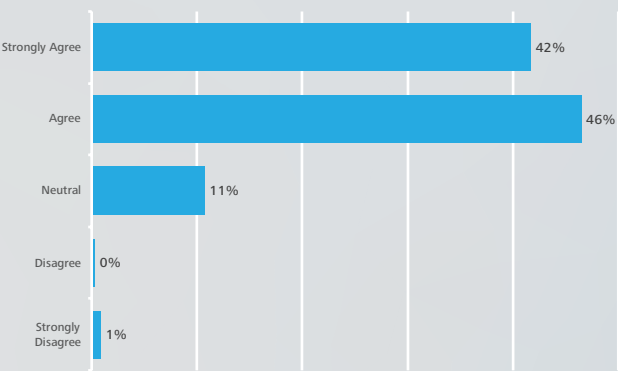


Figure 18 - Current and Planned Uses of AI

THE FUTURE

AI WILL ENABLE ORGANIZATION TO MANAGE RISK AND IMPROVE PREDICTABILITY



AI TO BECOME CORE COMPETENCY IN 3 YEARS

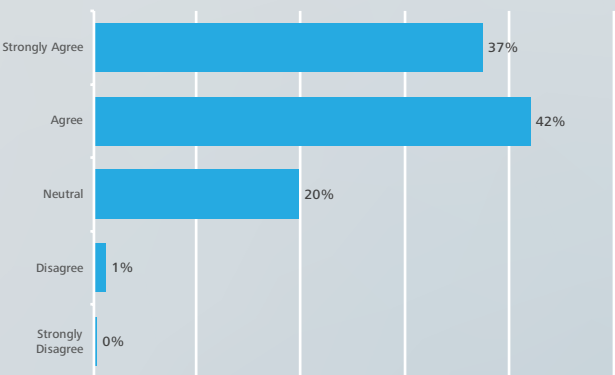


Figure 17 - The Future Importance of AI



PHOTO COURTESY OF GREYORANGE

GOODS TO PERSON DELIVERY WITH AI POWERED ROBOTS

CASE STUDY



Situation

A large Japanese home furnishing chain was facing changing order patterns, rising customer expectations and high SKU variability. This was driven by increasing online sales, resulting in high frequency and low quantity orders, expectation of same or next day delivery, and increasing variability of SKUs.



Actions

The company wished to put in place a system which increases efficiency and speed of fulfilling orders, does not add labor hours, and is easily scalable. It also looked to put in place a system which optimizes its warehouse operations real-time by intelligently detecting changing patterns and trends across the distribution center rather than using the traditional route of analyzing operations in fixed intervals. This led them to the MHI member GreyOrange's Butler System, which provides intelligent autonomous robots that deliver parts to the picking area in highly customizable mobile storage units.

This system takes traditional slotting to the next level, using AI technology to dynamically flex and optimally position items. An AI module centrally analyzes real-time demand and configuration patterns and then transmits instructions to bots to dynamically reposition inventory based on these learnings. The company's complex warehouse operations were no longer constrained to only backward-looking perspectives and fixed rack locations and slots. The operations were also not subject to be blind-sided by poorly communicated promotions that often rendered their historically-based slotting plans inefficient. Instead now they had a system which in real-time adjusted to demand, leading to increases in throughput, picking productivity, visibility, accuracy, and dynamic order prioritization.



Results

The company was able to lower operating costs by increasing storage efficiency by 15%, increasing throughput by 4x, improving inventory accuracy and on-time shipping, and substantially lowering labor costs from reduced walk time, wait time, and space optimization. The system of using customizable units with robots also provided the company with flexibility of inventory types, and the ability to scale quickly. Overall, real-time decision-making facilitated by AI capabilities, provided increased control and visibility across people, processes and systems and dramatically increased efficiency of the company's complex warehouse operation, transforming it from merely a cost center to an asset that is giving it competitive advantage.



AI FOR SMART PICKING

CASE STUDY



Situation

Preparing for the upcoming holiday season, a global apparel retailer was looking for innovative ways to use artificial intelligence to automate fulfillment operations. Faced with increasing challenges in the labor market, the retailer identified the manual picking operation to be highly labor intensive primarily due to a human's unique ability to handle items of all shapes and sizes. The retailer sought an AI powered robotic solution to handle this highly complex manual process and selected MHI member Kindred AI for their expertise in AI-powered robotics.



Actions

Evaluating the labor intensive tasks related to picking, the retailer started implementation with its manual putwall stations as a prime example of where the skillfulness of human hands are required to pick and handle individual items. The retailer installed a handful of Kindred's piece-picking robots enabled by AutoGrasp intelligence technology. AutoGrasp uses computer vision algorithms to enable the robot to assess shapes and sizes of SKUs, grasp algorithms combined with a custom gripper to ensure high degrees of picking accuracy, and motion planning algorithms to deliver a fast and efficient range of movement to place picked items safely in final destinations. The solution evaluates millions of data points to calculate and execute an optimal pick strategy for each task in real-time. This robotics intelligence platform, a concert of machine learning and reinforcement learning algorithms that play together to operate robotics in real-world production environments, was able to grow smarter with every pick, cycling through learning and executing pick strategies across the span of the retailer's SKU portfolio.



Results

By the end of peak season, the retailer's catalogue had grown by 70%. With the power of machine learning, the Kindred robots had successfully picked hundreds of thousands of items. AutoGrasp took little time to learn how to pick the vast assortment. As a result, the retailer was able to develop a stronger hiring plan for the following year, and installed more smart robots across its network of distribution centers.

A man in a dark suit is seen from the back, looking out over a city skyline at sunset. The sun is low on the horizon, creating a warm, golden glow and lens flare effects. The city features various high-rise buildings. A blue rectangular text box is positioned in the upper left quadrant of the image.

Elevating Supply Chain Digital Consciousness

“Leading companies are elevating their ‘supply chain digital consciousness’ to drive the kind of innovation that enables them to gain competitive advantage and thrive in today’s always-on economy.”

- George Prest, CEO of MHI

Supply chain leaders are increasingly recognizing that digital is the future of supply chain. However, many do not yet have the necessary mindset to make that future a reality. As a result, many organizations run the risk of evolving too slowly and failing to respond as changes escalate into serious threats at digital speed.

MHI and Deloitte developed the Supply Chain Digital Consciousness framework to help organizations assess their digital mindset and gauge their progress on the journey to becoming more digital. An elevated supply chain digital consciousness is important because it

helps an organization gain perspective and move more quickly toward digital solutions.

The framework also provides a practical view of what leading supply chains are doing to harness the power of digital-related business and technology innovations, enabling supply chain leaders to map out their organization’s own unique digital adoption journey.

The Supply Chain Digital Consciousness framework characterizes a supply chain on four levels of awareness, across five digital categories:

Levels of Awareness



Dormant

Immature state with little to no digital capability. Waiting to adopt foundational digital innovation. No automation or digital connectivity.



Developing

Early stages of digital adoption, with low levels of connectivity and automation.



Heightened

Moderate maturity of digital innovations, including collection of information from sensors, as well as automation to collect and analyze digital information.



Elevated

Full maturity with connected systems and automated processes that harness the value of digital data and support proactive decision making through advanced analytics and artificial intelligence.

Digital Categories

Leadership

Company leaders are focused on aligning the company's strategy, workforce, culture and technology to meet the digital expectations of customers, employees and trading partners.

Innovation/Technology

A culture of experimentation and innovation is in place that drives digital advancement. Technology strategies are also in place that explore the art-of-the possible through a digital lens — pairing technology with core business capabilities to enable a company to keep pace while adapting to the rapidly changing digital landscape.

Customer Engagement

A customer-first mindset that seeks to connect with customers and effectively anticipate and influence their needs.

Talent

Digital talent and skills are present throughout the organization, with clear strategies for attracting, retaining and growing the digital talent of the future.

Workplace Environment

Embracing and using digital technology to create an attractive and compelling work environment and culture that help attract and retain talent.

“Firms that use the Supply Chain Digital Consciousness assessment to identify and prioritize areas where they should take action will reap big rewards now and even bigger ones in the future.”

Annette Danek, SVP Supply Chain of Penguin Random House

Find Your Supply Chain Digital Consciousness Index

The framework to assess digital consciousness spans all dimensions of supply chain, from talent and culture, to technology and innovation adoption, to customer experience. Evaluating their supply chain operation against this framework can help companies understand their current level of digital adoption⁴ and then identify gaps and next steps to boost digital consciousness.

The assessment produces a Digital Consciousness Index (DCI) that quantifies an organization's current level of supply chain digital consciousness, as well as the level of progress it has made toward its desired end-state.

ASSESS YOUR SUPPLY CHAIN DIGITAL CONSCIOUSNESS INDEX (DCI)



DORMANT



DEVELOPING



HEIGHTENED



ELEVATED

DIRECTIONS

Each statement finishes the sentence "is/has your company..."

For each assessment category, read the attributes and circle which awareness level most closely reflects your current environment under the "CURRENT" section. Then, under the "DESIRED" section, circle the level that you would like to move your company to.

At the end, fill out the scorecard to find your Supply Chain DCI. Each level is scored as follows:

Dormant	-	1 point
Developing	-	2 points
Heightened	-	3 points
Elevated	-	4 points



LEADERSHIP

DORMANT	DEVELOPING	HEIGHTENED	ELEVATED
Disconnected from customers, employees and stakeholders; unaware of market dynamics or competitive threats	Beginning to connect with customers, employees and stakeholders; listening to feedback and ideas	Consistently connecting with employees, customers and stakeholders, and acting on feedback and ideas	Looking at the business through a digital lens to identify areas where technology could make a major impact
Lacking clarity on how technology can support its business strategy	Becoming aware of emerging innovations; open-minded to technology investment	Regularly communicating its strategy and articulating the role of innovation in supporting the strategy	Developed a comprehensive, long-term digital innovation strategy, clearly aligned to achievement of business goals
Discouraging of creativity; dismissive of ideas	Starting to encourage change and adoption of new technologies	Made analytics an integral part of the decision-making process	Created executive-level inclusion for innovation in the form of C-Suite innovation/digital officer(s)
Lacking awareness and understanding of emerging innovation	Developing an understanding of how emerging technology can support its business strategy	Developed a clear understanding of emerging innovations and technologies; developed a technology roadmap	Taking strategic risks to invest in emerging innovations and technologies



INNOVATION/TECHNOLOGY

DORMANT	DEVELOPING	HEIGHTENED	ELEVATED
Using little or no existing or emerging innovative technology	Beginning to use <i>connected</i> or <i>automated</i> innovations	Using <i>connected</i> and <i>automated</i> innovations based on their business impact	Using or adopting <i>connected</i> and <i>automated</i> and <i>advanced analytics</i> and <i>artificial intelligence</i> innovations based on their business impact
Heavily constrained by legacy systems as compared to competitors	Beginning to explore ways to leverage data and analytics for corrective actions based on historical negative trends	Collecting and leveraging data and analytics for forward planning	Assembling and leveraging data and analytics for predictive and prescriptive insights
Risk-averse toward innovation and technology	Beginning to take small risks to adopt innovation	Developing concrete plans for adoption of additional technology; taking calculated risks for innovation	Defining innovation as a core focus and competency; technology roadmap in place and regularly updated
			Taking creative risks for innovation; fail-fast approach



CUSTOMER ENGAGEMENT

DORMANT	DEVELOPING	HEIGHTENED	ELEVATED
Not connected to customers, with limited awareness of shifts in requirements	Making insights from customers a priority and attempting to maintain their engagement	Conducted "day in the life" exercises for new and existing customers	Making customer experience a strategic focus; connected to customers through multiple channels
Lacking insights into customer preferences or value triggers	Establishing a feedback loop for capturing customer feedback and profile data	Prioritizing relationship building with customers through multiple channels	Leveraging technology to give each customer a personalized experience based on digital information collected through interactions with them
Satisfied with the status quo in terms of customer service	Making adjustments to service and product offerings based on customer feedback	Proactively adjusting to anticipated changes in customer preferences and value levers	Proactively sensing and anticipating customer needs and developing keen insight into customer value levers
Experiencing a declining customer base			Creating programs to stimulate and predict customer and market demand



TALENT

DORMANT	DEVELOPING	HEIGHTENED	ELEVATED
Continuing to focus only on recruiting new workers with existing skill sets	Beginning to focus on retention as well as recruitment of workers with skillsets that include digital capabilities	Offering consistent training courses for new and emerging innovations and technologies	Attracting resources with business insight as well as technical skills ("Purple People")
Providing minimal training or information about specific emerging innovations and technologies to learn about	Beginning to expand training courses to cover new innovations and technologies	Allowing workers to participate in platforms and communities to share ideas and learn new skills from experts in other organizations	Encouraging workers to meet regularly and participate in platforms and communities to share ideas and learn new skills from experts in other organizations
Investing minimally in people or technology	Beginning to allow workers to form communities to learn about innovation and technology advancements	Developing comprehensive talent recruiting, retention and development programs	Cultivating a diverse workforce (age, gender, race, etc.)
	Open to investing in people and technology	Investing in people as well as technology	Providing professional growth and learning plans for employees



WORKPLACE ENVIRONMENT

DORMANT	DEVELOPING	HEIGHTENED	ELEVATED
Utilizing little to no innovative technology in the workplace	Beginning to experiment with new technologies in the workplace	Encouraging an open/sharing culture through employee-led initiatives	Encouraging and supporting continuous learning, particularly about digital innovations and technologies
Offering minimal opportunities for personal or professional growth	Exploring workspace concepts to encourage communication, collaboration and sharing of ideas	Open to new tools and flexible working schedules	Using adaptive training programs tailored to each workforce segment
Providing a workplace where workers do not like to spend their time	Encouraging and supporting formation of worker communities focused on innovation and technology	Encouraging corporate, social and personal responsibility across the company and individually	Providing opportunities for workers to grow personally as well as professionally; becoming a talent magnet
		Creating a work environment where workers enjoy spending their time	Incorporating flexible work arrangements supported by technology that enables work to be mobile



TOTALS

CURRENT

DESIRED

Calculate your Supply Chain DCI

Total 'CURRENT' Score / 5 = ____

Calculate Progression Along your Journey

Total 'CURRENT' Score / Total 'DESIRED' Score = ____%

Actions for **Supply Chain Leaders**



“Converting supply chain data into actionable insights is imperative. AI can make those decision faster, smarter and cheaper.”

- Scott Sopher, Deloitte Consulting LLP

Building a digital, always-on supply chain is a difficult and complex challenge. Here are some key actions to take to elevate consciousness within each of the five categories of the Supply Chain Digital Consciousness framework.

Leadership

- Measure your Supply Chain Digital Consciousness Index (DCI) and use it to determine and prioritize gaps
- Define a comprehensive strategy for digital supply chain, including digital initiatives that are core to achieving the overall business strategy
- Increase investments⁵ in supply chain innovation. Focus on an overall program for digital transformation, not just individual investments and initiatives
- Look to the future by appointing a strategic team to develop scenarios of future business conditions and how your supply chain will need to adapt

Innovation/Technology

- Foster a culture of experimentation and innovation
- Establish an innovation think tank within your organization to keep employees up-to-date on new technologies and to encourage employee engagement
- Develop technology strategies that explore the art-of-the-possible through a digital lens
- Focus on pairing technology with core business capabilities

Customer Engagement

- Develop a customer-first mindset that seeks to connect with customers in order to anticipate and shape their needs

- Involve customers and suppliers when assessing the value of digital investments and defining business case parameters

Talent

- Appoint a C-suite champion for talent and create a new, forward-looking supply chain talent model
- Invest in continuous learning and development focused on digital education
- Implement a reverse or dual mentoring program to pair younger, digital native talent with seasoned leadership to bolster the digital knowledge and comfort of the seasoned talent and pollinate leadership traits to the younger talent
- Assemble a cross-functional, digital native advisory panel to vet ideas and opportunities to improve the company's digital posture and trajectory
- Partner with regional STEM, career and technical education and university programs to develop connections to future supply chain talent pools

Workplace Environment

- Create opportunities in the workplace to develop digital skills
- Provide a compelling environment for achieving career growth ambitions while acquiring digital skills and experience (which makes employees want to stay in both the short and long term)
- Allow freedom to fail on the path to success
- Create a socially responsible brand to attract your future workforce

Conclusion

“Firms that focus on the fundamentals of the Supply Chain DCI and put AI to use as soon as possible will put themselves at a significant advantage. Those who start sooner, rather than later, will reap big rewards now and even bigger ones in the future.”

- George Prest, CEO of MHI

These are times of unprecedented change and volatility as businesses around the world strive to harness the power of digital innovations to keep pace with rising customer expectations and improve the efficiency, effectiveness and competitiveness of their operations on a global scale.

Digital innovation presents both challenges and solutions. On one side, it is driving change at a neck-snapping pace and disrupting entire industries, with competitors emerging from nowhere to challenge long-established market leaders and business models. On the other side, digital solutions are enabling new capabilities, new market opportunities, new ways of working and new levels of performance.

Businesses that make smart use of supply chain innovation can give themselves a competitive advantage in the marketplace and position themselves to be the disrupters, rather than the disrupted. They can also reach new customers and achieve levels of efficiency and effectiveness that were previously unimaginable.

By elevating its supply chain digital consciousness, an organization can improve its ability to adapt and flourish in today's increasingly digital world. But achieving the vision of a digital, always-on supply chain is neither easy nor free. Success will likely require significant effort and investment, both in technology and, just as important, in building a culture of digital innovation that will attract workers with the skills necessary to create, operate and maintain a digital supply chain.

According to survey respondents, spending on these technologies appears to be at an inflection point. As the pace of investment in supply chain innovation escalates, the price of inaction will be severe.

The Supply Chain Digital Consciousness framework can help you understand your organization's position on the digital journey and enable you to map out a future path to supply chain innovation and adoption that flips all the right levers for your supply chain.



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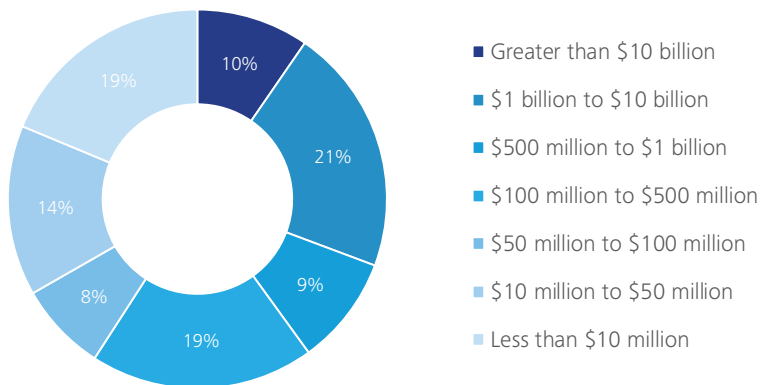
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About the Report

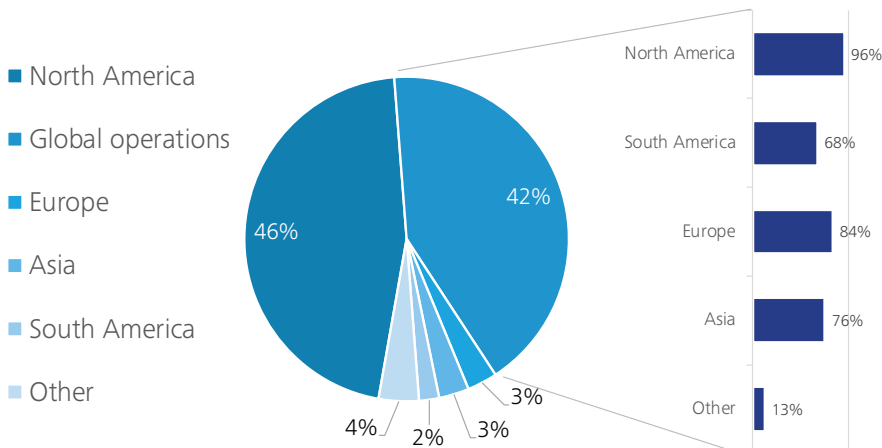
The 2019 MHI Annual Industry Report is our sixth annual study of emerging disruptive technologies and innovations that are transforming supply chains around the world. The findings are primarily based on an in-depth global survey conducted in late 2018, which involved 1,052 supply chain professionals from a wide range of company types and industries.

Two-thirds of the participants are executives with the role of CEO, Vice President, General Manager, or Department Head. Participating companies range in size from small to large, with 59% reporting annual sales in excess of \$100 million, and 10% reporting annual sales of \$10 billion or more.

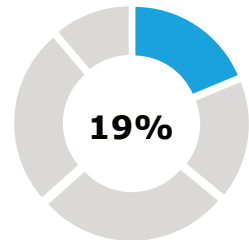
COMPANY SIZE BY REVENUE (USD)



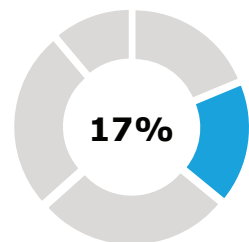
RESPONDER PROFILE BY GEOGRAPHY



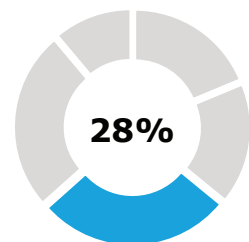
RESPONDER'S ROLE



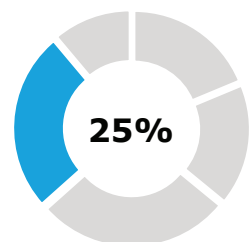
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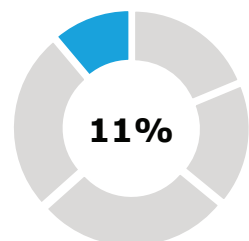
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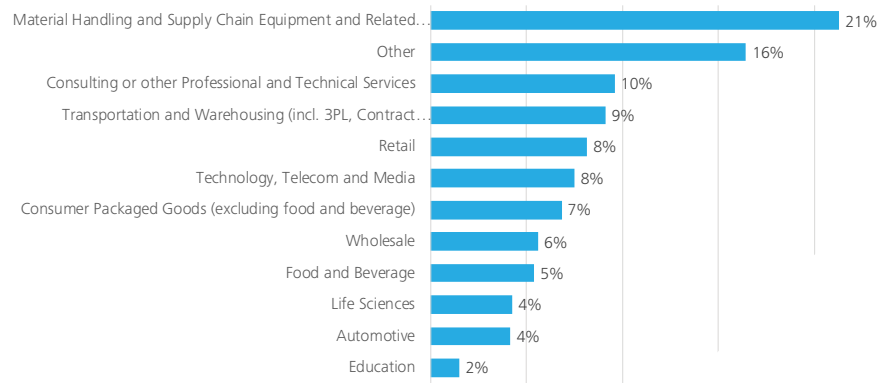


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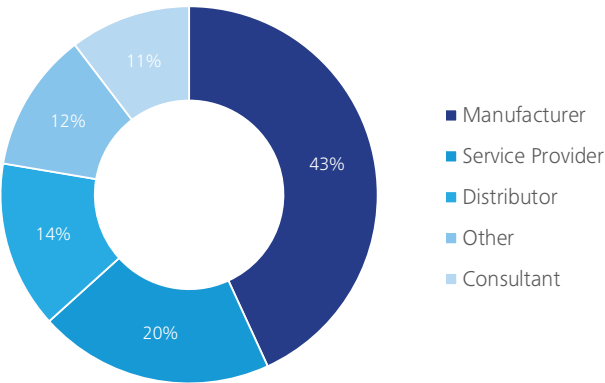


OTHER

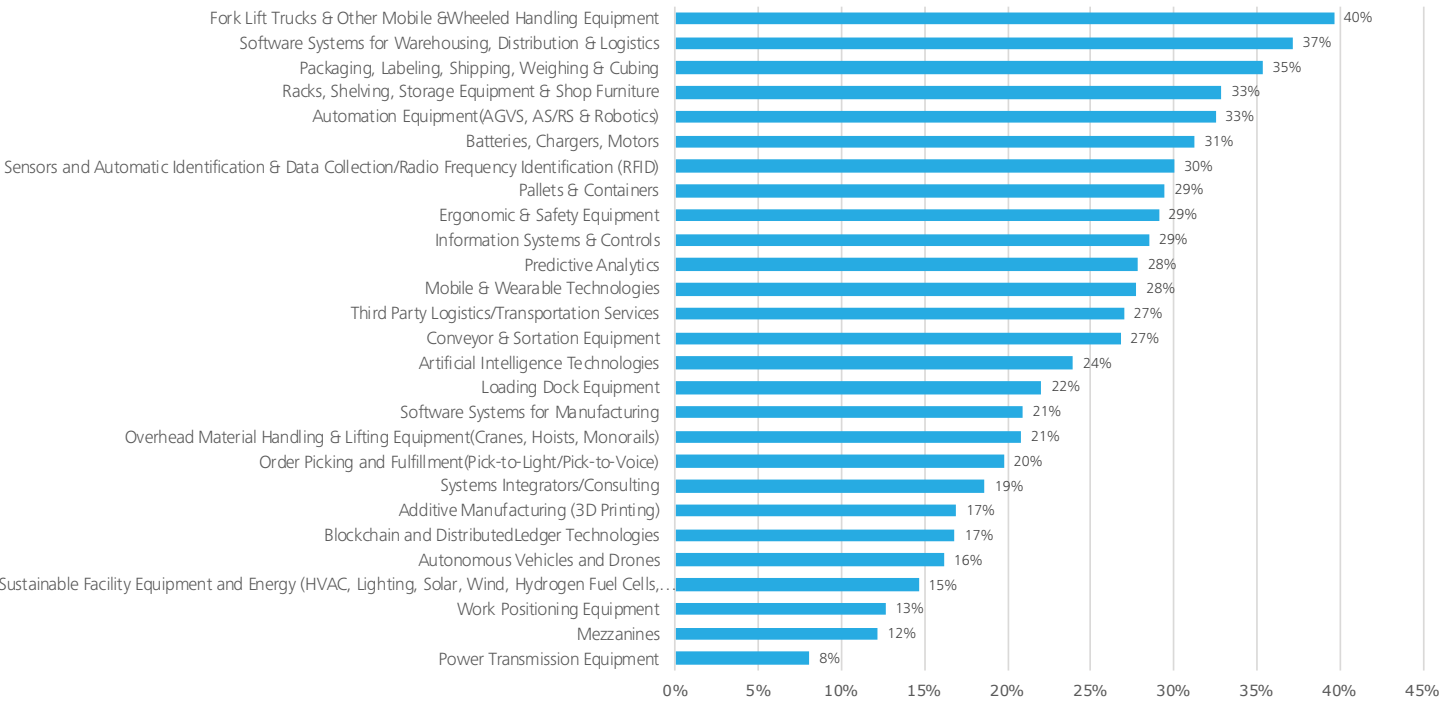
RESPONDER'S INDUSTRY



RESPONDER'S COMPANY TYPE



INVESTMENT IN PRODUCTS AND SERVICES OVER NEXT THREE YEARS



Acknowledgments

We would like to acknowledge the hundreds of organizations that participated in our survey. We would also like to thank the MHI Board for their contributions to the survey and conclusions.

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MHI is an international trade association that has represented the material handling and logistics industry since 1945. MHI members include material handling, logistics and supply chain equipment and systems manufacturers, integrators, consultants, publishers, and third party logistics providers.

MHI offers education, networking and solution sourcing for members, their customers and the industry as a whole through programming and events. The association sponsors trade events, such as ProMat and MODEX to showcase the products and services of its member companies and to educate manufacturing and supply chain professionals on the productivity solutions provided through material handling and logistics.

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