



ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN THE SUPPLY CHAIN

AI's Impact on Future Trends and the Four Elements of the Supply Chain

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Table of Contents

3- Introduction

4- What Is Artificial Intelligence

5- What is Machine Learning?

6- Types of AI

8- Three Challenges for the Next Decade

9- How AI Will Impact These Trends

10- The Four Elements of the Supply Chain


12- How AI Will Impact the Elements of Supply Chain in the Next Decade

18- Material and AI

22- Space and AI

24- Conclusion

26- About Supply Chain Mavens



When we think of Artificial Intelligence (AI), a cornucopia of thoughts, ideas, facts, and fiction comes to mind for many of us. These can range from the mundane to the fantastic, from practical to unworkable, from utopian to dystopian, and nearly everything in between. Most of the time AI intrigues us. Many times, it scares us, but it always stimulates our thought and captivates our imaginations.

This white paper will not re-hash the history of AI, nor will we list its downsides or pitfalls. We will not be discussing AI in a setting where it has become self-aware and realizes that humans serve no real purpose other than servicing and repairing them. Nor will we debate our ability to understand the technology we are creating or our ability to manage it.

What we will discuss in this paper is the promise and limits to Artificial Intelligence around supply chain management. We will discuss the what's, whys, how's and impact of AI as it pertains to the supply chain's four basic elements and the skills that supply chain professionals need to use and master AI in the foreseeable future.

What is Artificial Intelligence?

The *APICS Dictionary* defines Artificial Intelligence as

“Computer programs that can learn and reason in a manner similar to humans. The problem is defined in terms of states and operators to generate a search space that is examined for the best solution. In contrast, conventional programming collects and processes data by algorithm or fixed step-by-step procedures. 2) an area of computer science that attempts to develop AI computer programs.”¹

While this definition hardly seems complete, it begins to set the baseline for discussion. Other definitions provide more of a framework and context. For example, one source² defines AI as “the development of computer systems that are capable of performing tasks that require human intelligence such as decision making, object detection, solving complex problems and so on.” Still another³ defines AI as “An entity that performs behaviors that a person might reasonably call intelligent if a human were to do something similar.”

What is Machine Learning?

Again, we will first go to *The APICS Dictionary* for a definition. *The APICS Dictionary* defines Machine Learning (ML) this way:

“Artificial intelligence software that is capable of analysis, self-training, and observation to improve its own performance. It is often used to assist with planning and forecasting.”

It is primarily the result of mathematical models including algorithms. ML algorithms are used to create software that is built into the hardware of AI. So, while AI is used to build self-driving cars, autonomous mobile robots (AMRs), and the Alexas of the world, algorithms are what make them work and improve their performance.

AI is viewed in two ways, referred to as Type 1 and Type 2.⁴ Type 1 is also referred to as Capability Based AI and Type 2 as Functionality Based AI. There is some overlap between the types as we will see in a moment. Both are shown in Figure 1 below.

Types of AI

Type 1

Type 1, or Capability AI is divided into three groups:

Narrow AI

Narrow AI can perform dedicated tasks with intelligence. It can however, only perform a specific task and can become unreliable and erratic if pushed beyond its limits, therefore it is also referred to as weak AI. Some of the functionality includes self-driving cars, programs that play chess, speech and image recognition, and purchasing suggestions for ecommerce programs. Examples of Narrow AI include Siri, Alexa, and IBM's Watson chess program. It is the most commonly available AI.

General AI

General AI can perform any intellectual task with human like or better efficiency. The concept of General AI is to develop a machine that can think on its own. Currently General AI is only a concept and does not yet exist. Therefore, it is out of scope of this paper.

Strong AI

Strong AI denotes a level of intelligence in systems that could surpass human intelligence. Characteristics of Strong AI include the ability to think, reason, solve a problem, make judgements, and communicate on its own. As with General AI, Strong AI only exists as a hypothetical concept and is also outside the scope of this paper.

Type 2

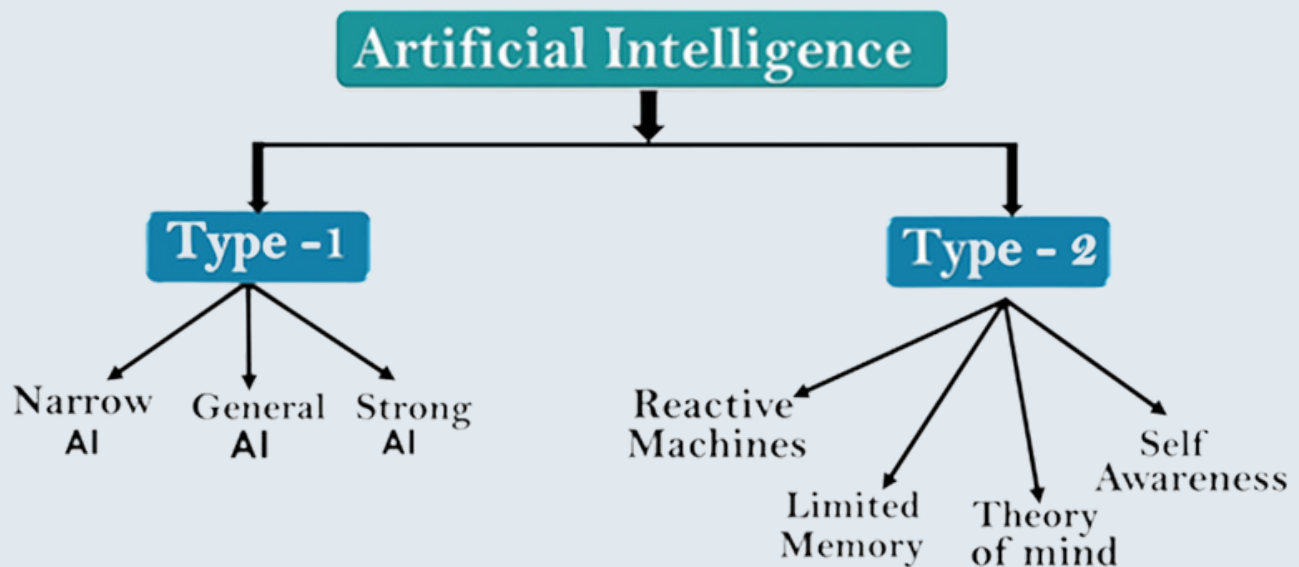
Type 2 AI machines are divided into four categories:

- Reactive Machines
- Limited Memory
- Theory of Mind
- Self-Awareness

Reactive and Limited Memory are similar in function to Narrow AI in Type 1. Reactive machines only react to limited functionality such as playing chess, whereas self-driving cars fall into the category of Limited Memory machines.

The other two categories--Theory of Mind and Self-Awareness--exist only as theories at present and are also outside the scope of this paper. So, in short, while we have made progress in AI, we are still well within the Narrow AI Type 1 and Reactive Machines/Limited Memory of Type 2 (depending on which type you prefer). General and Super AI categories remain within the realm of science fiction for now.

Figure 1



Three Challenges for the Next Decade⁵

In the post-Covid world there are at least three compelling trends that will affect organizations and their supply chains in the decade of the 2020s. How we deal with them will significantly affect the way of life and standard of living for ourselves and future generations. These trends are:

1

The irretrievable loss of institutional knowledge as the Baby Boomer generation transitions into retirement. Baby Boomers have been retiring at an average rate of about 2 million people per year since their generation began retiring in 2011. This rate jumped to 3.2 million in 2020 primarily because of Covid-19 which also spawned “The Great Resignation” as people, and not just Boomers, left the workforce and as organizations deal with the pressures and pushback from workers as they return to their offices.

2

According to McKinsey,⁶ supply chain disruptions lasting a month or more occur on average every 3.7 years. Due to the increasing rate of change in the world, we will no doubt continue to see disruptions on a more frequent basis in data security, transportation, technology, the geopolitical situation, and business. Some disruptions will take place due to disturbances in the supply chain, natural disturbances that are weather related. Others include mechanical glitches such as production or transportation breakdowns, fires, supplier issues and cyberterrorism. However, the most challenging disruptions will be those caused by transformational change. This is where AI and ML will have the highest impact. According to many experts Artificial Intelligence and its products will be the ultimate disruptor of the next decade or more. Interest in AI and ML is peaking. This change will affect organizations to their core. Transformational change (including AI) will often be a “bet the company” radical shift disrupting not only new markets and products, but how people daily work and act, with the result of impacting the culture of the organization.

3

Climate change will shift from a crisis to a CRISIS. Governments and the private sector will have to work together to solve the environmental crisis that faces us all. This means that governments and corporations must develop programs, initiatives, incentives, and laws that educate all parties on the benefits of sustainability. We will need to reward those that meet and exceed near term and long-term goals, ensure that everyone participates as fully as possible and discipline anyone or group violating the laws or guidelines. AI will be instrumental in helping to solve the problems created by climate change.

How AI Will Impact These Trends

AI will be a positive force influencing all three of these trends.

First, implementing AI will help ease the labor shortage that will be caused by the Boomers (and others) leaving the workforce. AI is automating nearly every industry. Distribution centers are now being designed to move material by either conveyor or autonomous mobile robots (AMRs) and Automated Guided Vehicles (AGVs) and use a minimum of people, and while a true “lights out” facility is still in the future; we are moving in that direction. Already we are seeing automated checkout kiosks in grocery and other retail stores. The workforce itself will age as well, with the population over 60 increasing. Scanning systems, ambient sensing, intelligent assistants, collaborative robots (cobots) designed to work with humans in the same workspace, assisting people to make them more productive and to improve safety.

Many jobs will be eliminated using AI, but many more will be created. Radical change, such as AI is both a job destroyer and a job creator. Repetitive, routine jobs will most likely to be eliminated in the short term. Positions that require dexterity (e.g. picking and truck loading), or that require problem solving skills or critical thinking skills will be enhanced. AI makes the contributions of humans more important because it helps us to excel, many times in unanticipated and astonishing ways.

Secondly, while many of the changes happening in supply chain management are incremental, AI is transformational. AI’s ability to automate decision making, optimize systems, and solve data-intensive problems greatly improves decision making cycle time, increases forecast accuracy, mitigates the bullwhip effect, and lowers overall costs. These are order-of-magnitude improvements which can provide a sustained competitive advantage.

Third, AI will provide sustained and lasting improvements as the world combats climate change. AI’s ability to optimize entire systems reduces greenhouse gases (GHGs) while simultaneously shifting energy usage to more economical times within the day or night, managing power usage by shutting down unneeded systems, and creating innovative ways to produce high-GHG materials such as concrete and steel.

The Four Elements of the Supply Chain

At its core, supply chain management is the study of the networks of suppliers, manufacturers, distributors e-tailers and retailers that form the universe of what we call commerce. In this universe, the supply chain's "elements" are its building blocks and form the foundation on which their organizations are built. To the ancient Greeks earth, air, fire, and water formed the basis for everything. For supply chains, the four elements of people, material, equipment, and space define its breadth, depth, and its limitations. Without these elements supply chains cannot exist.

1 People

People, the first of the four elements, include those with both direct and indirect connections to the organization. They include an organizations' employees, management, suppliers, and customers. Also included are the organization's stakeholders; the shareholders, creditors, the community at large, quite literally everybody that has an interest in the ongoing success of the organization.

Of the four elements, people are the single most important. They represent not only the sources of supply (suppliers) and demand (customers), but also the primary means of conversion (employees and management), and sources of investment (shareholders and creditors). Changes to the organization--both positive and negative--are always the result of the decisions and actions of people. The challenges are considerable for and with people in organizations as they implement AI and transition into a post-Covid society.

2 Material

Any item demanded by a customer (finished goods), supplied by a supplier (raw material) and partially completed, or sub-assembly items (work in process) fall into the category of materials. Materials are the second of the four elements. Materials are the fulcrum of trade and primary source of revenue and profit in the supply chain.

Although ordinarily physical in nature, materials can also be provided as services rendered, or as a combination of the two. More and more, materials are sold on a temporary basis, in the form of leased products (vehicles, equipment, buildings, and even clothing), especially since the advent of the circular economy. Even entertainment can be leased nowadays in the form of streaming services.

The Four Elements of the Supply Chain

3 Equipment

Equipment used in the supply chain comes in all sizes and serves various functions. Within a factory or distribution center it can be as simple as a pallet jack. It can be as complex as an Automated Storage and Retrieval System (AS/RS). Connecting networks consist of machines such as trucks, trains, pipelines, air cargo and a myriad of various methods of water transportation.

Ever since the advent of Malcom McLean's shipping container (Figure 4) in 1956, which revolutionized international trade, containers have been the mainstay of international shipping. Just as the pallet is the ubiquitous linchpin of a unit load, so too is the shipping container to world trade.⁷ Today about 70% of global trade is carried on ships and other forms of maritime transportation. Approximately two thirds of that material is shipped in containers. Containers can be transferred by truck and rail and make convenient temporary storage, making them probably one of the most flexible pieces of supply chain equipment available.

This category also includes information technology equipment, software, and Artificial Intelligence systems.

4 Space

Space is the final requirement and the fourth element of the supply chain. Supply chain professionals need space in the form of buildings and yards to store materials, equipment, and to house employees – at least the ones that are not working remotely – and as a place where equipment can be located permanently or temporarily.

For supply chain professionals, space is also the element that is the most difficult to get and keep in balance. It seems that there is either too much or too little. Whenever new space is obtained, it is quickly filled with material or equipment, and more is required. Companies that are rapidly growing never have enough, and those that are stagnating or shrinking, cannot get seem to rid of it fast enough.

How AI Will Impact the Elements of Supply Chain in the Next Decade

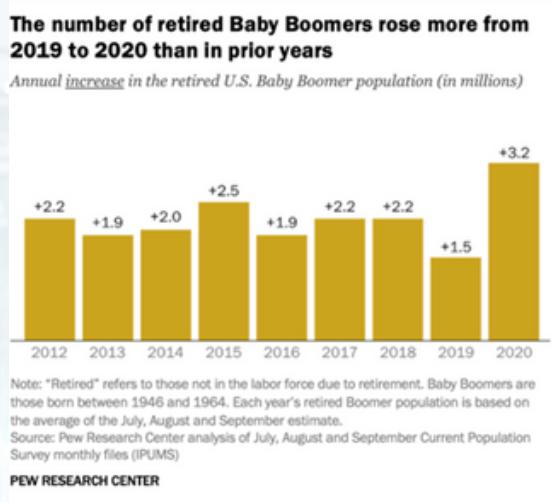
People and AI

As the graph in Figure 2 shows, there has been a marked increase in the number of Baby Boomers that retired in 2020. It is safe to say that because of Covid the rate of Boomer retirements will remain high for some time. Those that can afford to retire early will probably opt to do so.

Further complicating the issue is what is known as “The Great Resignation.” Many employers are reporting acute labor shortages as millions of jobs go unfilled. In April 2021 alone, more than 4 million people quit their jobs. Jobs in education, retail, health care, hotels, and restaurants are experiencing shortages of between 4% - 9%, although no industry is immune. See Figure 3.

Workforce talent – employees and managers – is now at a premium and will be for the foreseeable future. Job vacancies have an inflationary effect on wages in many industries and the supply chain is no exception. Overall, from 2021 wages are up an average of 4.5%,⁰ the largest gain in two decades. Workers with specialized or technical skills are job hopping as they see demand for their services increasing as too many job openings compete for too few people to fill them.

Figure 2



Source: Pew Center ⁸

Figure 3



Source: The Daily Shot ⁹

As Boomers continue to leave the employment rolls, it seems logical that the introduction of AI would be a perfect solution, right? Replacing everyone who leaves the workforce with robots seems a perfect answer.

WRONG! While AI and the robot army may do many things well, there are limits.

First, AI lacks the ability to reason or use common sense. Robots cannot rearrange their workstations so that tools and parts are more easily reached, making the process more efficient. That requires changing its programming--which requires a programmer (person) to implement.

Second, AI is not creative. It cannot conceive new processes, tools, or products to make or grow the organization. AI also cannot solve problems that require deep experience and intuition. Many people after years of training and exposure to real-life situations develop a “gut feeling” about a problem. Such things as investigation or abstract problem solving cannot be accomplished by AI.



So, while Artificial Intelligence can definitely improve supply chain management and will replace some of the people that are doing dangerous, repetitive, mundane work and make and even optimize lower-level decision making, there are many specialized applications where people are required. AI can, however, assist people in decision making and free people up to be creative and to solve the complex problems that require years of experience to solve.

How can the cumulative knowledge of an entire generation with the size and breadth of the Boomers (amounting to approximately 3 billion years of experience) be passed on to the workforce of the future? Such a loss could be devastating. Here are several solutions to address the potential loss of institutional knowledge.

One way is to use Knowledge Transfer (KT). KT is a process by which an experienced employee transfers job-related knowledge to another person. Studies show that when an employee leaves the organization, they can take about 70 percent of company knowledge with them. This knowledge is ultimately lost and will have to be re-learned. Most of the reason for this is that many organizations lack a formal knowledge transfer program.



Knowledge Transfer software, using AI with natural language processing, can easily scan documents to identify key terms, phrases, and information that will help new employees understand their roles even after experienced people have left the organization. AI can also be used to collect, develop, access, and share information. AI assisted knowledge transfer can automate repetitive tasks, improve insights into processes, and streamline the decision-making process for organizations. AI can also raise the engagement of employees who request more transparency and fairness in dealings with management. People want to be treated as individuals, to be trained well, provided with a meaningful career path, and trusted to do the right thing and make their own decisions. Training them to work with AI, cobots, and automated processes increases their knowledge and value and eliminates the fear of being replaced.

Artificial intelligence can also assist people in making their organizations sustainable. Programs can be used to calculate the supply chain's carbon footprint. They can also be used to shorten the organization's supply chains. Most food in the United States travels about 1,500¹¹ miles from farm to processing to table, while apparel travels as much as 40,000¹² miles, and the typical iPhone travels nearly to the moon and back¹³ before it was purchased. Long supply chains are fragile and shorter supply chains are disrupted less often. In the post-Covid world, consider using AI to assist in regionalization, nearshoring, or reshoring.

All enterprises are continually looking for ways to consume less energy. Implementing an AI-assisted energy management system throughout your supply chain reduces energy consumption and saves energy in two ways; by reducing greenhouse gases (GHG) emissions and by saving the organization money.

Another way to reduce GHG's is to switch to renewable energy sources. This is another win/win. Modern warehouses are flat-roofed buildings and are highly conducive for installing solar panels. Depending on the size of your facility, you may be able to offset some or all your utility expenses. Some organizations even sell energy back to their utilities. Subsidies may be available from local, state, or federal agencies, further reducing capital costs. Also, consider convincing management to purchase energy from utilities that use renewable sources.

To combat the loss of the Boomers and The Great Resignation, enlightened employers have also started reexamining not only their compensation plans, but also their policies, procedures, and management styles to retain employees and to attract new talent. People working from home during the pandemic found that their stress levels dropped significantly as they were able to reconnect with friends and family and avoid commuting. In general, people are rethinking their career choices and their work / life balance. Many have enjoyed working from home and balk when asked to return to an office or company facility full-time. Many organizations are now allowing a mix of work from home options to try to combat the rise in turnover. Recent surveys show that between 38 percent and 48 percent of employees are considering changing their jobs in the next 6 - 12 months.¹⁴ This is alarming employers because turnover is expensive. Studies show it costs over \$4,000 to hire an employee, not including training (Glassdoor).¹⁵ Working from home is better for the environment as fewer cars are on the road during rush hours.

Artificial Intelligence can be used to improve employee engagement by streamlining and automating mundane tasks, allowing people to make higher level decisions, and feeling like what they are doing really makes a difference. Recent surveys show that only about 32% of employees are actively engaged in their work.¹⁶ Engaged employees are much more productive, are late and absent less often, and are more loyal to their employers.



Several years ago, I wrote an article entitled, “How to Hire for the Modern Supply Chain.” In it I outlined three skills that I look for when hiring new talent. Those skills were analytical, abstraction, and financial skills. Those skills are more important today than ever. When I wrote that article, I felt that having those skills would set an applicant apart from their competition. Today, they are required to simply be considered for a supply chain position. Incidentally, those first two skills (analytical and abstraction) are beyond the ability of AI systems.

Today, I would add one more skill for the supply chain professional. That is the ability to think critically. Critical thinking involves the ability to analyze, evaluate, and incorporate information from various sources and perspectives. It is a crucial skill for supply chain management, which involves coordinating the flow of goods and services from suppliers to customers in a complex and dynamic environment. Critical thinkers are natural skeptics. They are also able to change their minds on an issue as the facts surrounding the issue change.

“The world we live in now requires that we continually relearn, that we routinely rethink our decisions, and that we regularly reevaluate the way we work and live.”

”from the book, *Critical Thinking: Tools for Taking Charge of Your Professional and Personal Life* by Richard Paul and Linda Elder.”¹⁷

I once worked for a manager who said, “Anyone can do it with people.” The question remains, try getting anything worthwhile accomplished without them! At some level, people will always be part of the solution. Now what needs to be done is to prepare people for the challenges that AI will provide, both in terms of threats to their livelihoods and to their opportunities for their careers. For supply chain professionals this means that lifelong learning is essential. Keeping abreast of the latest supply chain concepts and thoughts through continuous training and applying insights to real-world situations is essential both to the organization and in keeping people relevant and engaged.



Material and AI

As the pandemic expanded, material shortages first happened with grocery and consumer products. Initially these shortages were much like weather-related disruptions; consumers quickly cleaned out grocery store shelves. But the pandemic outlasted even the longest hurricane or earthquake disaster and soon many products were in chronic short supply. Remember the shortages of toilet tissue, milk, and flour? Those were caused when demand and supply were thrown out of balance and were only solved when capacity was shifted from commercial markets into consumer markets. Many products follow significantly different processes when prepared for different marketplaces. When people stayed home, they stopped using much of the material that was provided by their company (commercial) sector. They had to rely much more on the consumer (retail) sector. What was once relatively balanced between the commercial and consumer markets became seriously unbalanced as more and more of us worked from home.

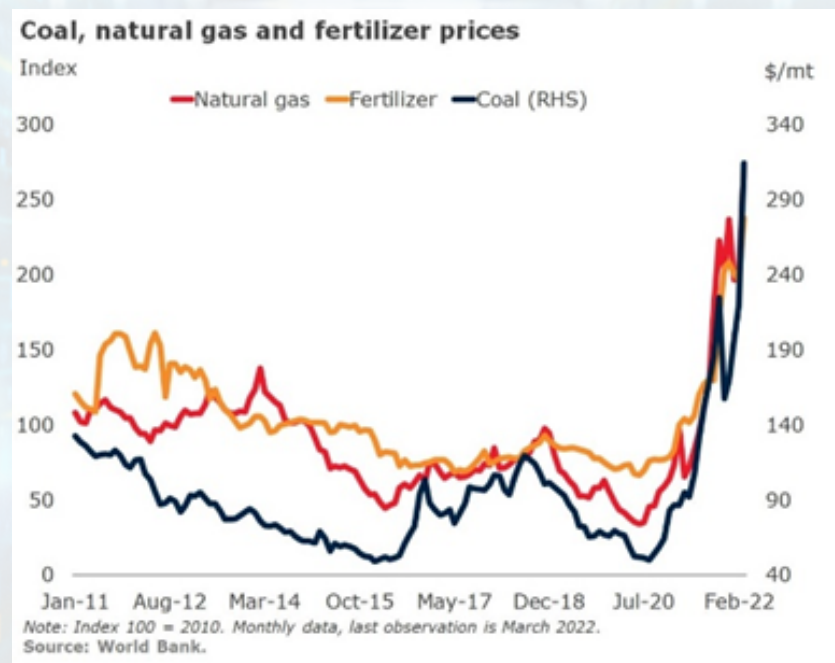
There were other material shortages as well. As people stayed home, they rediscovered the family meal, increasing demand for breakfast cereal and comfort food such as cake mixes, macaroni and cheese, pasta, hot dogs, chicken, and hamburger. Cleaning products used in the home were also in short supply.



Other material shortages started in China as factories were idled and ports shut down due to Covid. When the pandemic first hit and people were in lockdown, demand for automobiles decreased dramatically. This resulted in reduced demand for automobile parts, among them computer chips. Chip makers quickly adjusted and rebalanced their demand requirements, even reducing production and reallocating capacity as needed. This caused massive shortages when the lockdowns ended and new and used car demand skyrocketed.

Shortages of material pushed prices up in nearly every market. See Figure 4.¹⁸ These “Covid Premiums” created a cascade effect which spilled over into a wide range of industries and are now global in scope.

Figure 4



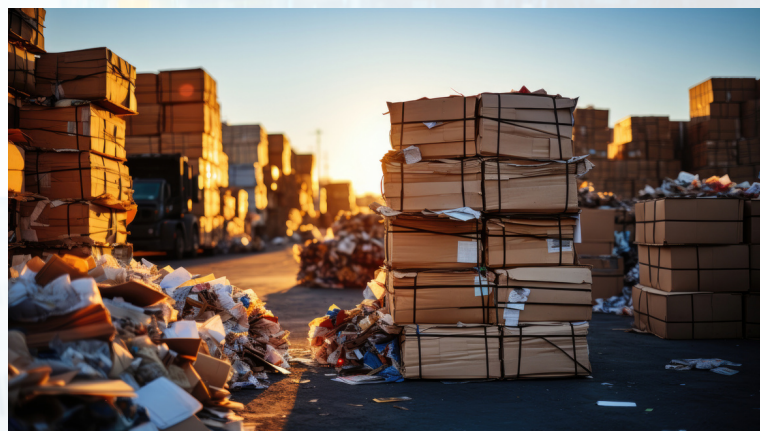
Source: The World Bank

They were found in international and domestic shipping, in the cost of shipping containers, housing prices, literally everything that is subject to a shortage now has a price premium on it that is blamed on Covid. This has been further magnified as the recent war in Ukraine has pushed up the prices of energy, bulk minerals, and grain. As time progressed, prices for many materials have come down, although many still remain high. And while predictions of a worldwide recession loomed for a while, today many economists, politicians, and consumers alike now believe that many economies around the globe will experience a “soft landing” as many of these price hikes prove to be temporary in nature. Time will tell.

The key to keeping inflation in check is to bring demand and supply back into balance. It must be done while simultaneously keeping costs low and service levels high. Living in the post-Covid world, enterprises need to consider where and how they source their materials. A study by Texas Christian University¹⁹ showed that companies with supplier and customer relationships based on trust fared better during business downturns. Such companies were better able to secure supplies of scarce material or negotiate better payment terms. Additionally, companies are rethinking their sourcing strategies to find additional or alternative suppliers, or are regionalizing, nearshoring, or reshoring their manufacturing.

Artificial intelligence can greatly aid sourcing and procurement by making forecasts more accurate, automating routine processes, and enabling procurement professionals to make decisions quickly, accurately, and efficiently. For routine and repetitive purchases, forecasting systems with AI can provide a higher level of accuracy to demand projections. Procurement AI will find qualified suppliers, gather cost data about what the product should cost, develop bid documents, and send them to the supplier population. It can gather the bids, determine that the bids are within specifications and recommend a winner, or a group of potential winners. The procurement professional can then negotiate the best and final offer (BAFO) and make the award(s). When procurements are for key materials and services requiring higher level expertise and possibly Chief Procurement Officer (CPO) involvement, AI can identify a list of preliminary suppliers, assist in developing specifications and terms of service.

AI can help procurement professionals meet sustainability targets and reduce total cost of operations by assisting them in analyzing an all-electric or hybrid fleet of vehicles. This can include company automobiles, the private truck fleet, the material handling truck fleet (e.g. AMRs and forklifts). AI can also assist packaging engineers in reducing or reconfiguring package design.



Packaging is the greatest polluter of landfills. By focusing on using just enough packaging to adequately protect the product and by using recycled material or material that can be recycled, companies can significantly reduce their carbon footprint. Effective packaging saves in three ways – first in the cost of reduced packaging, second in the cost of transportation, and third in the cost of trash hauling.

Leverage AI when considering the purchase or lease of new facilities and utilize green building practices. GHGs from concrete and steel manufacturing account for nearly 20% of annual emissions.²⁰ While low-GHG steel and concrete are still in the future, other green building concepts can be used now. These include energy management systems, cool roofs, and natural air conditioning.

Digital transformation programs utilize AI to minimize an organization's carbon footprint by using less energy, fewer resources (e.g. paper), and producing less waste. A Supply Chain Control Tower is an excellent solution as it integrates inbound and outbound transportation, complies with geopolitical Trade Agreements, consolidates shipments, ships via the lowest cost/best service carriers, routes shipments in the most efficient manner, and tracks everything in real time or near-real time.

Lastly, supply chain professionals should encourage their organizations to incorporate circular economy disciplines²¹ in the design of products and the procurement of materials. Circular economy products can be repaired and refurbished during their useful life and then can be remanufactured and recycled when they reach the end of their usefulness. The ultimate goal is net zero waste. It is a huge culture change that will require a total change in the mindset of everyone in the organization.



Space and AI

As we transition to post-Covid supply chains, the use of space will see great changes. The pandemic has changed the landscape of retail forever and while brick and mortar traditional retailing is far from dead – people still like to get out of their homes – e-commerce has grown far faster than it would have without the nudge from the pandemic. Digital Commerce 360²² a leading research organization, estimates the pandemic added over \$218 billion to e-commerce's bottom line in the past two years.

The vast amount of demand data now available to supply chain professionals can be leveraged for the benefit of the supply chain and the organization. Customer and supplier data, including volume, sales dollars, profitability, credit score, payment history, returned merchandise frequency, supplier scorecard, customer scorecard, level of risk, etc., provide the organization with huge opportunities to improve operations using AI. The effect of this growth has caused demand for warehouse buildings to increase exponentially. Vacancy rates at the end of 2021 were at an all-time low of 3.4% in the US according to Prologis²³ with some parts of the country (Los Angeles, California's Inland Empire, and Boston) at 2% or less. This is despite a near record of 270 million square feet of capacity added in the last year.

The squeeze on space has forced new 5-year lease rates up into the 25% range. Rates are expected to increase 10% or more in the coming year. Currently there is 390 million square feet of warehouse space in the pipeline although 70% is already pre-leased. AI can be used to efficiently expand an organization's distribution network by placing new distribution centers where they are needed the most, based on strategic plans, demand forecasts and market segmentation.



Retailers and e-commerce companies have become creative in their use of space. Many retailers are using micro-fulfillment processes such as BOPUS (buy online pickup in store) where purchases can be made on their website and picked up at the local retail store with minimal human contact. Rather than having national or regional hubs, the push for same/next day delivery has shifted companies toward smaller facilities in and around major and secondary population centers (i.e. dark stores). Some of these locations are in existing multistory buildings. Others are reconverted traditional stores within shopping malls that have closed. Many of these have proven to be attractive since they require minimal redesign. These locations often have access to major highways and interstates. Again, through the use of AI, such decisions can be made quickly with a high level of confidence and accuracy.

As new warehouse facilities open, few resemble those of the past. While humans are the greatest asset in the warehouse, most modern warehouses have minimal staff and have maximized their use of automation, including automated storage and retrieval systems (AS/RS), automated mobile robots (AMRs), powered conveyors, automated guided vehicles (AGVs), and the software systems to link them together. One of the highest cost activities in a warehouse is moving material around the facility. Product moves add little value and ties up humans when they could be allocated to more productive endeavors, such as picking and retrieving material or strategic undertakings such as inventory control.



The amount of space and its total cost of ownership can be greatly reduced in warehouse networks using AI and automation. Wherever possible, consolidate parcel to LTL, and LTL to TL for inbound and outbound material. Consolidation saves the cost of fuel, delivery (number of trucks) and labor. Through the implementation of supply chain transformational efforts, the distribution operation itself can become virtually touchless and paperless. People can focus on managing higher-level issues such as exceptions and glitches instead of day-to-day routine issues. As fewer employees are needed to do repetitive jobs such as driving forklifts or lifting and stacking boxes, workplace injuries can drop significantly. The use of AI-powered robots has reduced the lost-time injury rate at Amazon distribution centers by 69% between 2019 and 2022.²⁴ In fact, by optimizing distribution centers using AI, companies have seen as much as a 40% reduction in square footage required.²⁵

Conclusion

Artificial intelligence will be the most significant game changer and the most important tool for supply chain professionals for decades to come. It will impact every aspect of the supply chain from the trends affecting it to each of the elements that comprise it. AI will both destroy and create jobs in the industry and organizations will succeed or fail because of it.

Supply chain professionals cannot fear AI. They must embrace it. Yet they also need to question it and understand both its advantages and limitations. AI is neither a nemesis, nor a savior. It is a tool, plain and simple. How we use that tool will dictate our success or failure.

As Klaatu, the alien played by Michael Rennie in the 1951 sci-fi classic, *The Day the Earth Stood Still* said before he left Earth,

“The choice is yours.”

Footnotes

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About Supply Chain Mavens

We Provide Customized Training Solutions for Your Supply Chain

Supply Chain Mavens offers certification programs for APICS CPIM, CSCP, CLTD, CTSC, SCOR-DS and DDPP.

Earn your ASCM Certification in one of our public classes.

Supply Chain Mavens Inc. trains with small, medium and Fortune 500 size companies to provide an understanding of Industry Best Practices and to guide your team through the implementation process.

The Supply Chain Mavens Difference

We are not just trainers, we are your partners. We'll stick with you through your team's entire certification process.

Supply Chain Mavens are experienced supply chain professionals. We have been in your shoes and we understand the complexities involved in supply chain planning and inventory management.

No cookie cutters here! We will collaborate with you to develop tailored training solutions for your supply chain team.

Read on to understand how the concepts discussed in this whitepaper map to APICS certification program content.

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