

[Benefits of AI in Supply Chain](#)

What Is AI in Supply Chain?

Businesses use AI to manage and optimize supply chain activities—such as monitoring product quality, balancing inventory levels, and identifying fuel-efficient delivery routes—with more efficiency than traditional software.

Artificial intelligence (AI) is a general term for applications that simulate human intelligence and perform complex tasks. Its subfields include machine learning (ML), in which systems learn from consuming vast amounts of data rather than being programmed with step-by-step instructions. Thanks to this learning process, AI systems can outperform traditional software in functions such as deciphering information from video feeds, interpreting spoken and written text, predicting future market behavior, making decisions in complex scenarios, and surfacing insights buried in large data sets.

These kinds of capabilities are proving extremely useful in managing and optimizing workflows across almost every leg of the supply chain. For example, supply chain systems powered by ML algorithms can discover patterns and relationships within data sets that are often imperceptible to humans or non-AI systems, so they can more accurately forecast customer demand—which leads to more economically efficient inventory management. AI can also analyze factors such as traffic and weather conditions to recommend alternative shipping routes, reducing the risk of unplanned delays and improving delivery times. It can monitor workspaces to spot poor quality control procedures and health and safety violations. And new use cases are constantly emerging as supply chain professionals continue to experiment with the technology.

Key Takeaways

Organizations use AI to optimize shipping and delivery, manage warehouse capacity, track inventory, forecast demand for specific parts and components, improve worker safety, and help ensure the integrity of transaction records throughout global supply chains.

While AI can deliver massive productivity benefits to the supply chain while cutting operational costs, implementing the technology can be difficult and expensive, especially when it involves training custom-made ML models on proprietary data.

Manufacturers and logistics providers can take steps to prepare their supply chains for the integration of AI systems and the way these systems can transform the management and operation of their logistics networks.

AI in Supply Chain Explained

Companies are employing AI systems in their supply chains to help optimize distribution routes, boost warehouse productivity, streamline factory workflows, and more.

Manufacturers of finished goods often rely on hundreds, if not thousands, of components shipped from partners around the globe to arrive in their assembly facilities on a coordinated schedule. AI is proving it can find patterns and relationships buried within large data sets that help optimize these logistics networks, which span cargo freighters, delivery trucks, warehouses, and distribution centers. Supply chain optimization also requires tracking physical goods every time they switch hands. Here, AI can automate documentation with its ability to intelligently enter, extract, and classify data embedded in text files to help ensure the integrity of multiparty transactions.

Some manufacturers are taking advantage of AI in forecasting, using it to predict production capacity and optimize warehouse capacity based on customer demand. Some are enlisting AI to flag potential delays and equipment malfunctions before they cause production problems. Others are using AI to derive operational insights from large streams of data that flow from proliferating Internet of Things (IoT) devices and sensors installed across their storage and transportation infrastructure.

While AI offers many potential benefits to the supply chain, implementing the technology can be difficult and expensive. Running intelligent applications in production requires powerful computing systems—either on-premises edge servers or cloud-based instances—that typically need to receive data from integrated sensors and devices deployed in the field as part of an Industry 4.0 approach. Businesses typically realize the greatest benefits when they train machine learning models on their own data sets, an even more compute-intensive and data-dependent process.

End-to-End Supply Chain Transparency with AI

Modern supply chains have become so intricate, entangled, and expansive that manufacturers struggle to maintain end-to-end oversight of the flow of materials and goods arriving in their facilities. AI's unique ability to rapidly analyze large data sets can illuminate the inner workings of even the most complex logistics networks.

When ingesting massive streams of logged data and other logistics signals, intelligent algorithms trained through machine learning often surface valuable insights, such as causes of variability or ways to improve capacity for processes with fixed and variable time elements that lead to bottlenecks. And AI-powered supply chain management (SCM) tools are better than traditional systems at tracking vast quantities of supplies in real time as they pass through intermediary manufacturing and distribution partners on the way to becoming finished products. This enhanced visibility and traceability can help manufacturers identify suppliers who are potentially violating quality or ethical sourcing practices.

By upgrading supply chain transparency, AI use can create time and cost savings, which we'll describe more later. It can also help manufacturers ensure that the components they use to make their products are sourced in accordance with ethical, quality, and sustainability standards, a responsibility that regulators and many consumers expect them to fulfill. Organizations simply can't afford to work with suppliers—even those based overseas—that infringe on labor, good governance, or environmental rules, and analytics tools embedded in AI-enabled supply chain applications can identify patterns that reveal fraudulent or unethical sourcing.

Benefits of AI in Supply Chain

Manufacturers have been at the forefront of AI innovation, experimenting with and deploying various forms of the technology across the many production facilities, storage and distribution centers, and transport vehicles in modern supply chains. This can yield a number of benefits.

1. Improved warehouse efficiency

AI can make warehouses more efficient by helping organize their racking and design their layouts. By evaluating the quantities of materials transported through warehouse aisles, ML models can suggest floor layouts that speed access to and the travel time of inventory—from receiving to racks to packing and shipping stations. They can also plan optimal routes for workers and robots to shuttle inventory faster, further boosting fulfillment rates. And by analyzing demand signals from marketing, production line, and point-of-sale systems, AI-enabled forecasting systems help manufacturers balance inventory against carrying costs, further optimizing warehouse capacity.

2. Reduced operating costs

With AI's ability to learn complex behaviors and work under unpredictable conditions, repetitive tasks, such as counting, tracking, and documenting inventory, can be completed with greater accuracy and less labor; bottlenecks are identified and mitigated. By identifying inefficiencies and learning from repetitive tasks, AI can reduce the cost of operating a complex supply chain.

AI can also save manufacturers and distribution managers money by reducing the downtime of vital equipment. Intelligent systems, especially those processing data from IoT devices in smart factories, can identify malfunctions and breakdowns in their early stages or predict them before they happen, limiting disruptions and the associated financial losses.

3. Fewer errors and less waste

AI can usually spot anomalous behavior from both humans and machines much sooner than people can. That's why manufacturers, warehouse operators, and shipping companies are training algorithms to expose flaws in their workflows, employee errors, and product defects. Cameras installed in logistics hubs, assembly lines, and delivery vehicles feed into computer vision systems that use AI to inspect work to reduce recalls, returns, and rework. The system can catch worker and machine mistakes before products are misassembled or sent to the wrong destinations, saving time and material waste. Intelligent systems can also conduct root cause analysis, assessing large volumes of data to find correlations that explain failures and equip teams to make better fixes sooner.

AI is also directly embedded in ERP systems used to manage financial transactions as goods flow through the supply chain, helping companies avoid costly billing and payment errors.

4. More-accurate inventory management

Manufacturers are taking advantage of AI's capabilities to manage their inventory levels with greater precision and efficiency. For example, AI-powered forecasting systems can use inventory information shared from a downstream customer to gauge that customer's demand. If the system determines that the customer's demand is decreasing, then it will adjust the manufacturer's demand forecasts accordingly.

Manufacturers and supply chain managers are also increasingly deploying computer vision systems—installing cameras on supply chain infrastructure, racks, vehicles, and even drones—to tabulate goods in real time and monitor warehouse storage capacity. AI also records these workflows in inventory ledgers and automates the process of creating, updating, and extracting information from inventory documentation.

5. Optimized operations through simulations

Supply chain managers can run AI-powered simulations to gain more insights into the operations of complex, global logistics networks and recognize ways to improve them.

They're increasingly using AI in conjunction with digital twins—graphical 3D representations of physical objects and processes, such as assembled goods or factory production lines. Operations planners can simulate various methods and approaches on digital twins—how much would output increase if they added capacity at point A versus point B?—and gauge results without disrupting real-world operations. When AI selects the models and controls the workflows, these simulations become more accurate than those run with traditional computing methods. This application of AI can help

engineers and production managers assess the impacts of redesigning products, swapping out parts, or installing new machines on the factory floor.

In addition to 3D digital twins, AI and ML can also help create 2D visual models of external processes so planners and operations managers can evaluate the potential impact of changing suppliers, redirecting shipping and distribution routes, or relocating storage and distribution hubs, for example.

6. Improved worker and material safety

AI systems can monitor work environments throughout the supply chain, such as assembly lines, storage facilities, and shipping vehicles, and flag conditions that jeopardize the safety of workers and the public. That might mean using computer vision to enforce the use of personal protective equipment (PPE) or verify that workers follow other company safety protocols and Occupational Safety and Health Administration standards. Or it could mean processing data from systems aboard vehicles such as trucks and forklifts to monitor whether drivers are operating them safely and soberly. When monitoring factory equipment, AI can help predict malfunctions and other potentially dangerous situations. And AI-powered wearable safety devices can increase protection: Consider sensor-enabled vests that connect to AI systems, analyzing warehouse workers' movements and alerting them to the risk of injury based on their posture, movements, or location in the warehouse.

AI systems informed by sensors throughout distribution facilities and vehicles also help ensure that hazardous materials are properly handled and disposed of, protecting those who live and work nearby. AI can automate hazardous tasks, allowing workers to avoid situations that pose risks. For example, smart robots might use AI algorithms along with cameras and sensors to plot the most efficient route through a warehouse, then transport hazardous materials while avoiding objects in their path and relaying results to a warehouse management system. If accidents and failures occur, AI can perform root cause analysis to discover their exact causes and prevent repeats.

7. More-timely deliveries

Manufacturers that assemble products via complex supply chains are especially dependent on timely and well-coordinated deliveries; delayed arrival of a single component can set back an entire production schedule. AI is taking on the task of lessening these delivery holdups.

Logistics companies use machine learning to train models that optimize and manage the delivery routes by which components move along the supply chain. These models can prioritize shipments based on order volumes, delivery promises, contractual deadlines, customer importance, or product availability. And they can provide all nodes in the distribution network with more-accurate estimated times of arrival, identifying shipments that, if delayed, risk creating larger problems.

8. Improved supply chain sustainability

By driving operational efficiencies, AI can make supply chains more sustainable and lessen their harmful environmental impact. For example, ML-trained models can help organizations reduce energy consumption by optimizing truckloads and delivery routes so trucks burn less fuel while delivering supplies. AI can also help decrease the amount of wasted product at various stages of the supply chain. Consider AI-driven production planning that analyzes past inventory levels, current demand forecasts, and real-time machine maintenance statuses to help ensure a manufacturer doesn't overproduce.

AI is also used to analyze the lifecycles of finished products and deliver insights that contribute to a circular economy, where materials are reused and recycled. And supply chain planning and sourcing

systems with built-in AI can help increase transparency across suppliers, and enable them to adhere to both environmental and social sustainability standards, such as paying workers fairly.

9. More-precise demand forecasting

AI has become the gold standard for predicting demand based on both internal data signals, such as sales pipelines and marketing leads, and external signals, such as broader market trends, economic outlooks, and seasonal sales trends. Supply chain planners can use AI embedded in demand planning software to estimate not only demand but also the potential impact of scenarios such as economic downturns or severe weather events on demand, as well as on their own costs, production capabilities, and ability to make deliveries.

Challenges of AI in Supply Chain

Putting AI to work in planning and managing supply chains can't be done overnight. While the technology offers tremendous potential to reduce costs and simplify processes, it can sometimes be expensive and difficult to deploy. There are some common challenges companies face when infusing intelligence into their supply chain operations.

Training costs. As with any new technology, implementing AI and integrating it into production environments requires training the people who will interact with those new, sometimes intimidating systems. Training employees and overcoming their resistance to change typically requires scheduling some downtime, which comes at a cost. Prior to this downtime, partners throughout the supply chain should work with their AI vendors or integrators to develop training programs that are both constructive and affordable—though it's worth noting that any training approach will likely incur a financial cost.

Startup and operational costs. Costs of implementing AI typically go beyond procuring and integrating the hardware and software that run these systems. Machine learning algorithms don't always need to be built from scratch; there are prebuilt models available that can be tweaked to fit a multitude of supply chain use cases. To realize the greatest benefits, however, companies should train the models on their own data. Collecting, aggregating, validating, transforming, and cleaning large amounts of quality data can require a huge effort. If businesses don't properly prepare a high-quality data set, they risk a reminder of the old maxim: garbage in, garbage out. Training the ML model with this data is a compute-intensive phase that usually demands servers powered by graphics processing units (GPUs), which can cause cloud services bills to spike and monopolize on-premises resources.

Operating and managing AI systems at scale across a global logistics network isn't a one-and-done effort. While running AI systems isn't as compute-intensive as training them, it's an ongoing process that requires powerful platforms, whether edge servers or cloud-based virtual machines. However, these cloud-based solutions are making AI technology more accessible and affordable. And some cloud infrastructure vendors offer managed data science platforms that simplify the process of building ML models, automating their evolution, and managing AI workflows.

Complex systems. AI systems have a lot of moving parts, including devices and sensors that stream real-time data, GPU-powered servers used for the initial and evolutionary training of machine learning models, edge and cloud servers that run those models in production, and applications that act on the patterns discovered or recommendations made. Organizations must integrate these elements across the many nodes of a global supply chain. They must also consistently monitor these systems and tune their performance, as well as identify and fix glitches.