Usage of Artificial Intelligence in Supply Chain and Operations Management

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Abstract

Our world has experienced a heightened demand for the usage of artificial intelligence (AI) in the past 15 years. An industry that has experienced a variety of changes and challenges specifically is supply chain and operations management. Through the use of artificial intelligence, the supply chain is better able to predict and analyze the many possible future outcomes that may occur in the supply chain industry. This has been proven through the recent COVID-19 pandemic and will continue to be challenged throughout many future risks and concerns. Some concerns include the social and ethical use of artificial intelligence, climate change, job displacement, and increased reliance on artificial intelligence. The recent introduction of GPT-4 is causing a decrease in general data analytics and even making them obsolete. Artificial intelligence requires robust technology, and the demand for individuals who are artificial intelligence savvy will increase in the coming years. Barriers to entry include the cost of implementing and these efforts are likely to fail on the first attempt. The usage of artificial intelligence proves to impact supply chain especially within the healthcare industry. This was especially at play during the COVID-19 pandemic when hospitals quickly implemented artificial intelligence applications to gather patient information, rank client health, and delegate remaining resources. Artificial intelligence is proving to be prevalent in analyzing supply chain issues and this trend will continue in the future.

Introduction

A question that people may have about artificial intelligence is, what problems can artificial intelligence solve within the supply chain? VP analyst in Gartner's Supply Chain Practice, Noha Tohamy, says during an interview with EPS News "organizations are still so early on in their adoption that some of the expected benefits might be hyped or overestimated, and the risks might not be fully understood and therefore minimized". Tohamy also says that one of the more impactful ways artificial intelligence can be used is by allowing staff that work on the supply chain to interact with the technology in a more natural language to ask questions and

get more in-depth answers about key performance indicators and supply chain performance. (EPS News)

While doing our research we found countless recent news articles relating to artificial intelligence. Reading through a Forbes Newsletter, they had the chance to speak with Deloitte's US SAP (Systems, Applications, and Products in data processing) Supply Chain Offering Leader, Subit Matthew. He had many things to say about how artificial intelligence could help improve efficiency, user experience, and deliver new processes and innovation. "Imagine if you can actually take your Integrated Business Platform, put artificial intelligence on top of it and be able to simulate any and all supply chain events that could happen, you have a set of answers before it actually even happens." Subit Matthew said when describing how artificial intelligence will ultimately be a good thing in supply chain operations.

SupplyChainBrain says that there are 3 key areas where artificial intelligence is set to make a significant impact on the supply chain industry. The first area being warehousing and transportation, when broken down, this area has many ways artificial intelligence can make an impact on routing decisions by calculating the least amount of travel time and fuel consumption. Also based on the first category artificial intelligence will also be able to help with inventory and movement, analytics, and predictive analytics. The second key area is manual processes and workflow, when broken down, makes an impact on scanning events, appointment scheduling, and tracking and tracing technology. The third area talked about is personalized customer service, when broken down, customers can talk with chatbots and conversational artificial intelligence which can handle customer inquiries and provide real-time updates. Artificial intelligence can identify and address issues in the supply chain before they escalate to ultimately give the customer a better product.

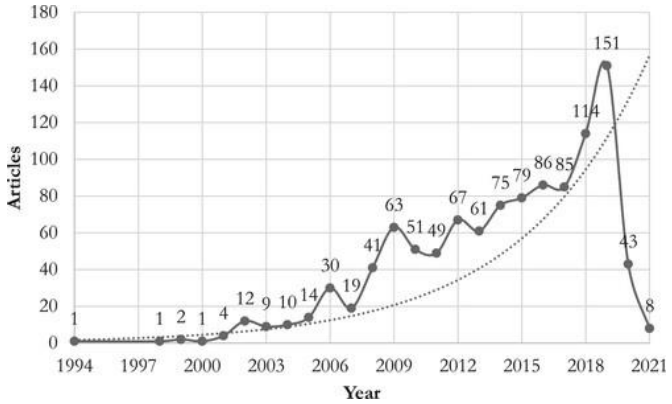
Ever since COVID-19 shocked the world and caused so many problems regarding the supply chain, whether it is related to the shortage of employees or lack of demand due to the pandemic, people wanted to find answers to help stop the disruptions happening in the supply chain. Harvard Business Review goes into detail about how global companies can use artificial intelligence to prevent supply chain disruptions. A company called Unilever uses an artificial intelligence application to find alternative suppliers for businesses when they cannot purchase

from their existing supplier, “The software generates a list of potential new suppliers by scraping websites for data on suppliers’ finances, customer ratings, sustainability scorecards, diversity scores, intellectual property information such as patents and design awards, customs documents from U.S. Customs to validate international trading experiences.” This is just one of the ways that artificial intelligence is already enhancing the supply chain. “Artificial intelligence is predicted to take supply chain resiliency to the next level by leveraging the vast amount of data now available across the enterprise” (Forbes Newsletter).

An Ernst & Young poll, that surveyed over 250 executives in the “retail and consumer packaged goods industry found that 53% of leaders feel that economic and inflationary pressures, as well as keeping pace with constantly changing consumer preferences, are among their top three pressures keeping them up at night” (CrowdFundInsider). They also asked each executive about artificial intelligence and 99.6% of executives said they are experimenting with generative artificial intelligence to help enhance their supply chain. This shows just how prevalent artificial intelligence really is in the world today.

Literature Review

The last 15 years have proved to be a definitive time for advancements in artificial intelligence in a vast number of industries. The supply chain management industry has experienced a massive influx of artificial intelligence publications in the last 15 years. The surge of publications starting in 2012 is credited to Industry 4.0 which theorized the artificial intelligence thinking of man-made interfaces (1). The chart below shows the recent jump in publications in the last 15 years(1).



Artificial Intelligence Publications – (1)

The main artificial intelligence research searches in supply chain management were identified as (a) supply chain network design, (b) supplier selection, (c) inventory planning, (d) demand planning, and (e) green supply chain management (1). Supply chain network design is involved in determining the best location and size for facilities as well as the flow of products. "Min, Ko, and Ko proposed a nonlinear integer program and utilized genetic algorithm(GA) for solving the multi-echelon supply chain network design (SCND) problem involving product returns and freight consolidation across geographical areas and holding time (Min, as cited in source 1)." Holding time refers to the period in which inventory is stored in a warehouse before it is sold. Supplier selection involves picking the right suppliers for your business and operations, and artificial intelligence has helped advance the analytics for determining costs, performance, tracking, and management of suppliers. The purpose of inventory planning in artificial intelligence is to control demand variability, inventory levels, and customer service. Peidro developed a model to solve inventory planning issues by inventing fuzzy linear programming in a multi-echelon, product, and period supply chain network (Peidro, as cited in source 1). Demand planning involves the logistics, manufacturing, and sourcing of supply chain activities. Yu, Graham, and Min invented an agent-based demand forecasting technique to data mine and predict future aggregate demand of products (Yu, as cited in source 1). Lastly, green supply chain management is a growing concern among producers to ensure sustainability with rising environmental pressures. Govindan, Khodaverdi, and Jafarian developed a fuzzy multi-criteria decision-making model to solve sourcing problems involving finding green suppliers based on the Triple Botton Line (Govindan, as cited in source 1).

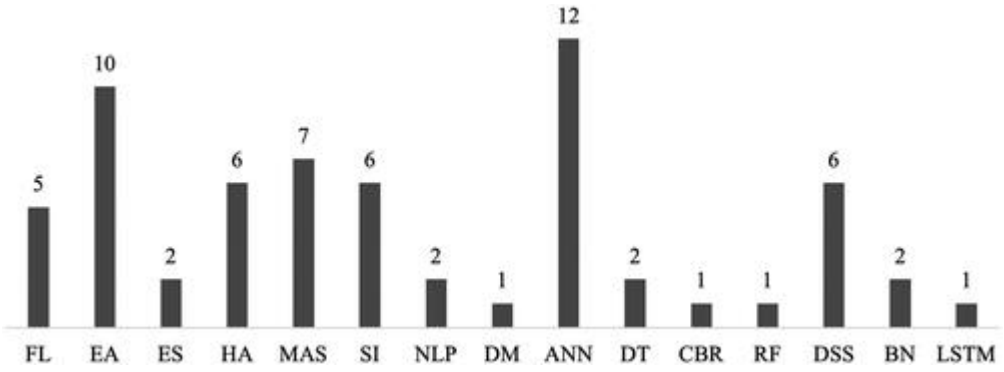
The emergence of artificial intelligence has sprung a reaching concern for explainability. This explainability is defined as neurosymbolic artificial intelligence, and is expressed as combining neural structures with logical reasoning (2). There are 5 main pillars within neurosymbolic artificial intelligence research for supply chains. The first pillar involves improving explainability in artificial intelligence to improve its adoption in real-world processes. As artificial intelligence in the supply chain is still in its early stages, research is concerned with the capabilities and performance improvements. The second includes the exploration of knowledge and graphical approaches to model data. The recent studies of graph neural

networks (GNN) helps to uncover hidden relationship risks between buyers and suppliers. These studies are applied in the works of Zhou (Zhou, as cited in source 2) where graphs are used to predict manufacturing quality using data from IoT devices, and Shi (Shi, as cited in source 2) on predicting food safety risk levels. The third pillar is applying intermediate abstraction techniques to deal with data such as text, images, and graphs. Neurosymbolic artificial intelligence tries to solve these issues by transforming the data into sub-symbol abstractions as embeddings that can be processed into downstream tasks. The fourth pillar emphasizes research on prior knowledge to reduce required data and eliminate bias. Machine learning models tend to need large data and will usually pick up biases, so a helpful solution may be to integrate prior knowledge into these models. The fifth pillar involves the exploration of meta and hybrid learning techniques. The ultimate goal of this pillar is to optimize the configuration of another system to enhance another machine learning model.

"Supply chain organizations have emphasized AI as a competitive advantage, a secret weapon, and a key successful factor in improving operational performance, promoting process integration, and achieving sustainable supply chain (4)." While this quote from Xinyue Hao sounds pleasing, the Technology-Organization-Environment (TOE) framework has a focus on studying how these advancements will affect the three-fold of technological, organizational, and environmental contexts. Focusing on the technological side, TOE identifies the internal and external technical aspects of a company and their advantages, compatibilities, and complexities. The organizational sector is mainly focused on resources such as firm size, management, leadership style, and HR quality within the firm. Environmental aspects encompass the structure of the industry, competition, regulatory environment, and development of economics.

Notable algorithms under the study of artificial intelligence have given credit to artificial neural networks (ANN), evolutionary algorithms (EA), multi-agent systems (MAS), heuristics algorithms (HA), swarm intelligence (SI), decision support systems (DDS), and fuzzy logic (FL) (4). ANN has been proven to manage supplier relationships, SI and FL are integrated to plan and schedule production, and FL and MAS have been used to build supply chain resilience. Given these technological advances the study quotes, "a total of 82%, did not prioritize the scrutiny of

particular AI techniques (4)." This statistic should be considered, and firms should be inclined to explore these artificial intelligence techniques. Many firms are continuously expanding their usage of artificial intelligence through these popular algorithms. The diagram below shows the distribution of artificial intelligence techniques that are gaining significant attention in supply chain networks (4). The diagram highlights ANN having the highest amount of usage with EA and MAS coming in second and third ranking.



Notable Artificial Intelligence Algorithms – (4)

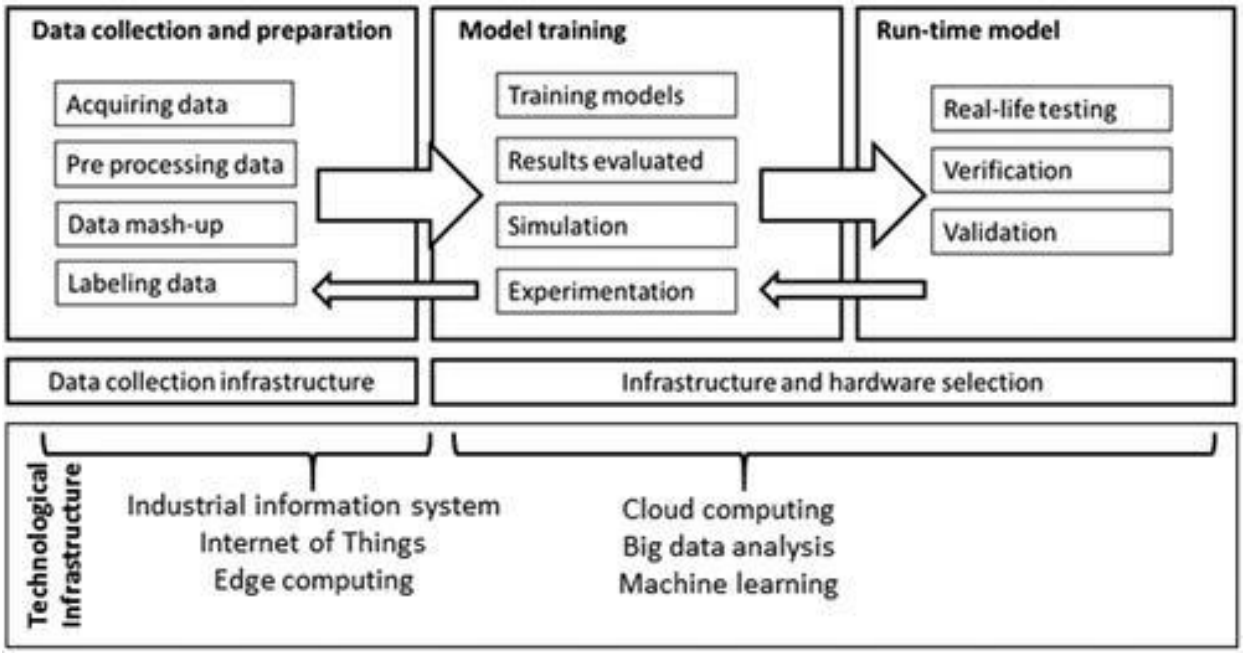
Before the surge in artificial intelligence systems, the main system of learning pertained to machine learning (ML). Data analytics was also heavily utilized to improve quality and efficiency. These techniques require massive amounts of data and are now considered obsolete due to the recent introduction of ChatGPT launched by OpenAI on December 1, 2022 (5). This new form of artificial intelligence now predicts user output based on user input, whereas machine learning focused focuses on analyzing input. This technological advance is significant because ChatGPT now made artificial intelligence accessible to anyone and not just select artificial intelligence engineers. In March of 2023, OpenAI introduced GPT-4 which was given the ability to write, interpret, execute code, and run complex data analytics. GPT-4 has already proven to provide analytical advice for choice of suppliers. It has also aided with integration in sales, demand forecasting, production and logistics optimization, and customer sales (5).

Artificial intelligence in supply chains also raises some concerns and dangers. Some worry that it will increase the reliance on artificial intelligence to carry out tasks. There are also times in when delegating authority to these systems is not sufficient. Another worry is concerns with the unethical usage of artificial intelligence. Many worry that artificial intelligence will

displace human workers and introduce new vulnerabilities. A solution to job displacement is impact sourcing which encourages employing socio-economically disadvantaged people. “One of the pioneers of impact sourcing is Sama, a training-data company that focuses on annotating data for artificial intelligence (AI) systems and claims to support an ethical AI supply chain through its business operations (3).” Sama has come to recent negative attention due to recent information being shared that employees are being paid less than $2 an hour. Employees also experienced trauma from their work as well as being penalized for efforts to form a union. Sama claims to be an ethical artificial intelligence company, but evidence clearly contradicts this claim. Companies and consumers should be aware of the social impacts that the usage and sourcing of artificial intelligence causes.

While there are many social concerns and negative risks associated with artificial intelligence, there are also many risks connected to supply chain management, that can be mitigated with the help of artificial intelligence. “Hence, it is necessary to address the inability in prediction and learning using AI integrated techniques to overcome the limitations in traditional approaches (9).” It is apparent in the previous quote that artificial intelligence performs better than traditional approaches in certain scenarios. The article goes on to inform us that artificial intelligence is best at developing risk prediction and learning models, integrating potential optimization techniques which would develop a more resilient supply chain, and discovering a holistic risk management framework. Although these risks are quite generalized artificial intelligence is also good at mitigating specific risks. One example of this is the large risk of climate change within the supply chain. A recent study explained the cost of these climate change risks when they said, “according to Carbon Disclosure Projects (CDP) poses $1.3 trillion risk to the global supply chain over next five years (6).” This amount could result in almost a 4% jump in the national debt if we do not plan in advance, which is where artificial intelligence comes in. This could be seen as just-in-time production planning artificial intelligence methods that adjust to fluctuating demand. This is why it is important to integrate artificial intelligence into the supply chain, and improve supply chain operations, and strategic planning (6).

After hearing about the positive risk mitigation that could come with artificial intelligence, we must also understand that there are many barriers to entry when it comes to articulating an artificial intelligence supply chain. A few challenges of adopting artificial intelligence into the supply chain include creating a clear artificial intelligence strategy in the organization, a need for robust technological infrastructure, and the expensive burden that comes along with Artificial intelligence (10). This holds especially true when it comes to supply chain management, as top-level management makes long-term decisions and decide how the company will complete its entire supply chain process. While making these tough decisions top-level managers must decide whether adopting artificial intelligence is worth the large expense obligations. "Also, a review by International Data Corporation (IDC) shows that only 30% of organizations reported a 90% achievement rate for AI implementation (9)." This tells us that on top of artificial intelligence being very expensive it most likely will also take multiple attempts of implementing it for the artificial intelligence to actually work. This is why top-level managers must decide how they are going to develop, train, and deploy their version of artificial intelligence. Listed below is a diagram of how artificial intelligence is commonly developed and deployed into supply chain management (10).



Artificial Intelligence Development and Deployment – (10)

Data collection and preparation includes the collection of structured and unstructured data. After collecting the data, they will screen it, eliminate irrelevant data, acknowledge missing data, and extract indicators. All of these steps are used toward enhancing the training process. Next, the artificial intelligence enters a learning process, where it uses repeat learning, and evaluation processes to increase forecasting accuracy. The final step is to deploy the model into the actual business process, fixing any errors that might occur at any stage of development and deployment along the way.

Overcoming such barriers has proven to be a tough process, as many people are not educated on artificial intelligence implementation. With this in mind there is still hope for the supply chain, as barriers start to be dismantled in the upcoming years. "Policy makers, researchers, industry practitioners and governments need to come together to build a conductive environment for AI to thrive (6)." This quote addresses the common issues within artificial intelligence, explaining that there are barriers to entry within all users of it, and that we all must adopt artificial intelligence together for it to run at its full potential. They go on to explain that possible solutions include creating principles to practice artificial intelligence, in the form of laws, which is derived from the idea that artificial intelligence is in its early stages, and that there are still very few laws regarding artificial intelligence. Additionally, we need to support artificial intelligence starting at a top-level management perspective and continue this support throughout each level within an organization. Possible ways of supporting artificial intelligence include putting in the effort to better understand it, identify areas where it can succeed, building a strategy, training it, and then lastly implementing it (6). Through the process of eliminating barriers more organizations, small and large will be able to implement artificial intelligence into their everyday operations.

Once implemented into the business artificial intelligent can help with many forms of decision making. Listing a few we see optimization, expert systems, planning, scheduling, simulations, and modeling, (8). Artificial intelligences' ability to help the decision making process has a lot to do with its ability to analyze large sets of data. "Applying AI in modelling and simulation allows for advanced scenario-based analysis; thereby enhancing decision making through better understanding of system behavior (8)." Through the use of artificial intelligence

companies are able to create better prediction based models, that help the company determine the best course of action with certain production lines. When referring to planning and scheduling we see artificial intelligence helping make decisions with a certain set of constraints in place. Planning helps optimize the order of activities, and scheduling helps with the allocation of tasks to resources. “Not only have recent AI advancements enabled managers to detect and predict disruptions that may impact normal system operations (e.g., fraud detection, predictive maintenance and system failures), but they have also assisted with system recovery in a more responsive and data-driven fashion (8).” With the use of artificial intelligence companies are better predicting year-to-year activities.

Furthermore, there are many other advantages to using artificial intelligence in supply chain management. A few to list are its involvement in systematic inventory management, improving customer service, timely delivery, and improving safety. Although in the addition to the advantages there are also many disadvantages, some of which include artificial intelligences lack of creativity, and inability to improve without human interaction (7). This presents reasoning as to why artificial intelligence does not always succeed the first time, as there are still multiple disadvantages within adopting artificial intelligence into the supply chain. Although adopting artificial intelligence doesn’t always work the first time around it is still worth putting in the time, effort, and resources to do so, as it can help with many ongoing and future risks; the most well-known example of this risk was seen during the recent pandemic.

The COVID-19 pandemic has caused many disruptions in global supply chains. It has exposed weak aspects in supply chains far beyond what most people have witnessed in their lives. The kinds of disruptions seen affects every nation and industry, and the sudden and dramatic changes in demand and supply that have happened throughout the pandemic do not help either. COVID-19 has damaged customers’ ability to pay for their goods and services, suppliers are unable to produce and supply raw materials to meet demand, and it has disrupted the entire supply chain, leading to shortages of essential items (12). “The use of Artificial Intelligence driven Risk Management, therefore, allows firms to not only enhance firm performance but is also a driver for accelerating firm performance through robust agility in operations. Managing SC agility requires real-time visibility. Utilizing artificial intelligence driven

Risk Management to harness fast and big data enable managers to rapidly predict risks via identification and quantification from past impact and prescribe mitigating strategies tailored to the particular scenario"(Dwivedi, as cited in source 13). The insights derived via processing large data can be utilized to improve both operational performance and financial performance (12).

Artificial Intelligence has been shown to be an excellent method for simulating adaptability in complex systems, hence enhancing their structure, reconfigurability, and adaptability (15). Artificial Intelligence Techniques have a large impact on the growth of new iterations of adaptable structures. Also, the arrival of artificial intelligence has brought about a noteworthy time for the adaptive capabilities of the Healthcare Supply Chain. This has resulted in definite advantages in the implementation of new applications. An explanatory instance is predictive analytics, which can use artificial intelligence algorithms to anticipate demand by analyzing historical data, seasonal patterns, and external variables such as disease outbreaks. Healthcare facilities may use these predictions to optimize their inventory levels, guaranteeing a continuous availability of crucial medical resources such as personal protective equipment and drugs while avoiding excessive stockpiling (15). According to statistics compiled by The American Public Media Research Lab, more trade employees and associates were exposed to the virus than other groups in various occupations, including delivery partners and other workers. Healthcare professionals, educators, and nursing home staff are a few more professions that were exposed to significant levels of the virus (11). Artificial intelligence was very important to monitoring the COVID-19's progress, identifying high-risk individuals, quickly containing the pandemic, and helping to make predictive assessments of the Healthcare Supply Chain so that hospitals, schools, and other workplaces could get the supplies they needed during the pandemic.

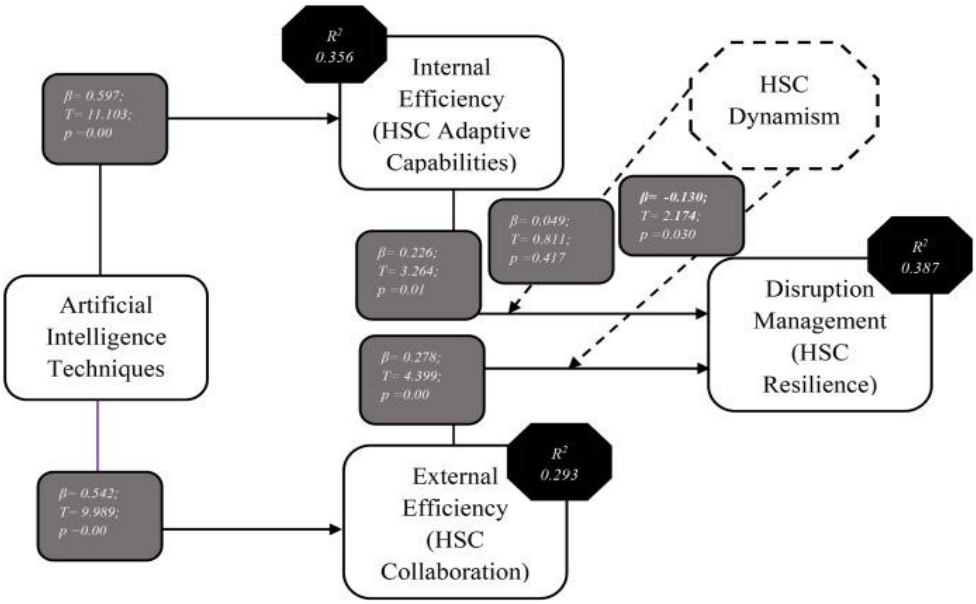
Artificial Neural Networks (ANN, a subset of AI) can help with the COVID-19 problems, and now any other epidemic that comes upon us. ANN's can help by estimating demand of supplies needed by hospitals by examining past sales data, market patterns, and outside variables such as variations in consumer behavior due to the past pandemics we have had. ANN's can help reduce supply chain risk as well, they offer insights to potential hazards and

their influences on product manufacturing processes (11). These plans can be used by upper management to create plans that alleviate supply chain risk.

Within this research journal (15), five hypotheses were tested. These hypotheses were made based on information collected from a large number of businesses, their final sample size was 335 after throwing out the businesses who did not meet selection criteria. Most important to this discussion were Hypothesis 1 (H1) and Hypothesis 2 (H2). H1: "artificial intelligence techniques positively influence the internal efficiency of Healthcare Supply Chain operations". H2: "artificial intelligence techniques positively influence the external efficiency (collaboration) of Healthcare Supply Chain operations".

Looking at H1, they did a study which indicates that the widespread use of artificial intelligence techniques has a substantial positive impact on the internal efficiency of Healthcare Supply Chain operations (15). Internal efficiency is your company's ability to create new processes and its ability to look over old ones to make sure they are going smoothly.

Looking at H2, they found data that suggests that the artificial intelligence techniques' pervasive adoption has a major positive effect on the external efficiency of Healthcare Supply Chain operations (15). External efficiency reflects how well the business is meeting the wants and the needs of customers.



The Influence of Artificial Intelligence Techniques on Disruption Management – (15)

Artificial intelligence can be applied in several OSCM processes, such as order intake, supplier selection, quality control, production planning and control, smart connected products, services and maintenance, transportation, warehouse management, sales processes, and customer interfaces (14). Supply-chain operations reference model (SCOR) is a process reference model for improving supply chain management. There are many benefits of generic and specific artificial intelligence applications in OSCM, all based on the SCOR processes; Plan, Source, Make, Deliver, Return (14). This table shows countless amounts of benefits that can be realized from applying artificial intelligence in Operations and Supply Chain Management

Analysis

Artificial intelligence is apparent in our world now more than ever, growing rapidly each day, all of which started from an idea that aspired back in 1955. Throughout the next many years, artificial intelligence remained silent, until its ramp-up which started in 2012 with the introduction of Industry 4.0. From this point forward artificial intelligence saw critical growth regarding increased attention from supply chain management publishers, until around the time of COVID-19 when everyone and everything took a pause around the world. Through the new attention that artificial intelligence was getting came the introduction of many new forms. Some of the more popular include Artificial Neural Networks (ANN), Evolutionary Algorithms (EA), and Multi-Agent Systems (MAS), each of which helps manage supply chain relationships, efficiency, and resilience. In addition to the new creation of supply chain model algorithms, we also believe that artificial intelligence serves as a better alternative to conventional business analytic tools, seen as Microsoft Office Suite, Oracle, and Tableau. In fact, most of these large analytic tools are integrating artificial intelligence into their own software, showing the impact that artificial intelligence has had on supply chain management tools, used around the world every day. We foresee these more generic data analytics tools to become more obsolete within the industry in the future. Artificial intelligence in the coming years will continue to encourage the use of automated analytics instead of tedious manual processes.

The next key point that we discovered was that artificial intelligence can help mitigate many risks, including large and small risks that may affect the company, environment, or customers negatively. Examples provided in our paper include future climate change risks, along

with the ongoing COVID-19 pandemic. While diving deeper into each of these topics we realized that artificial intelligence comes at extremely high costs. As business majors, the cost constraint came to mind as we analyzed the upfront costs. The cost constraint describes the relationship between costs and benefits, determining that the costs of implementation should not exceed the benefits. Our belief is that artificial intelligence will produce greater rewards, derived from a more efficient supply chain generated through the use of artificial intelligence. In addition to high costs, we found that artificial intelligence needs a lot of robust technology to perform its tasks, along with the challenge of incorporating artificial intelligence through the top-level management structure. Through this point we determined that there aren't many well experienced artificial intelligence users in the economy today. This creates a demand for people of this nature, which also increases the artificial technician labor costs. Our group came into this with an understanding that artificial intelligence stands for "human created intelligence" which explains the need for talented workers within the industry. These are some of the greatest barriers to entry, and by knocking down these walls we believe that supply chain management will better the economy and their company.

Another concern with the use of artificial intelligence that was discussed earlier are the social and ethical issues that have risen. It is no question that individuals in a wide range of industries have questioned whether the increase of artificial intelligence will put their career at risk. It is also important to be mindful whether the usage of artificial intelligence applications is ethical. Artificial intelligence has experienced recent backlash regarding the company Sama as the company been found to undercompensate employees. It will be important moving forward to ensure that the usage and ease of artificial intelligence is not causing further issues to our society. Personally as consumers, we would like to support companies that are ethically utilizing artificial intelligence due to our commitment to social morals. We also have worries that companies will over rely on artificial intelligence, so companies must ensure that they maintain a healthy balance between manual and automated tasks. Overall, we believe that these social and ethical issues are prominent issues and should not be ignored and swept under the rug by the supply chain industry.

We then dove into the recent effects of artificial intelligence during the COVID-19 pandemic. We touched on the concept of inventory shortages during COVID-19, especially in the health care industry, and how artificial intelligence can help mitigate these effects in the future. We also believe that artificial intelligence will be more prone to predicting and forecasting these disastrous events as well. As a result, our entire supply chain, economy, and society will be better prepared. Our group was able to relate directly to these effects through direct secondhand knowledge, as we have multiple family members in the health care industry.

Through interviewing a family member, we learned that during COVID-19 the healthcare industry used artificial intelligence in many ways. The conversation started off with the reiteration of how inflated demand was during this time, which created a need for increased inventory optimization, and delegation. One difference that we saw is that ethics get more involved within the healthcare industry during COVID. This is because hospitals were using artificial intelligence to gather patient information, in which the artificial intelligence software would then rank the patients based on their condition and prior conditions. This could be seen as ranking someone that has cardiovascular disease lower than someone that was healthy prior to getting COVID. Based on the results an ethics committee would then decide where to delegate their resources, since they only had a few resources to begin with. Other uses of artificial intelligence within this industry were the use of computer-generated programs, which sent reminders to the doctor or patient, to ensure that they are getting the right care when needed. Lastly, we learned that artificial intelligence was also used with RFID trackers, which helped with the tracking of the inventory available, these two things also led to hospitals being able to trade certain supplies between each other.

Conclusion

The use of artificial intelligence is forecasted to rise in the coming years, this rise in use is currently making the use of data analytics obsolete for some businesses. They have artificial intelligence programs that can do all of that for them. Artificial intelligence is also helping on the risk mitigation side of the supply chain in the fact that artificial intelligence programs can sense disasters before they happen. Businesses are utilizing these programs on the supply chain to stop bad product from going out, to help line workers complete their jobs faster, and to select

the most cost-efficient suppliers. Although artificial intelligence programs can be timely and expensive, the benefits outweigh the shortfalls for some businesses. Chat GPT and GPT-4 is helping close some of these barriers and gaps by making artificial intelligence accessible to all people instead of a select few engineers. Artificial intelligence is helping with COVID-19 research as well as helping to mitigate risks on the supply chain that were caused by the COVID-19 pandemic, the disruptions caused will help to make sure those same disruptions do not happen again. Overall, artificial intelligence is projected to maintain its growth in the supply chain industry in the coming years.