Using Artificial Intelligence to Improve Logistic Supply Chains in Air Transport

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إستخدام الذكاء الإصطناعي لتحسين سلاسل الإمداد في النقل الجوي

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ABSTRACT

This study seeks to evaluate the influence of artificial intelligence on the enhancement of logistics supply chains in air significant by investigating the contributions of automation,

blockchain, machine learning, and cloud computing to operational efficiency, inventory management, demand forecasting, and risk management.

The research used a descriptive analytical methodology, using both primary and secondary data. Statistical analytic techniques were used to evaluate the impact of artificial intelligence on logistics supply chains in Sector air significant. The research focused on experts within the sector air significant sector, including airline operators, logistics managers, and scholars in artificial intelligence and logistics.

The findings indicated a significant effect of artificial intelligence on the enhancement of logistics supply chains, with automation markedly increasing operational efficiency, blockchain optimizing inventory management, machine learning facilitating demand forecasting, and cloud computing bolstering risk management. The research advocates for investment in artificial intelligence technology, the implementation of ongoing training programs for staff, and the promotion of inter-company cooperation to exchange expertise on AI applications.

Keywords: Artificial intelligence, logistics supply chains, air significant, automation, blockchain, machine learning, cloud computing.

المستخلص:

تسعى هذه الدراسة إلى تقييم تأثير الذكاء الاصطناعي على تعزيز سلاسل التوريد اللوجستية في النقل الجوي من خلال التحقيق في مساهمات الأتمتة والبلوك تشين والتعلم الآلي والحوسبة السحابية في الكفاءة التشغيلية وإدارة المخزون والتنبؤ بالطلب وإدارة المخاطر.

استخدم البحث منهجية تحليلية وصفية، باستخدام البيانات الأولية والثانوية. تم استخدام تقنيات التحليل الإحصائي لتقييم تأثير الذكاء الاصطناعي على سلاسل التوريد اللوجستية في النقل الجوي. ركز البحث على الخبراء في صناعة النقل الجوي، بما في ذلك مشغلي الخطوط الجوية ومديري الخدمات اللوجستية والعلماء في مجال الذكاء الاصطناعي والخدمات اللوجستية.

أشارت النتائج إلى تأثير بارز للذكاء الاصطناعي على تعزيز سلاسل التوريد اللوجستية، مع زيادة الأتمتة بشكل ملحوظ في الكفاءة التشغيلية، وتحسين إدارة المخزون بالبلوك تشين، وتسهيل التعلم الآلي للتنبؤ بالطلب، وتعزيز الحوسبة السحابية لإدارة المخاطر. يدعو إلى الاستثمار في تكنولوجيا الذكاء الاصطناعي، وتنفيذ برامج تدريبية مستمرة للموظفين، وتعزيز التعاون بين الشركات لتبادل الخبرات في تطبيقات الذكاء الاصطناعي.

الكلمات المفتاحية: الذكاء الاصطناعي، سلاسل التوريد اللوجستية، النقل الجوي، الأتمتة، البلوك تشين، التعلم الآلي، الحوسبة السحابية

1- Introduction:

In an increasingly integrated world, supply chains and logistics form the basis of worldwide commerce, allowing constant flow of goods and services between continents. Notwithstanding their basic purpose, these networks face persistent and growing problems including inefficiencies, mounting expenses, and vulnerability to disruptions from geopolic wars, pandemics, and natural disasters. Particularly sensitive to these limitations is the sector air significantation sector, which depends much on time-sensitive activities. Rising running costs and strict regulations worldwide aggravate the problem and emphasize the need for innovative ideas. Rising as a possible answer able to solve these challenges and revolutionize logistics management is artificial intelligence (AI Chen et al., 2024).

On a regional basis, the Middle East and North Africa (MENA) area shows both possibilities and difficulties in logistics and air significantation. The area offers great opportunities for economic growth given its special position at the junction of Europe, Asia, and Africa. Still, the actual realization of this promise is sometimes hampered by infrastructure limitations, logistical inefficiencies, and slow rate of technological adoption. Recent research highlights the revolutionary possibilities of artificial intelligence in

overcoming these challenges by means of process simplification, resource maximization, and resilience building (Belhadi et al., 2021).

Egypt, a major player in the MENA area, has many opportunities but also reflects various problems. Trade, travel, and even general economic development depend on the sector air significantation sector. Its growth has been hampered, though, by inefficiencies in logistics, rising gasoline prices, and poor technological integration. By incorporating artificial intelligence technology into logistical supply chains, Egypt may be able to tackle pressing sustainability concerns, enabling real-time decision-making, improve resource use, and therefore generate significant efficiency (Bag et al., 2021).

Examining Egypt's air significantation sector as an illustration of the revolutionary power of artificial intelligence, this paper Essential to the economy of the country, the sector faces complex problems including changing demand patterns, high running expenses, and growing environmental concerns. Using AI technologies such predictive analytics, automation, and decision-support systems offers a convincing way to solve these issues and improve resilience, sustainability, and efficiency while also increasing (Raafat, et al., 2021).

Three connected factors—— artificial intelligence, logistics supply chain effectiveness, and sustainability——are under investigation in this paper. By optimizing efficiency, reducing costs, and thereby minimizing risks, artificial intelligence functions as the catalyst improving supply chain performance. By enabling ecologically conscious behavior like fuel consumption optimization and emissions reduction, artificial intelligence can concurrently promote sustainability (Sarkar et al., 2021). The linked elements underline the major impact artificial intelligence might have on changing logistics processes.

The sector air significantation sector finds great relevance for these factors, so they justify their selection. Directly influencing reliability and competitiveness, the performance of logistics supply chains is basic for operational success. Concurrently with this, sustainability addresses growing global concerns about the environmental effects of airline travel. Reflecting global trends in innovation and resilience, AI links these sectors and offers a coherent approach that harmonizes operational objectives with sustainability needs,

therefore harmonizing operational objectives with sustainability requirements (Ahmed & El-Kodasy, 2023).

Egypt's air significantation sector was chosen because of its strategic importance and possibilities for development based on creativity. Ready for a technological revolution, the sector—identified as a regional powerhouse with great untapped potential. Examining the impact of artificial intelligence on logistics operations finds the ideal setting in the unique mix of challenges and opportunities. This study focuses on this sector to provide useful information for Egypt and increase global knowledge of the use of artificial intelligence in logistics improvement (Ibrahim & Youssef, 2024).

2- literature Review.

2.1- Artificial Intelligence:

Concept of Artificial Intelligence.

The fast-developing subject of computer science known as artificial intelligence (AI) is concerned with building machines that can carry out tasks that have historically needed human intelligence. These activities include natural language processing, pattern detection, decision-making, and problem-solving. Its capacity to evaluate enormous volumes of data, learn from it, and make predictions or judgments without explicit programming forms the basis of artificial intelligence. Because AI can automate complicated operations, it is being used in a variety of industries, including human resource management, logistics, and healthcare (Johnson & Tan, 2022). According to Allal-Chérif et al. (2021), artificial intelligence (AI) is especially changing corporate processes like procurement, where automation and predictive analytics are increasing productivity and decreasing errors.

AI is essential to the logistics sector for streamlining supply chains and increasing operational effectiveness. AI systems are useful instruments for managing intricate supply chain networks because they can forecast demand, optimize delivery routes, and save operating costs. By optimizing routes to save carbon emissions while guaranteeing on-time delivery, Chen et al. (2024) demonstrate how AI may strike a compromise between environmental objectives and operational effectiveness. Building resilient supply chains that

can adjust to unforeseen obstacles, such natural disasters or global pandemics, requires AI's capacity to anticipate disruptions and identify potential hazards, as highlighted by Belhadi et al. (2021). In addition to improving corporate performance, these skills show how AI may improve resilience and sustainability.

Beyond logistics, AI's applications extend to various sectors, including healthcare and agriculture. Damoah et al. (2021) demonstrate how AI-powered drones are improving the efficiency and sustainability of the healthcare supply chain, particularly in delivering medical supplies to remote areas. Similarly, AI is driving sustainable practices in agriculture, as explored by Di Vaio et al. (2020), by optimizing production processes and improving food safety. AI's ability to analyze large datasets and provide actionable insights is transforming how organizations operate and respond to challenges, enhancing both operational efficiency and resilience. As AI continues to evolve, its integration into diverse industries will foster further innovation and improvements across various sectors.

AI Advantages in Supply Chain

AI offers significant benefits in supply chain management by improving decision-making and operational efficiency. AI excels at analyzing large data sets, forecasting demand, predicting disruptions, and automating processes, thereby reducing human error and enhancing performance. According to Russell and Norvig (2016), AI's ability to learn from data and make informed decisions allows supply chain operations to become more efficient and responsive. Mustafa (2020) asserts that AI applications in supply chains, such as predictive analytics and automation, help companies streamline their planning, improve inventory management, and enhance customer service, ultimately reducing costs and improving overall performance. Additionally, AI enhances the resilience and sustainability of supply chains by enabling companies to anticipate and mitigate potential risks. Chen et al. (2024) highlight how AI can improve logistics to balance operational efficiency and sustainability, such as reducing carbon emissions while ensuring timely delivery. AI's ability to predict disruptions and recommend proactive measures helps maintain smooth operations even during unexpected events. Damoah et al. (2021) illustrates how AI-powered

technologies such as medical drones are enhancing supply chain efficiency in the healthcare sector, ensuring timely delivery of critical supplies while supporting sustainability. These developments demonstrate the potential of AI to improve not only the operational aspects of supply chains but also their ability to adapt to changing conditions and contribute to sustainable business practices.

Most Used Artificial Intelligence Tools in Logistic Supply Chains

AI has revolutionized the supply chain management and logistics sector with various tools that enhance efficiency, improve decision-making, and improve sustainability. One of the most widely used AI tools is machine learning, which allows systems to learn from historical data and improve over time. As Russell and Norvig (2016) note, machine learning algorithms are crucial in forecasting demand, optimizing delivery routes, reducing delays, and ensuring that logistics operations run smoothly. Machine learning models can also help with inventory management and trend analysis to predict future needs and reduce the risk of stockouts or overstocking (Mustafa, 2020). These capabilities enable supply chain managers to make data-driven decisions that enhance overall operational efficiency. Another important AI tool in logistics is robotic process automation (RPA), which automates repetitive tasks such as sorting, packing, and inventory tracking. RPA systems reduce human error and increase operational speed, especially in warehouse management. Davidi (2024) highlights the increasing use of RPA in logistics, helping companies streamline workflows and reduce manual labor. Additionally, AI-powered optimization algorithms, as discussed by Chen et al. (2024), are being used to enhance route planning by evaluating factors such as cost, efficiency, and sustainability. These tools are essential for balancing operational efficiency with environmental goals, such as reducing emissions. AI-powered drones, as highlighted by Damoah et al. (2021), are also becoming increasingly important for delivering goods, especially in remote areas, thereby improving logistics efficiency while supporting sustainability initiatives.

Importance of Logistic Supply Chains Management (SCM).

Supply chain management and logistics are essential to a company's success, particularly in light of international trade and the growing need for efficiency. The capacity of logistics to optimize the flow of goods and services is what makes it so important; it guarantees that items reach customers in a timely and economical manner. In order to increase the operational efficiency of SMEs in Romania and support their competitiveness and expansion, Kherbach and Mocan (2016) contend that logistics is essential. Businesses may maximize inventory, cut expenses, and enhance customer satisfaction—all of which are critical components of long-term success—by efficiently managing supply chains. The effectiveness of logistics operations is especially crucial in sectors like e-commerce, healthcare, and food manufacturing where prompt delivery is crucial. In addition, the role the role that supply chains and logistics play in boosting resilience has grown, particularly in the face of global upheavals. The increasing demand for robust supply chains that can swiftly adjust to unforeseen difficulties, like pandemics, natural disasters, or changes in the economy, is highlighted by Belhadi et al. (2021). Supply chain decision-making may be improved, risks can be reduced, and any disruptions can be anticipated by logistics systems that are effectively integrated with cutting-edge technology, including artificial intelligence. Gupta et al. (2021) describe how AI-based solutions increase supply chains' resilience by facilitating real-time data analysis and proactive reactions to interruptions. This resilience is especially crucial for sectors like agriculture, where the capacity to adjust to shifts in supply and demand is critical. In 2020, Di Vaio et al. investigate According to Gupta et al. (2021), AI-based technologies increase supply chains' resilience by facilitating real-time data analysis and prompt disruption responses. For sectors like agriculture, where the capacity to adjust to shifts in supply and demand is crucial, this resilience is especially important. Di Vaio et al. (2020) investigate how AI applications in the agri-food sector might guarantee supply chain sustainability and boost productivity, giving the sector a tactical edge in times of crisis. To put it briefly, supply chain management and logistics are essential to company performance because they promote sustainability, resilience, and efficiency across industries.

Enhancing the Efficiency of Logistics and Significantation Services Using Artificial Intelligence

AI is increasingly being used to improve the efficiency of logistics and significantation by optimizing various processes and automating routine tasks. One of the main ways AI can improve logistics is through predictive analytics and real-time data analysis. According to Fang et al. (2023), AI applications enable logistics companies to forecast demand, predict potential delays, and optimize routes in real time, resulting in faster deliveries and reduced operational costs. By analyzing historical data, AI systems can identify patterns that help in making better decisions, allowing companies to adjust their supply chains proactively rather than reactively. In significantation, AI algorithms help in route optimization by assessing traffic conditions, weather patterns, and other variables to determine the most efficient routes, ensuring timely deliveries and reducing fuel consumption. Furthermore, AI enhances communication and operational efficiency in logistics and significantation systems. Miran et al. (2024) highlight that AI-powered communication tools are revolutionizing how logistics companies interact with their customers and manage operations. Natural language processing (NLP) and AI-powered chatbots enable seamless communication between suppliers, distributors, and customers, improving responsiveness and customer satisfaction. Additionally, AI enables automated vehicle management systems, where self-driving vehicles or drones can be used for significantation and delivery, enhancing efficiency and reducing human intervention. These developments help reduce human error, speed up processes, and ensure that goods are significanted in a more streamlined and environmentally friendly manner. The integration of AI into logistics and significantation systems not only improves operational performance, but also supports sustainability by reducing resource use and emissions. The role of AI in logistics and significantation is particularly evident in adapting to the challenges posed by unforeseen circumstances, such as pandemics or natural disasters. Stošić Mihajlović and Trajković (2020) discuss how the logistics sector has leveraged AI during the COVID-19 pandemic to keep supply chains running despite global disruptions. AI's ability to quickly adapt to changing conditions, predict supply shortages, and optimize the

movement of essential goods has proven to be crucial in such situations. This adaptability ensures that logistics operations remain efficient and resilient, even in times of crisis. With these AI-powered solutions, logistics companies can improve operational efficiency in the short term and sustainability in the long term, making AI an indispensable tool in the modernization of logistics and significantation.

Challenges in the Smart Logistics Field Using Artificial Intelligence:

1. **Privacy and Security Concerns:** Data collection and processing are among the biggest challenges in AI applications, as AI in the significantation sector relies heavily on large datasets containing sensitive information such as locations, traffic conditions, and vehicle or aircraft movements. Protecting this data from breaches and leaks is crucial. AI-powered companies must comply with data protection regulations like the General Data Protection Regulation (GDPR) to ensure privacy and data security (Smith & Kumar, 2021).

2. **Updating Legacy Systems and Technologies:** Many significantation and logistics companies continue to rely on legacy systems and technologies that do not effectively support AI integration. Updating these systems can be costly and time-consuming, and challenges may arise when trying to integrate new AI-powered technologies with older systems. These upfront costs can affect the financial viability of small or medium-sized logistics companies (Nguyen & Patel, 2020).

3. **Transition Costs and Learning Curve**: Implementing AI requires significant investment in new technologies and employee training. These transitions can be expensive, and there is a steep learning curve for employees who must acquire new skills to work with intelligent systems. Additionally, it may take some time before these AI systems become fully optimized and effective (Garcia & Sharma, 2021).

4. **Impact of Automation on Human Jobs:** As AI and automation increase in the significantation sector, there is a clear threat of technology replacing certain human jobs. Tasks that require manual labor or repetitive work, such as operating trucks or aircraft, may be automated. This creates social and economic challenges as workers will need to learn new skills to adapt to the changing job landscape in this evolving sector (Williams & Thompson, 2022).

5. **Preparing for Future Technologies and Integration with Other Tech:** AI technologies are advancing rapidly, and companies need to be prepared to adopt emerging technologies such as **blockchain** and **5G**, which may require significant infrastructure changes. Integrating AI with these new technologies could unlock significant performance improvements, but it also presents challenges related to system compatibility and high adaptation costs(Chowdhury & Lee, 2023).

6. **Change Management and Adapting to a Changing Environment:** As AI technologies evolve within the sector, employees will need to adapt to the constant changes in tools and processes. This requires a cultural shift within companies to encourage innovation and continuous learning. The sector is likely to see rapid changes in the work environment, and companies must be able to respond flexibly to ensure continued success and sustainability (Davis & Davis, 2023).

Applications of AI in Logistics

- **Demand Forecasting and Inventory Management**

AI technologies, such as predictive analytics and machine learning, enable logistics companies to forecast demand accurately. By analyzing historical data, Artificial Intelligence can predict seasonal fluctuations and changes in consumer behavior, optimizing inventory levels to avoid overstocking or stockouts. This enhances efficiency in inventory management and helps reduce operational costs (Fang et al., 2023).

- **Route Optimization and Traffic Prediction**

AI-powered algorithms optimize significantation routes by analyzing real-time traffic data, weather conditions, and other relevant factors. This ensures timely deliveries, reduces fuel consumption, and minimizes delays. AI helps logistics companies make data-driven decisions, improving operational efficiency and sustainability in the supply chain (Miran et al., 2024).

- **Autonomous Vehicles and Drones**

AI is increasingly integrated into autonomous vehicles and drones used in logistics, improving efficiency in last-mile delivery. AI enables these technologies to navigate roads,

avoid obstacles, and make real-time decisions, reducing human intervention and operational costs. Autonomous systems also help with faster deliveries and reduce the environmental impact by optimizing routes (Miran et al., 2024).

- **Communication Enhancement with NLP and Chatbots**

AI-powered communication tools, such as natural language processing (NLP) and chatbots, enhance real-time interactions between customers, suppliers, and logistics providers. These tools automate customer service tasks, provide immediate responses to inquiries, and streamline communication across the supply chain, improving overall customer satisfaction (Miran et al., 2024).

- **Blockchain Integration for Transparency and Traceability**

AI integrated with blockchain technology helps ensure greater transparency and traceability in logistics. By automating data collection and analysis on blockchain platforms, AI enables real-time tracking of goods, reducing the risk of fraud and ensuring the authenticity of transactions. This combination enhances trust and security in logistics operations (Govindan et al., 2024).

- **E-commerce Logistics Optimization**

Artificial Intelligence plays a critical role in enhancing e-commerce logistics by optimizing warehouse management, inventory tracking, and last-mile delivery. AI-driven algorithms help e-commerce companies process orders faster, manage inventories more efficiently, and ensure timely deliveries to meet growing consumer demands (Malhotra & Kharub, 2024).

AI in the Significantation and Logistics Sector

AI is increasingly playing a pivotal role in enhancing efficiency within the significantation and logistics sector. According to Miran et al. (2024), AI-driven communication tools, such as natural language processing (NLP) systems and chatbots, are transforming how logistics companies interact with customers, suppliers, and other stakeholders. These tools facilitate real-time, automated communication, breaking down language barriers, providing immediate responses to customer queries, and streamlining

information exchange across the supply chain. As a result, AI contributes to faster decision-making, reduced human errors, and a significant improvement in customer satisfaction, which is essential for ensuring smooth logistics operations.

In addition to improving communication, AI is critical in optimizing logistical processes and decision-making. Fang et al. (2023) emphasize how Artificial Intelligence technologies like predictive analytics and machine learning help logistics companies forecast demand, optimize inventory management, and determine the most efficient significantation routes. By analyzing large volumes of data, AI enables companies to anticipate fluctuations in demand, optimize supply chain operations, and enhance route planning to minimize delays and fuel consumption. This not only improves delivery times and reduces operational costs but also helps companies better manage potential disruptions, leading to more resilient and responsive logistics systems. Ultimately, AI's ability to optimize both communication and operational workflows is transforming the significantation and logistics sector, driving greater efficiency and enhancing service delivery.

3- Previous Studies

The following table shows previous studies related Inward research topic:

Study	Objectives	Methodology	Results
Farahbod et al. (2024)	To examine AI's impact on supply chains and logistics, focusing on disparities across industries with varying capital intensities.	Conducted a ten-item survey among supply chain managers in aerospace, retail, hospitality, and significantation industries.	The results showed that AI significantly impacts capital-intensive industries like aerospace more than labor-intensive ones such as hospitality. Highlighted managers' awareness of AI's transformative potential and its implications for resource allocation and investment, aligning with the role of AI in improving supply chain performance.
Dwivedi (2024)	To explore SCM and logistics post-COVID-19, emphasizing challenges and the role of advanced technologies like AI.	Analysis of challenges in inventory management, demand forecasting, significantation efficiency, and sustainability; examined the role of AI, IoT, and automation.	Identified key challenges in maintaining inventory levels, optimizing significantation, and achieving sustainability. Highlighted AI's role in enhancing operational efficiency, reducing costs, and improving customer satisfaction, which aligns with the study's focus on AI's impact on logistics performance

Study	Objectives	Methodology	Results
			and sustainability.
Richey et al. (2023)	To address the research gap on AI's role in logistics, including its benefits and challenges such as ethical concerns and operational difficulties.	Provided a comprehensive analysis of AI tools, ethical considerations, and strategies for implementing AI in logistics.	Concluded that AI enhances data processing, storage optimization, and operational efficiency but presents challenges like worker retraining and ethical concerns. Provided a roadmap for structured research and practical implementation strategies, which relate to the current study's aim of exploring AI's transformative potential in logistics operations.
Belhadi et al. (2021)	To investigate AI's role in building resilient supply chains and propose a decision-making framework for its application.	Developed a framework using AI-based techniques like fuzzy systems, Wavelet Neural Networks, and EDAS. Collected data from 479 manufacturing companies to analyze impactful AI applications in supply chain resilience strategies.	Found that AI tools like fuzzy logic and machine learning are highly effective in enhancing supply chain resilience. This supports the current study's focus on AI's role in improving logistics performance and addressing operational challenges, especially in dynamic environments like air significantation.
Boute & Udenio (2021)	To explore AI's opportunities in logistics and supply chain management and its role in decision-making and workflow automation.	Analyzed data from digital logistics applications and IoT technologies to assess AI's impact on decision-making and integration of supply chain operations.	Concluded that AI enhances decision-making efficiency and strengthens integration in logistics, supporting the idea that AI augments human capabilities rather than replacing them. This finding aligns with the study's emphasis on leveraging AI to enhance efficiency and integration in Egypt's air significantation logistics sector.

Source: Prepared by the researcher based on previous studies.

Previous studies collectively highlight the transformative potential of Artificial Intelligence (AI) in logistics and supply chain management, with varying focuses and applications, these studies collectively reveal a gap in localized research tailored to the unique challenges and opportunities within developing regions like Egypt, underscoring the need for focused studies to unlock AI's full potential in the Egyptian air significantation sector.

4- Research Gap:

The research gap emphasizes Egypt's air significantation significant sector poor relationship between variables:

- AI is not being used to improve air significant sector logistical operations.
- Inadequate link between modern technology such as AI and environmental policies.
- Inadequate coordination between management and technical elements to maximize operational effectiveness
- A dearth of research catered to the difficulties and possibilities in Egypt's air travel sector.

5- Research Problem & questions.

The existing literature reveals a significant gap in understanding how AI can be applied to improve logistics and supply chain management in the sector air significantation sector, particularly in developing regions such as Egypt. While AI has been shown to enhance logistics performance in other sectors and more advanced regions, there is limited research on its potential to address the unique challenges faced by Egypt's air significantation sector.

This research claims that the weak linkage between AI and logistics performance is evident within the sector air significantation sector in Egypt. Despite global advancements in AI applications, the integration of these technologies into the Egyptian air significant logistics remains underdeveloped, which hinders operational efficiency and competitiveness.

Secondary data collected from various sources reveals several challenges that impact the sector air significantation sector in Egypt (Abdel Wahab, 2023). These include storage space deficiencies, particularly at Cairo International Airport, which struggles with a shortage of cargo storage areas and outdated refrigerated facilities, directly affecting logistics performance. Additionally, there is a lack of expertise among personnel in cargo handling, unloading, and significantation, which reduces operational efficiency. The sector also faces a significant need for infrastructure development, requiring substantial investment in airports and logistics facilities to enhance competitiveness. Administrative challenges, such as the need for market restructuring and empowering private logistics companies, hinder EgyptAir's and the broader sector's efficiency. Environmental challenges, including the adoption of

sustainable practices to reduce carbon emissions, also remain critical. The logistics supply chains in air significantation are essential for ensuring operational efficiency, reducing costs, and improving service quality. However, issues such as poor operational efficiency, inventory management difficulties, inaccurate demand forecasting, and risks related to cargo movement persist. The International Air Significant Association (IATA, 2023) researchs that over 30% of air significant companies struggle with cargo handling, storage, and distribution. Demand forecasting remains inaccurate in 25% of cases, leading to further inefficiencies. Additionally, cybersecurity risks and market fluctuations exacerbate challenges. AI, through technologies like automation, blockchain, and machine learning, offers promising solutions to improve operational efficiency, inventory management, demand forecasting, and risk mitigation, with studies showing a 20-30% improvement in operational performance when AI is integrated.

Min question "How can artificial intelligence be used to improve logistics supply chains in air significant"?

Sub-research Questions:

- How does the use of automation affect the improvement of operational efficiency in logistics supply chains in air significant?
- How does the use of blockchain contribute to improving inventory management within logistics supply chains in air significant?
- How can machine learning techniques improve demand forecasting in logistics supply chains in air significant?
- What is the role of cloud computing in risk management within logistics supply chains in air significant?

7- Research Objectives:

To analyze the use of artificial intelligence in improving logistics supply chains in air significant. To achieve this, the following sub-objectives must be accomplished:

- To study the role of automation in improving operational efficiency in logistics supply chains in air significant.
- To evaluate the role of blockchain in inventory management within logistics supply chains in air significant.
- To analyze the role of machine learning in improving demand forecasting in logistics supply chains in air significant.
- To explore the role of cloud computing in risk management within logistics supply chains in air significant.

8- Research Model

The following shows the general framework for the study variables:

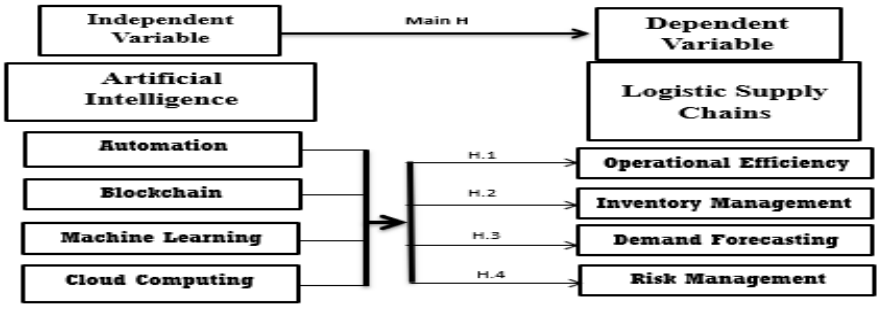

Figure No. (1): Study Framework.

Source: Prepared by the researcher

9- Hypotheses

Main Hypothesis: "There is a statistically significant relationship between the use of artificial intelligence and the improvement of logistics supply chains in air signification." This main hypothesis is divided into four hypotheses as follows:

H1 There is a statistically significant effect of Using Artificial Intelligence on Operational Efficiency in Air Significant.

H2 There is a statistically significant effect of Using Artificial Intelligence on Inventory Management in Air Significant.

H3 There is a statistically significant effect of Using Artificial Intelligence on Demand Forecasting in Air Significant.

10- Methodology:

The methodology employed in investigating the role of (AI) in logistics and signification systems typically involves both qualitative and quantitative approaches to explore its impact on operational efficiency and communication. According to Miran et al. (2024), a mixed-methods approach is often adopted to comprehensively analyze AI's role in enhancing logistics processes. This may include case studies, surveys, and interviews with logistics professionals, as well as data analysis through Artificial Intelligence tools such as machine learning models or optimization algorithms. These methods help to gather both subjective insights from sector experts and objective data on AI's effectiveness in improving communication, streamlining processes, and automating tasks in the logistics sector. By using real-time data, (AI) systems can be tested in simulated environments to evaluate their performance across different scenarios, providing insights into the potential improvements in operational efficiency and communication systems.

In addition to qualitative and case-based research, a significant part of the methodology also involves empirical testing of (AI) applications in logistics through controlled experiments and data-driven analysis. Fang et al. (2023) highlights the importance of integrating (AI) technologies like predictive analytics, machine learning, and route optimization models into supply chain management processes. Their methodology focuses on evaluating the impact of these (AI) tools on logistics operations through simulations and testing within real-world settings. This involves collecting and analyzing data on key performance indicators (KPIs) such as delivery time, fuel consumption, and customer satisfaction before and after the implementation of (AI) technologies. The findings from these empirical tests provide a comprehensive understanding of how (AI) can optimize supply chain processes, enhance demand forecasting, and improve overall operational efficiency. By combining both theoretical frameworks and empirical testing, these methodologies allow for a holistic evaluation of AI's transformative role in logistics and signification

10.1- Population and Sample Size:

The population for this study consists of employees in administrative positions within the sector air significant sector, with a total number of approximately 20,324 individuals in 2023. The purpose of this study is to explore the impact of using (AI) on logistic supply chains in air significant, focusing on this specific group of employees.

The sample size for this study was determined using the statistical tables provided by Krejcie & Morgan (1970), with a margin of error of 0.05 and a confidence level of 95%. According to these tables, for a population of 378 Employees in Air Significant, the appropriate sample size was calculated to ensure the results' accuracy and reliability within the specified statistical limits.

10.2- Data Collection Procedure

The following types of data were used to achieve this approach from the following sources:

- **Secondary Data:**

This data was utilized to build the theoretical framework of the study. It relied on various references, including books, articles, and previous academic theses, as well as published research relevant to the topics of Artificial Intelligence and Logistic Supply Chains. The secondary data was crucial for identifying the theoretical background and providing context for the study.

- **Primary Data:**

This data was collected through a field survey conducted to test the validity of the study's assumptions. The data was gathered directly from employees in the sector air significant sector, serving as the basis for analysis and further investigation.

11- Descriptive Statistics:

11.1- Descriptive Statistics of AI:

The following Table no. 1 presents the descriptive statistics for the variable "Using Artificial Intelligence" in the context of air logistics operations.

Table (1): Descriptive Statistics for Using Artificial Intelligence Variable.

N	Items	Mean	S.D.	Ranking
1	Automation powered by AI enhances your efficiency in cargo handling and processing.	4.08	0.81	1
2	Automated systems help you reduce delays in air freight logistics.	3.96	0.80	2
3	AI-based automation minimizes the likelihood of scheduling or operational errors in your work.	3.61	0.73	5
4	Automation improves the timeliness of deliveries you manage.	3.79	0.74	3
5	Automation in logistics improves the quality of service you deliver to customers.	3.68	0.83	4
Automation		**3.82**	**0.78**	**first**
1	Blockchain technology ensures secure documentation of air cargo transactions you handle.	3.72	0.77	3
2	Blockchain reduces discrepancies in the logistics data you share with other stakeholders.	3.62	0.41	5
3	Blockchain enhances trust and collaboration in the supply chains you work with.	4.02	0.94	1
4	Blockchain improves your ability to trace goods in air logistics.	3.68	0.83	4
5	Blockchain systems prevent fraud and mismanagement in the logistics operations you oversee.	3.88	0.88	2
Blockchain		**3.78**	**0.76**	**second**
1	Machine learning models accurately predict demand for air logistics services you manage.	3.42	0.72	3
2	Predictive analytics optimize air cargo route planning in your operations.	3.59	0.71	1
3	Machine learning helps you identify potential risks in the logistics supply chain.	3.21	0.97	5
4	Predictive tools enhance your ability to allocate resources effectively in freight operations.	3.57	0.88	2
5	Machine learning improves the decisions you make in logistics management.	3.35	0.79	4
Machine Learning		**3.42**	**0.81**	**third**
1	Cloud platforms enable real-time tracking of air cargo movements in your operations.	3.32	0.664	3
2	Cloud computing makes it easier for you to share logistics data with stakeholders.	3.65	0.735	1
3	AI-driven cloud systems improve the reliability of logistics operations you manage.	3.21	0.642	4
4	Cloud computing enhances coordination with other supply chain partners you collaborate with.	3.19	0.638	5
5	Cloud technologies enable you to make more informed, data-driven decisions in logistics.	3.56	0.712	2
Cloud Computing		**3.68**	**0.677**	**Fourth**
Overall Indicators		**3.67**	**0.78**	

Table no. 1 shows descriptive data on the use of AI in air logistics across four important categories: automation, blockchain, machine learning, and cloud computing. Automation scored highest (3.82), indicating its importance in increasing cargo handling efficiency, delays, and service quality. It is followed by blockchain (3.78), which improves trust, fraud prevention, and

traceability. Machine learning (3.42) and cloud computing (3.68) were also valued but scored lower, while enhancing predictive analytics and real-time tracking of logistics services. Conclusion: Key AI technologies, namely automation and blockchain, are driving performance. Air logistics applications for machine learning and cloud computing need further research.

11.2- Descriptive Statistics of L.S.C:

The dimensions of the dependent variable (achievement of logistics supply chains) were evaluated to determine their availability. These dimensions were subsequently ranked according to their importance from the viewpoint of the study participants, as follows:

Table (2): Descriptive Statistics for Logistic Supply Chains Variable.

N	Items	Mean	S.D.	Ranking
1	Streamlined processes enhance the efficiency of air cargo operations you manage.	3.62	0.76	2
2	Automation helps you minimize delays in air significant logistics.	3.49	0.73	4
3	Efficient resource allocation optimizes the logistics operations you oversee.	3.41	0.84	5
4	Technology enables you to reduce turnaround times in air cargo handling.	3.56	0.86	3
5	Advanced systems allow you to minimize waste in logistics processes your control.	3.71	0.80	1
Operational Efficiency		**3.55**	**0.79**	**Third**
1	Real-time inventory tracking improves the stock management in your air logistics operations.	3.81	0.82	1
2	Automated tools help you address overstocking and understocking in your supply chain.	3.79	0.77	2
3	Inventory turnover rates are enhanced in the operations you manage.	3.72	0.93	3
4	Storage utilization is optimized in the sector air freight systems you oversee.	3.61	0.71	5
5	Inventory levels align with demand fluctuations in your air cargo operations.	3.68	0.64	4
Inventory Management		**3.72**	**0.77**	**Second**
1	Accurate forecasting tools help you predict air cargo demand effectively.	3.88	0.80	1
2	Forecasting techniques align logistics capacity with the sector air cargo volumes you anticipate.	3.81	0.72	2
3	Advanced analytics allow you to respond to market fluctuations in your operations.	3.60	0.95	5

N	Items	Mean	S.D.	Ranking
4	Demand forecasting supports the planning for peak air cargo periods you manage.	3.72	0.75	3
5	Predictive analytics improve your strategic decision-making in air significant logistics.	3.67	0.87	4
Demand Forecasting		**3.73**	**0.81**	**First**
1	Risk assessment tools enable you to identify and mitigate potential disruptions.	3.41	0.682	4
2	Contingency planning minimizes operational risks in the logistics systems you manage.	3.35	0.67	5
3	Enhanced security measures reduce theft or damage in your cargo operations.	3.68	0.736	3
4	Effective risk management helps you minimize financial losses in logistics.	3.76	0.752	2
5	Compliance measures ensure regulatory risks are addressed in your air significant operations.	3.81	0.762	1
Risk Management		**3.602**	**0.720**	**Fourth**
Overall Indicators		**3.66**	**0.79**	

Table No.2 presents descriptive statistics for the "logistics supply chains" variable in air significant operations, which includes four main categories: operational efficiency, inventory management, demand forecasting, and risk management. Among these categories, demand forecasting received the highest average score (3.73), indicating its critical role in improving decision-making and aligning logistics capacity with expected shipment volumes. Inventory management followed closely (3.72), with real-time tracking and automated tools playing a key role in improving inventory management. Operational efficiency (3.55) and risk management (3.60) ranked third and fourth, with advanced systems, effective forecasting, and risk mitigation strategies contributing to their importance in air logistics. Overall, the results highlight the importance of demand forecasting and inventory management in enhancing logistics performance, while operational efficiency and risk management remain essential but have a slightly lower impact.

12- Test the Hypotheses of the Study:

The hypotheses of the study will be tested by analyzing the relationship between different variables and the use of AI technologies in logistics supply chains. The following main hypothesis will be evaluated:

"There is a Statistically impact of Using Artificial Intelligence on Logistic Supply Chains in Air Significant". This main hypothesis is divided into four : Sub-hypotheses as follows:

12.1- The First Hypothesis:

States that: "There is a statistically significant effect of Using Artificial Intelligence on Operational Efficiency in Air Significant."

Table No. (3): Results of a regression analysis of the effect of Using Artificial Intelligence on Operational Efficiency.

N	Dimensions	(R^2)	(F)	Coef (β)	(T)	p-value
1-	**Automation.**	0.247	101.90	0.419	10.095	0.000
2-	**Blockchain.**	0.210	82.60	0.434	9.089	0.000
3-	**Machine Learning.**	0.229	92.15	0.503	9.599	0.000
4-	**Cloud Computing**	0.226	88.26	0.465	9.256	0.000
	Total	**0.333**	**155.11**	**0.654**	**12.45**	**0.000**

Statistical significance at level (0.01).

Source: Prepared by the researcher based on the outputs of the SPSS program.

Operational efficiency in air significant logistics and the application of artificial intelligence (AI) are significantly positively correlated, according to the regression analysis results in Table (3). All four aspects of AI—automation, blockchain, machine learning, and cloud computing—have significant contributions, and statistical significance is indicated by p-values of 0.000. Blockchain and machine learning account for 21% and 22.9% of the variation in operational efficiency, respectively, whereas automation has a coefficient of 0.419, explaining 24.7% of the variance. The variance is explained by cloud computing in 22.6% of cases. AI technologies together account for 33.3% of the variation in operational efficiency, according to the entire model, which has an R2 of 0.333. The model's statistical

significance at the 0.01 level is confirmed by an F-statistic of 155.11. This demonstrates how significantly AI may improve operational effectiveness in air logistics.

12.2- The Second Hypothesis:

States that: "There is a statistically significant effect of Using Artificial Intelligence on Inventory Management in Air Significant."

This hypothesis was divided into sub-hypotheses, and multiple linear regression was used to determine the effect of the independent variable (the use of artificial intelligence) on the dependent variable, inventory management, as a dimension of the dependent variable, and then the relationship was used to predict the value of one of the variables in relation to the other variable. Regression analysis was used using the (F&T) test as follows:

Table No. (4): Results of a regression analysis of effect of Using Artificial Intelligence on *Inventory Management.*

N	Dimensions	(R^2)	(F)	Coef (β)	(T)	p-value
1-	Automation.	0.246	110.939	0.447	10.047	0.000
2-	Blockchain.	0.245	100.523	0.502	10.026	0.000
3-	Machine Learning.	0.282	121.551	0.598	11.025	0.000
4-	Cloud Computing	0.263	112.256	0.541	10.565	0.000
	Total	**0.372**	**183.502**	**0.740**	**11.546**	**0.000**

Statistical significance at level (0.01).

From the previous table No. 4, we find that at the significance level (0.01) and degrees of freedom (310), the value of the (F) test indicates the quality of the relationship model and the validity of reliability without errors, as the value of (F) reached (183.502), which is statistically significant at the significance level (0.01). The value of the coefficient of determination (R^2) equals (0.372) to the effect that the variable (use of artificial intelligence (S.I)) explains the change in (inventory management) by (37.2%), and the percentage of random errors represented by the accuracy of the units of measurement for the variables remains the same, as it explains (24.6%) of the variance in the dimension (automation), explains (24.5%) of the variance in the dimension (blockchain), explains (28.2%) of the variance in the dimension (machine learning), and explains (26.3%) of the variance in the dimension (cloud

computing), which indicates the role and impact of the dimensions of the variable (use of artificial intelligence (S.I)) in explaining (inventory management).

12.3- Three Hypotheses:

State that: "There is a statistically significant effect of Using Artificial Intelligence on Demand Forecasting in Air Significant."

This hypothesis was divided into sub-hypotheses, multiple linear regression was used to find out the effect of the independent variable use of artificial intelligence on the dependent variable (forecasting demand), and then using the relationship to predict the value of one variable in terms of the other variable. Regression analysis was used by the (F&T) test as follows:

Table No. (5): Results of a regression analysis of effect of Using Artificial Intelligence on *Demand Forecasting*.

N	Dimensions	(R^2)	(F)	Coef (β)	(T)	p-value
1-	Automation.	0.243	99.428	0.422	9.971	0.000
2-	Blockchain.	0.120	42.380	0.334	6.510	0.000
3-	Machine Learning.	0.172	64.550	0.444	8.034	0.000
4-	Cloud Computing	0.152	55.621	0.398	7.152	0.000
	Total	**0.258**	**107.834**	**0.585**	**10.384**	**0.016**

Statistical significance at level (0.01).

From the previous **Table No. (5)**, we find that at the significance level (0.01) and degrees of freedom (310), the value of the (F) test indicates the quality of the relationship model and the validity of the dependence without errors, as the value of (F) reached (107.834), which is statistically significant at the significance level (0.01). The value of the coefficient of determination (R^2), which is equal to (0.258), indicates that the variable (use of artificial intelligence) explains the change in (demand forecasting) by (25.8%), and the percentage of random errors represented by the accuracy of the units of measurement for the variables remains, as it explains (24.3%) of the variance in the dimension (automation), explains (12.0%) of the variance in the dimension (blockchain), explains (17.2%) of the variance in the dimension (machine learning), and explains (15.2%) of the variance in the

dimension (cloud computing), which indicates the role and impact of the dimensions of the variable (use of artificial intelligence) in explaining demand forecasting.

12.4- The Fourth Hypotheses:

of the main hypothesis state: "There is a statistically significant effect of using artificial intelligence on forecasting demand in air significant." This hypothesis was divided into four sub-hypotheses, and multiple linear regression was used to determine the effect of the independent variable (use of artificial intelligence (S.I)) on the dependent variable (demand forecasting), then using the relationship to predict the value of one of the variables in terms of the other variable. Regression analysis was used by the (F&T) test as follows:

Table No. (6): Results of a regression analysis of effect of Using Artificial Intelligence on Risk Management.

N	Dimensions	(R^2)	(F)	Coef (β)	(T)	p-value
1-	Automation.	0.243	99.428	0.422	9.971	0.000
2-	Blockchain.	0.120	42.380	0.334	6.510	0.000
3-	Machine Learning.	0.172	64.550	0.444	8.034	0.000
4-	Cloud Computing	0.152	55.621	0.398	7.152	0.000
	Total	**0.258**	**107.834**	**0.585**	**10.384**	**0.016**

Statistical significance at level (0.01).

From Table **No. (6)** above, it can be observed that at a significance level of (0.01) and degrees of freedom (310), the F-test value demonstrates the quality of the relationship model and confirms the validity of the reliance without errors. The F value was found to be (107.834), which is statistically significant at the (0.01) level. The coefficient of determination (R^2), which equals (0.258), indicates that the variable "use of artificial intelligence (S.I)" accounts for about (25.8%) of the variance in "risk management". The remaining percentage of random errors, represented by the accuracy of measurement units for the variables, is as follows: it explains (24.3%) of the variance in the "automation" dimension, (12.0%) in the "blockchain" dimension, (17.2%) in the "machine learning" dimension, and (15.2%) in the "cloud computing" dimension. This reflects the role and impact of the dimensions of the "use of artificial intelligence (S.I)" variable in explaining risk management.

13- Results:

The researcher arrived at several findings that could contribute to solving the research problem, answering its questions, and testing its hypotheses. These findings are summarized as follows:

The study found that Artificial Intelligence across all its dimensions has a significant impact on improving logistics operations in air significant. The results showed that Automation had the greatest effect, with a mean of 4.08, highlighting its major role in enhancing efficiency in cargo handling and processing. Blockchain followed with a mean of 3.78, demonstrating its importance in increasing trust and collaboration within supply chains. Machine Learning had a mean of 3.42, reflecting its impact on demand forecasting and risk detection. Cloud Computing scored 3.68, underlining its role in improving data sharing and decision-making. Overall, the dimensions of Artificial Intelligence had a high presence, with an average mean of 3.67, showing strong agreement among participants regarding its importance.

The study also revealed that Logistics Supply Chains in air significant are performing well across various dimensions. Demand Forecasting was the most impactful, with a mean of 3.73, emphasizing the importance of accurate forecasting tools in managing air cargo demand. Inventory Management followed closely with a mean of 3.72, highlighting the significance of automated tools for managing stock discrepancies. Operational Efficiency scored 3.55, showing the role of streamlined processes and technology in improving logistics. Risk Management came in fourth with a mean of 3.60, indicating the importance of risk mitigation tools. Overall, the logistics supply chain dimensions showed high availability with an average mean of 3.66, reflecting strong consensus among participants on their significance.

The study found that Artificial Intelligence significantly impacts Operational Efficiency, with all dimensions (Automation, Blockchain, Machine Learning, and Cloud Computing) showing positive effects. Specifically, Automation had the strongest effect (β = 0.419, t =

10.095, p < 0.01), followed by Blockchain (β = 0.434, t = 9.089, p < 0.01), Machine Learning (β = 0.503, t = 9.599, p < 0.01), and Cloud Computing (β = 0.465, t = 9.256, p < 0.01).

The study also found that Artificial Intelligence has a significant effect on Inventory Management, with Machine Learning showing the highest impact (β = 0.598, t = 11.025, p < 0.01), followed by Cloud Computing (β = 0.541, t = 10.565, p < 0.01), Blockchain (β = 0.502, t = 10.026, p < 0.01), and Automation (β = 0.447, t = 10.047, p < 0.01).

The study confirmed that Artificial Intelligence also has a positive effect on Demand Forecasting, with Machine Learning having the strongest effect (β = 0.444, t = 8.034, p < 0.01), followed by Automation (β = 0.422, t = 9.971, p < 0.01), Blockchain (β = 0.334, t = 6.510, p < 0.01), and Cloud Computing (β = 0.398, t = 7.152, p < 0.01).

14- Discussion of Results:

The results of this study represent a significant step towards understanding the impact of Artificial Intelligence (AI) in enhancing logistics operations in air significant. The study found that AI, in all its dimensions, plays a crucial role in improving operational efficiency and the effectiveness of supply chains in this sector, aligning with current research trends in AI applications for logistics. These findings strongly correspond with previous studies showing the significant role of AI in improving performance across various sectors, including air significantation.

One of the key results from the study was that Automation had the greatest impact on improving logistics operations, with the highest mean of 4.08. This highlights the significant role automation plays in enhancing efficiency in cargo handling and processing. This result is consistent with Farahbod et al. (2024), which found that AI has a greater impact on capital-intensive industries like aerospace compared to labor-intensive industries like hospitality, confirming the central role of AI in improving supply chain performance in air significant.

Additionally, the study found that Blockchain had the second-highest impact, with a mean of 3.78. This technology significantly contributes to increasing trust and collaboration within supply chains, underlining its importance in enhancing transparency and real-time data exchange. This finding aligns with Richey et al. (2023), who highlighted AI's role in

improving operational efficiency despite the challenges, including ethical concerns and logistical complexities, associated with these emerging technologies.

Furthermore, Machine Learning was found to have a significant effect on demand forecasting and risk detection, with the highest impact on demand forecasting ($\beta = 0.444$). This reflects AI's ability to improve the accuracy of demand predictions, thus optimizing resource allocation. These findings are consistent with Dwivedi (2024), who emphasized AI's role in improving forecasting efficiency and reducing costs in supply chain management, particularly in the post-COVID era.

In the area of Cloud Computing, the study showed a notable effect (mean = 3.68) in improving data sharing and decision-making. This result supports the findings of Belhadi et al. (2021), which highlighted the critical role of cloud computing and AI-based tools in enhancing supply chain resilience and providing timely, accurate data for better decision-making in dynamic environments such as air significant.

Regarding Inventory Management, the study revealed that Machine Learning had the most substantial effect ($\beta = 0.598$), reflecting its significant contribution to improving inventory prediction accuracy and addressing challenges related to stock management. This supports the findings of Belhadi et al. (2021), who found that AI techniques like machine learning are highly effective in improving supply chain resilience and overcoming operational challenges.

In terms of Operational Efficiency, all AI dimensions were found to positively impact efficiency, with Automation having the strongest effect ($\beta = 0.419$), followed by Blockchain ($\beta = 0.434$), Machine Learning ($\beta = 0.503$), and Cloud Computing ($\beta = 0.465$). These results emphasize the pivotal role of AI in optimizing logistics processes and improving overall operational efficiency, consistent with Boute and Udenio (2021), who concluded that AI significantly enhances decision-making and strengthens integration in logistics operations.

In conclusion, AI has a substantial impact on improving the operational efficiency and effectiveness of logistics operations in air significant. The results of this study are in line with previous research that underscores the role of AI in enhancing supply chain performance

across various dimensions. These findings open the door for further studies exploring AI applications in other sectors of logistics and significantation, contributing to the development of strategies aimed at improving performance and expanding the use of AI technologies.

15- Recommendations:

Based on the descriptive statistics and results of the study, the researcher will state some practical and actionable recommendations for strengthening the identified weaknesses to enhance the application of AI in air significant logistics supply chains:

- Strengthen AI Automation in Cargo Handling: Given that automation was the highest-rated dimension, it is essential to invest in further upgrading automation systems to enhance cargo handling efficiency. This should include integrating advanced robotics and automated sorting systems to reduce processing times and human error, directly contributing to improved operational efficiency.

- Expand Blockchain Integration for Trust and Collaboration: With blockchain receiving a solid rating for its potential to improve trust and collaboration, health administration and logistics providers should prioritize the development of blockchain-based systems for secure and transparent communication across the supply chain. This should be done through strategic partnerships and investments that focus on creating robust, blockchain-powered platforms for document verification and transaction tracking.

- Enhance Machine Learning Algorithms for Demand Forecasting: Machine learning scored lower compared to other AI dimensions, indicating that its potential is not fully realized. To address this, logistics managers should invest in developing and refining machine learning algorithms that can predict air cargo demand more accurately. This involves continuous data collection, model refinement, and collaboration with data scientists to improve the predictive accuracy and responsiveness of these systems.

- Improve Cloud Computing Utilization for Real-Time Data Sharing: While cloud computing was rated positively, its full potential has not yet been fully leveraged.

Strengthening cloud computing infrastructure will allow real-time data sharing across different stakeholders in the sector air cargo supply chain. This involves adopting cloud-based platforms that integrate operational data, inventory levels, and demand forecasting to make agile and informed decisions that can quickly address supply chain disruptions.

- Implement AI-Driven Inventory Management Tools: With inventory management receiving a high rating, but still requiring further optimization, logistics managers should focus on adopting AI-powered systems for better inventory tracking, automated stock replenishment, and reducing discrepancies. This would help streamline supply chain processes by using AI to predict inventory needs, manage stock levels efficiently, and minimize out-of-stock or overstock situations.

- Focus on Operational Efficiency through AI Integration: The relatively high ratings of automation, blockchain, machine learning, and cloud computing suggest that combining these AI-driven technologies can lead to significant improvements in operational efficiency. To realize this potential, logistics providers should invest in integrated AI solutions that unify these technologies across different stages of air cargo handling and significant. These systems should be designed to optimize workflows, improve decision-making, and enhance the overall effectiveness of logistics operations.

- Develop AI-Powered Risk Management Solutions: With risk management being highly rated, AI tools designed to detect and mitigate risks, such as weather disruptions or regulatory changes, should be expanded. This would include predictive analytics for potential risks in the supply chain and developing automated response systems that can provide early warnings and recommend mitigation strategies.

- Promote Continuous Training on AI Tools: Given the significant role AI plays in optimizing logistics operations, it is crucial to prioritize continuous training programs for staff, particularly in the areas of automation, machine learning, and blockchain technologies. Ensuring employees are equipped with the necessary skills to operate and manage AI systems will contribute to the overall success of AI adoption in air significant logistics.

- Foster Collaboration Among Stakeholders for Standardization: Collaboration among logistics providers, airlines, and tech companies is crucial for the standardization and seamless integration of AI technologies in the sector air significant supply chain. The study's findings suggest that sharing knowledge and best practices can lead to more effective AI applications. This can be achieved by creating platforms for regular discussions, workshops, and collaboration to enhance the sector's collective knowledge and technological capabilities.

By addressing these recommendations, logistics managers can improve the use of AI in air significant logistics, maximizing the potential of each AI dimension to drive improvements in operational efficiency, inventory management, demand forecasting, and risk management. This will lead to more streamlined, effective, and agile logistics processes that align with the needs and expectations of all stakeholders in the sector air significant supply chain.

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