
The Impact of Artificial Intelligence on the International Logistics Services Sector: A Case Study of Some Global Companies

Bechker Ilhem *

University of Badji Mokhtar Annaba, ANNABA

ilhem.bechker@univ-annaba.dz

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Abstract:

Artificial Intelligence (AI) is considered one of the most important modern technologies, contributing significantly to rapid technological advancement and enhancing opportunities for innovation and growth across various fields and sectors. One such sector is logistics services. This article aims to examine the impact of artificial intelligence on the logistics services sector, whether that impact is positive or negative, , while presenting some successful experiences of global companies that have benefited from artificial intelligence.

Several results were reached, most notably that artificial intelligence has several positive and negative effects in general, and on the logistics services sector in particular. The positive effects include enhanced demand forecasting, better inventory management, improved decision-making support, and efforts to foster environmental sustainability. The main negative effects involve high implementation costs and difficulties in ensuring data quality, among others

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* Corresponding author.

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1. Introduction :

The world today is witnessing remarkable advancements in technology and data processing within the framework of the Fourth Industrial Revolution, primarily driven by developed countries. These nations have shifted their focus from mechanical power to information, resulting in a qualitative leap across various aspects of their societies.

A range of modern technologies has emerged, contributing significantly to rapid technological progress and increasing opportunities for innovation and growth across various sectors. Among these technologies, artificial intelligence (AI) stands out for its crucial role in improving quality, expanding capabilities, enhancing operational efficiency, and boosting productivity. Several sectors have been profoundly transformed by AI, encompassing logistics, both domestic and international, where services are being reshaped in many ways.

Based on the above, the research problem statement can be formulated as follows:

- ✓ How has (and will) artificial intelligence affect international logistics services?

The following research questions arise from this research problem:

- ✓ What is artificial intelligence, and why is it important?
- ✓ What is the significance of international logistics services, and what challenges hinder their development?
- ✓ What challenges arise from the application of artificial intelligence to international logistics services?
- ✓ How does artificial intelligence contribute to enhancing logistics services in Germany and Vietnam, as well as in companies such as Amazon, DHL, Tesla, Viettel Post, and Western Digital?

Study Importance

The significance of this study lies in its focus on two key areas: artificial intelligence and logistics services. It aims to present the conceptual framework of both, and to analyze the impact of AI on international logistics services, with particular attention to both primary and secondary activities.

Study Objectives

This study aims to examine the effects of artificial intelligence on international logistics services, whether positive or negative. It also endeavours to clarify the theoretical foundations of both artificial intelligence and international logistics services.

Research Methodology

The historical method was employed to trace the various phases in the development of artificial intelligence. Furthermore, the descriptive-analytical method was adopted, as it is well-suited to the study's nature.

2.The Conceptual Framework of Artificial Intelligence

2.1Definition of Artificial Intelligence:

- ✓ Financial Stability Board Definition: Artificial intelligence is a collection of theories and algorithms that allow computer systems to perform tasks that would normally human intelligence, such as voice recognition, understanding texts in context, and in certain situations, improving these capabilities.
- ✓ Artificial intelligence is a scientific endeavor sought at facilitating human life through machine learning that simulates human cognitive abilities and processes. It improves human abilities via machines, enabling the human mind to focus on creativity and problem-solving, including planning and strategic thinking. (Mohammed Abdullah, 2024, p. 481)
- ✓ AI refers to a machine's capacity to simulate the human mind and its processes, such as thinking and exploration. With enormous breakthroughs in computers, it has been proved that AI can accomplish tasks much more difficult than previously imagined, such as examining and proving complex mathematical theories or playing high-level chess. AI is known for its high speed, precision, and vast storage capacity. However, no program to date can match the flexibility of the human mind, especially in analytical reasoning tasks. Conversely, some applications have matched expert-level performance in specific tasks, such as medical diagnosis, computer search engines, and voice or handwriting recognition. (Institute of Banking Studies, 2021, p. 03)
- ✓ Artificial intelligence, often known as machine intelligence and abbreviated as AI, is a branch of computer science. It is a key pillar of modern technology. AI is a recent discipline that investigates advanced methods of programming computers to engage in reasoning and inference similar to human intelligence. It encompasses understanding cognitive and computational processes that improve a computer's ability to solve complex problems. AI acquires information through practical experience and refers to the ability of coded algorithms to learn from data to perform automated tasks without the need for humans to explicitly program each step of the process.
- ✓ Definition by Marvin Lee Minsky: "Artificial intelligence is the construction of computer programs that perform tasks which are typically accomplished by humans, as these tasks involve high-level mental processes such as learning, memory organization, and critical thinking." (Jalal Ismail, 2023, p. 18)

2.2 Origin and Development of Artificial Intelligence: Researchers did not pay much attention to artificial intelligence technology until the late twentieth century. However, this does not imply that they were completely neglected prior to that point. In reality, the first programmable digital computer machine emerged in the early part of this century. Introduced in 1946, it measured 30 cubic meters in size and weighed 30 tons. It was developed in the United States at the University of Pennsylvania to perform calculations for U.S. Army artillery shells and was later used in nuclear physics.

- ✓ In the aftermath of World War II, computers appeared.
- ✓ In 1950, mathematician Alan Turing introduced the "Turing Test" while working at the University of Manchester. The test evaluates a computer's intelligence, deeming it intelligent if it can successfully imitate human thought. Following this, the first artificial intelligence program was developed by Christopher Strachey, head of programming research at Oxford University, who successfully ran a checkers game on a computer.
- ✓ At Cambridge University, Anthony Oettinger designed a simulation experiment that used a computer to model a person shopping in various stores, aiming to measure the computer's learning ability. This marked the first successful experiment in what would later be known as machine learning.
- ✓ Artificial intelligence officially emerged in 1956, with a growing interest in using modern technology to address human problems. This occurred when a group of scientists interested in AI research gathered at a conference held at Dartmouth College in Hanover, New Hampshire, USA. These individuals became leaders in AI research for several decades, particularly John McCarthy, known as the "father of artificial intelligence," who first used the term AI, and Herbert Simon, who founded AI laboratories at MIT and Carnegie Mellon University. They produced crucial research, involving programs that allowed computers to solve complex algebraic problems, prove logical theorems, and speak English. Although the conference attendees could not agree on a precise definition of AI, they agreed that AI encompasses creating machines whose intelligence resembles human intelligence.
- ✓ By the mid-1960s, this research was generously financed by the U.S. Department of Defense; simplified robots emerged, but the progress was insufficient to meet the expectations of technology users.
- ✓ In 1965, Herbert Simon predicted that machines would have the capability within twenty years to perform any task a human could do.
- ✓ However, by the mid-1960s, progress slowed; a ten-year-old child could defeat a computer in chess in 1965.
- ✓ In 1966, the U.S. Senate issued a report emphasizing inherent limitations in machine translation, which led to negative publicity for AI for about ten years.

- ✓ In 1967, Marvin Minsky predicted that within one generation, numerous AI problems would be largely solved.
- ✓ AI history witnessed various periods of frustration and financing shortages, known as "AI winters," most notably in the early 1970s when research projects failed to achieve their objectives.
- ✓ In the early 1980s, AI research experienced a revival due to the commercial success of expert systems, AI programs that mimic the knowledge and analytical skills of one or more human experts.
- ✓ By 1985, AI market profits exceeded one billion dollars, and governments started funding it again.
- ✓ In the late 1980s, AI witnessed another winter, as expert systems became ineffective and prohibitively expensive.
- ✓ During the 1990s and early 21st century, AI fulfilled remarkable success, regaining its presence and popularity thanks to considerable advances in computing power and internet connectivity. With ongoing technological progress, computers capable of learning and problem-solving autonomously appeared.
- ✓ In 1997, scientists programmed various equations and software into a computer called Deep Blue 2, designed by IBM to play against the world's best chess player at the time, Garry Kasparov. In their match, the computer defeated the human for the first time in history. (Jalal Ismail, 2023, pp. 19-21)

The following table presents the main stages of the development of artificial intelligence up to the year 2023.

Table N°1: Stages of Artificial Intelligence Development from 1950 to 2023

	Period	Events
1950 – Early 1980s: Artificial Intelligence	1950	Alan Turing introduced the Turing Test
	1956	John McCarthy coined the term Artificial Intelligence
	1965	The interactive chatbot ELIZA was launched
	1974–1980	The first AI winter occurred
1980 – 2009: Machine Learning	1987–1994	The second AI winter occurred
	1994	The Chinook program defeated Don Lafferty, the world's second-ranked checkers player
	1997	The Deep Blue program defeated Garry Kasparov, the world chess champion
	2009	Google developed a self-driving car
2010 – 2019: Deep Learning	2011	The Watson program defeated Ken Jennings, champion of the game show Jeopardy!
	2016	The AlphaGo program defeated Lee Sedol, the world champion of the game Go
	2019	The AlphaStar program defeated professional players in StarCraft II

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2020: Generative Artificial Intelligence	2020	GPT-3, a text generation model, was released
	2021	The ChatGPT chatbot was launched
	2023	The Gemini model was released

Source: Saudi Data and Artificial Intelligence Authority, Artificial Intelligence, 2nd Edition, April 2024, available online at:

<https://sdaia.gov.sa/ar/MediaCenter/KnowledgeCenter/ResearchLibrary/SDAIAPublications09.pdf>,

Accessed on: 15/05/2025 at 04:25.

2.3 Importance of Artificial Intelligence: The significance of artificial intelligence lies in the following:

- ✓ AI contributes to preserving accumulated human expertise by transferring it to intelligent machines.
- ✓ It enables humans to utilize natural language to interact with machines instead of computer programming languages, making machine use accessible to all segments of society, whereas previously advanced machines were exclusive to specialists and experts.
- ✓ AI plays a crucial role in many sensitive domains such as assisting in disease diagnosis and prescribing medication, legal and professional consultations, interactive education, security, and military applications, among others.
- ✓ Intelligent systems support decision-making processes, as they possess independence, accuracy, and objectivity. Thus, their decisions are free from errors, bias, racism, preconceived notions, or external and personal interference.
- ✓ Intelligent machines relieve humans from various risks and psychological pressures, enabling them to focus on more significant and humane tasks and manage their time better.
- ✓ AI applications contribute to fulfilling sustainable development goals, specifically Goal 7 (Affordable and Clean Energy), Goal 13 (Climate Action), Goal 14 (Life Below Water), and Goal 15 (Life on Land) (Al-Qahtani, 2022, p. 106)
- ✓ In the financial and banking sector, AI helps offer financial services more efficiently, reducing costs, enhancing quality, increasing customer satisfaction, improving financial inclusion, and boosting analytical capabilities. (Mohammed Abdullah, 2024, p. 482)
- ✓ In agriculture, AI assists in determining optimal planting times and assessing soil conditions to identify suitable crops, thereby increasing yield and quality.
- ✓ In medicine, AI aids healing and reduces diseases by diagnosing illnesses and recommending appropriate treatments grounded in disease type.
- ✓ It facilitates hiring by reading resumes to determine candidate qualifications.

- ✓ AI offers faster and simpler customer support to respond to their needs. (Institute of Banking Studies, 2021, p. 9)
- ✓ It stimulates growth and consumption: automating routine tasks enables companies to operate more efficiently, saving time and increasing growth. Likewise, AI helps companies identify new business opportunities, thus boosting their growth rate.
- ✓ It increases productivity: AI allows companies to streamline operations and optimize resources. By analyzing data and generating analytical insights, AI systems can detect inefficiencies and suggest improvements, resulting in higher productivity, increased profits, and stronger economic growth.
- ✓ It reduces costs: by automating tasks typically performed by humans, AI helps companies' lower expenses, saving on salaries and associated costs. At the same time, AI systems can identify wasteful activities and propose ways to optimize budgets.
- ✓ It improves decision-making: AI provides companies with data that might be difficult to detect through traditional analysis methods. By analyzing data and recurring patterns, AI enables more informed decisions, leading to better outcomes that benefit the overall economy. (IA School)
- ✓ AI contributes to increasing international trade and advancing logistics (which will be discussed later in more detail).

2.4 Objectives of Artificial Intelligence:

Generally, AI aims to understand the nature of human intelligence by developing computer programs capable of simulating intelligent human behavior. This means that the program can solve problems or make decisions in specific situations by determining methods to reach solutions or conclusions through various inferential processes embedded within the program.

Numerous economists identify three primary goals of AI, which are:

- ✓ Making devices smarter, which is the fundamental goal;
- ✓ Understanding the essence of intelligence;
- ✓ Making devices more useful.

Moreover, AI's purpose sometimes encompasses interpreting situations or texts. It is associated with constructive activity, the function of the situation, and its goal by solving problems related to design, planning, and diagnosis.

From the above, it is evident that the key objectives of AI include:

- ✓ Enabling machines to process information more similarly to how humans solve problems; in other words, through parallel processing, where various commands are executed simultaneously, closely mimicking human problem-solving.

- ✓ Gaining a better understanding of human intelligence by unraveling the complexities of the brain to simulate it. It is well known that the nervous system and human brain are the most complex organs, working in an interconnected and continuous manner to recognize and interpret information. (Al-Qahtani, 2022, pp. 108-109)

2. 5 Types of Artificial Intelligence:

Due to the tremendous recent advances in artificial intelligence research, conscious and intelligent devices have become a realistic possibility on the horizon. By "conscious devices," we refer to machines capable of understanding spoken instructions and recognizing images. Some of the most prominent types of artificial intelligence include:

a. Reactive Machines: Reactive machines are the simplest type of AI. They are unable to form memories or use past experiences to make immediate decisions. Current smart devices range from those with no abstract understanding of the world to those with highly specific, limited knowledge tailored to particular tasks. While some methods can enhance these devices' performance in certain games, such AI systems cannot easily adapt or interact with the world in the way we envision future AI might. These devices cannot perform different functions because they lack any understanding of the world, making them easily deceived.

b. Limited Memory: This type includes devices capable of examining the past, such as self-driving cars, which monitor the speed and direction of other vehicles. However, this process is not instantaneous; it necessitates clear objectives and continuous monitoring. These observations are added to a pre-programmed world model utilized by self-driving cars. This model involves road markings, traffic signals, and other critical features like curves, enabling the vehicle to decide when to change lanes to avoid collisions or cutting off other drivers. However, this simple past data fades fast and is not stored as part of the vehicle's long-term learning expertise. Conversely, human drivers accumulate years of experience behind the wheel.

c. Theory of Mind: In the near future, devices will become more advanced, not only in their perception of the world but also in other aspects and components. In psychology, this concept is referred to as the theory of mind: the understanding that thoughts and feelings influence behavior, not only in humans but potentially in other beings and entities as well.

d. Self-awareness: The final step is for devices to reach the stage where they are able to form perceptions about themselves. This will enable AI researchers to define consciousness and build machines that possess it. This concept extends the theory of mind related to the third type of artificial intelligence. (Institute of Banking Studies, 2021, pp. 05-06)

2. 6 Artificial Intelligence Technologies:

Numerous key technologies fall under the field of artificial intelligence, including:

a. **Machine Learning:** This includes:

- **Supervised Learning:** Learning the relationship between inputs and outputs utilizing labeled datasets offered by the user.
- **Unsupervised Learning:** Extracting patterns from unlabeled datasets.
- **Reinforcement Learning:** Interacting with the environment through trial and error to fulfill the best possible results.
- **Deep Learning:** Employing multi-layer neural networks to process data, which can be supervised, unsupervised, or reinforced.

b. **Natural Language Processing (NLP):** This encompasses:

- ✓ **Text Generation:** Creating meaningful text grounded in requirements.
- ✓ **Question Answering:** Automatically responding to users' questions.
- ✓ **Machine Translation:** Translating texts into different languages.

c. **Computer Vision:**

- ✓ **Object Recognition:** Identifying objects in images or videos.
- ✓ **Facial/Person Recognition:** Recognizing people through images, audio, or video.

d. **Speech Processing:**

- **Speech-to-Text:** Converting spoken language into written text.
- **Text-to-Speech:** Converting written text into spoken language.

e. **Robotics:**

- ✓ **Industrial Robots:** Utilized in industrial settings to automate processes and applications.
- ✓ **Service Robots:** Employed in commercial or personal contexts to perform specific tasks or services (The Saudi Authority for Data and Artificial Intelligence (SDAIA), April 2024, pp. 12-13)

2.7 Limitations of Artificial Intelligence:

The benefits of artificial intelligence in the economy are numerous; however, there are limitations and challenges that must be taken into account. Among them are the following:

- ✓ **Risk of Unemployment:** AI is likely to replace jobs in certain domains. Thus, to remain competitive, workers will need to acquire new skills.
- ✓ **Risk of Algorithmic Bias:** This can lead to unintended consequences and biased outcomes. AI algorithms cannot guarantee the accuracy of the data on which they are trained. If the information is incorrect or incomplete, the resulting algorithms may perpetuate or even amplify these errors. Such

flaws could result in unfair or discriminatory decisions in areas such as employment, lending, and insurance.

- ✓ **Market Monopoly:** Large companies that can significantly benefit from this technology may gain substantial competitive advantages. Affected sectors may experience reduced competition, resulting in decreased innovation. Ultimately, this could harm consumers and limit economic growth.
- ✓ **Risk of Misuse:** There is also the danger of AI being utilized for unethical purposes, such as market manipulation, data breaches, harassment, and more. (IA School)

3. Logistics Services

In this element, we will highlight the theoretical framework of local and international logistics services.

3.1 Definition of Logistics Services :

- ✓ It is the process of planning, implementing, and controlling the efficient flow and storage, as well as the separation of materials and final goods, along with managing related information, from the point of production to the place of consumption, with the aim of meeting customer requirements.
- ✓ It refers to the network of services that supports the physical movement of goods within and across borders. It encompasses various activities such as transportation, storage, brokerage, express delivery, terminal operations, and even data and information management. The effectiveness of transporting goods through these systems to their final destinations plays a crucial role in enabling a country's trade opportunities. (Bouchmoul, Rimi, & Hamidatou, 2020, p. 343)

3.2 Logistics Services Sector:

This sector is concerned with managing and organizing the processes of transporting and distributing goods and services from the production site to the final consumer. It encompasses various activities such as storage, transportation, inventory management, shipping, distribution, and delivery, in addition to overall supply chain management. The logistics sector is regarded as a crucial link between producers and consumers, seeking to ensure goods arrive on time, at the lowest possible cost, while maximizing efficiency. (AL HOBANI)

3.3 Importance of Logistics Services:

The significance of logistics services and their role in the economic sector lies in the crucial function they perform. Logistics services have a significant ability to reduce costs and increase profits, as they involve precise processes that rely on targeted planning and resource management for success.

Implementing logistics services is regarded as a fundamental component in meeting customer demands and outperforming competitors. Thus, logistics services are considered a significant element of supply chains. They

help companies grow and expand while reducing costs and the time required to transport products from one point to another.

All of this help companies expand regionally or globally. Given that supply chains are complex and sensitive, depending on changing customer requirements, a supply chain cannot guarantee high value without organized and efficient transportation. Therefore, logistics services are one of the most critical factors in the quality of any supply chain. With the multiple types of logistics services available, all of them hold significant importance. Below are the key benefits of logistics services:

a. Effectively coordinated logistics services lead to positive business outcomes: As businesses grow and expand, they increasingly rely on well-organized supply chains to support their growth, which can be fulfilled through logistics services. Thus, all types of effectively coordinated logistics services contribute positively to business development by improving efficiency and profitability.

b. Helping companies create the best value for customers: Delivering value to customers does not only mean quality or quantity but also availability. Given that all types of superior logistics services make products more accessible to an increasing number of people, logistics ameliorates and increases the value companies provide by enhancing goods and ensuring product availability. To deliver more value, companies either improve their logistics activities or rely on specialists.

c. Cost reduction and efficiency improvement: All types of logistics services help clearly reduce costs and enhance efficiency. Costs can be lowered by partnering with other companies offering transport and storage services. When companies start outsourcing transportation and storage services, they enhance operational efficiency and thereby fulfill a better reputation and a stronger brand.

d. Timely delivery of orders at the right place: Through multiple professionally organized logistics services, companies can meet short lead times by choosing experienced professional teams. This ensures business owners secure fast, safe shipping, storage, and delivery of their products to customers via reliable shipping and delivery systems.

e. Achieving success in supply chains: Supply chains are distinct networks among companies that manage the production, shipment, storage, and delivery of products. These networks are critical because they significantly affect sales and profits. However, without efficient and well-organized logistics services, supply chains cannot help your business gain a clear competitive advantage. Reliable logistics services contribute to the development and maintenance of a favorable corporate image, as well as the preservation of customer satisfaction and loyalty.

f. Maintaining customer satisfaction: Satisfied customers are the most valuable assets of any business, as they are the main drivers of supply chains. As a result, every company owner must first understand their

customers' needs, preferences, and demands before working tirelessly to provide them. Meeting the demands of existing and future consumers requires logistical solutions that assist businesses in maintaining customer satisfaction. (FASTCOO, 2023)

g. Fostering international trade: The logistics sector facilitates the efficient movement of goods and services across borders, enhancing trade exchange and enabling companies to access diverse global markets.

h. Enhancing supply chain efficiency: It helps organize logistics operations effectively, reducing operating costs and increasing supply chain efficiency. This leads to enhanced economic performance across many sectors.

i. Supporting logistics for various industries: Manufacturing, agriculture, and retail sectors rely on efficient logistics services to transport raw materials and final products. Without a strong logistics transport system, production and commercial operations may be disrupted.

j. Stimulating economic growth: The sector contributes to creating new job opportunities at different levels, from manual labor to expertise in planning and management, thereby promoting both local and international economies.

k. Improving competitiveness: Companies with advanced logistics systems can enhance their services and increase customer satisfaction, improve their capability to compete in both local and international markets.

l. Technology and innovation: The logistics sector fosters innovation and adoption of modern technologies such as artificial intelligence, robotics, and tracking technologies, which increase the speed and efficiency of logistics operations. (AL HOBANI)

It also contributes to:

- ✓ The presence of logistics services helps increase investment in various commercial sectors.
- ✓ Helping organizations in managing all the problems and complexities they encounter.
- ✓ Fulfilling the maximum possible benefit from all investments.
- ✓ Enhancing the physical flow from the source of the products to the endpoint (the consumer).
- ✓ Organizing all post-sale services and improving customer service.
- ✓ Identifying all programs associated with quality, purchasing, and production.

3. 4 Types of Logistics Services:

There are various types of logistics services, all working together integrally to satisfy all needs and guarantee the smooth flow of products in the best possible way. Each type of logistics service has its own procedures and objectives, but ultimately, all seek to fulfill the same goal. Below are the most significant types of logistics services in detail:

a. Storage Services: These involve obtaining the necessary licenses associated with appropriate storage operations relying on the type of materials stored, in accordance with legal provisions.

b. Transportation Services: Responsible for offering all suitable and licensed means of transport for shipping purposes. Each mode of transport has specific conditions and licenses that vary according to the nature of the transported items.

c. Shipping and Customs Clearance Services: These services are offered to investors or importers during the import or export of products and include a set of legal procedures.

d. Comprehensive Logistics Services: These represent inclusive types of logistics services that are not limited to one specific service but encompass various processes such as distribution, supply chain management, shipping services, and procurement management.

e. Integrated International Logistics Services: Similar to comprehensive logistics services but applied on an international scale. This type of logistics service requires specific qualifications from the company providing these services.

f. Refrigeration Services: Services associated with supplying and transporting refrigerated items, i.e., goods or products that necessitates refrigerators with cooling systems to maintain appropriate temperatures and ensure their preservation during transport.

g. Production Services: One of the most significant types of logistics services associated with transporting goods that require supply or distribution operations.

h. Emergency Services: This type of logistics service includes transporting goods or items during emergency situations until they can be transported again. (FASTCOO, 2023)

3.5 Measuring the Performance of Logistics Services:

Given that trade and logistics affect multiple sectors of the economy, forming a comprehensive picture of a country's overall performance can be challenging. This is why the Logistics Performance Index (LPI), part of the Connecting to Compete report published every two years, assesses countries across a range of indicators. The index allows governments to track their progress over time and compare their performance with that of similar countries. It considers factors such as the effectiveness of logistics services and skills, the quality of trade-related infrastructure, the cost of international shipments, and the timeliness of deliveries.

The Logistics Performance Index is a standardized benchmarking tool developed by the World Bank and published in 2007 to measure logistics performance and determine weaknesses in supply chains. It aims to assist countries in identifying the challenges and opportunities they face in commercial logistics and to define enhancement measures. (Khalat Kahil & Timaoui, 2022, p. 97)

The Logistics Performance Index offers two perspectives on a country's performance employing surveys of logistics professionals:

a. Domestic Logistics Performance Index:

This refers to the quantitative and qualitative evaluations of a country's services by logistics professionals working inside that country. This element offers detailed information on the country's infrastructure, quality of service providers, border procedures, and supply chain reliability. See the figure below.

b. International Logistics Performance Index:

This provides an assessment of the country's services by logistics professionals from outside the country. This component provides qualitative information on the perspective of the country's trading partners concerning the quality and nature of its logistics services. (World Bank, 2018)

The World Bank conducts the logistics performance survey every two years, covering 160 countries. Countries are ranked based on trade logistics features on a scale from 1.0 (worst) to 5.0 (best). The Logistics Performance Index includes six key elements as follows:

- ✓ **Customs:** Efficiency of customs clearance at the border, encompassing customs administrations, quality assurance agencies, and health and phytosanitary agencies.
- ✓ **Infrastructure:** Ports, roads, railways, airports, warehousing and transshipment facilities, and information and communication technologies.
- ✓ **Quality of Logistics Services:** Land transport, maritime transport, air transport, and freight forwarding agents.
- ✓ **Timeliness:** Timeliness of customs clearance and delivery within the scheduled or expected delivery timeframes.
- ✓ **Ease of Arranging International Shipments:** The ease of arranging shipments at competitive prices.
- ✓ **Tracking and Tracing:** The ability to track and trace shipments. (Khalat Kahil & Timaoui, 2022, pp. 97-98)

3. 6 Major Challenges in the Logistics Sector:

The logistics sector faces a set of significant challenges that impact its efficiency and its ability to meet growing demand. The most prominent of these challenges include:

a. Complexity of Global Supply Chains:

With increasing globalization and the interconnection of cross-border supply chains, managing and tracking the movement of goods in real time becomes difficult, increasing the risk of delays and disruptions.

b. High Transportation Costs:

Rising fuel prices, maintenance costs, and higher customs fees lead to increased operational expenses in transportation and shipping, negatively affecting the profitability of logistics companies.

c. Environmental Challenges:

As environmental sustainability gains significance, companies face intense pressure to reduce carbon emissions and enhance energy efficiency, requiring considerable investments in cleaner technologies.

d. Inadequate Infrastructure:

In some regions, infrastructure suffers from poor quality and underdevelopment, such as damaged roads or inefficient ports which obstructs transportation operations and prolongs delivery times.

e. Shortage of Skilled Workforce:

The sector lack qualified personnel, particularly in specialized areas like supply chain management and data analysis, resulting in insufficient skills needed to improve logistics performance.

f. Fluctuations in Supply and Demand:

Sudden demand shifts, such as those experienced during global crises like the COVID-19 pandemic, cause major disruptions in supply chains, complicating demand forecasting and inventory management.

g. Cybersecurity:

With increasing dependence on digital and technological systems, the logistics sector encounters considerable risks from cyberattacks and breaches, requiring strengthened security measures to safeguard data and digital infrastructure.

h. Legislative Changes:

Frequent changes in customs regulations and laws across countries complicate logistics operations, requiring companies to constantly adapt to maintain compliance and reduce delays.

Addressing these challenges necessitates the logistics sector to adopt innovative solutions and develop sustainable strategies to enhance efficiency and overcome obstacles in the global market

4.The Effects of Artificial Intelligence on the Logistics Sector

We will examine the positive and negative effects of artificial intelligence (AI) on the logistics sector.

4.1 Positive Effects of Artificial Intelligence on the Logistics Sector: These can be summarized as follows:

- **Demand Forecasting:** AI can analyze sales data and external factors to offer accurate demand forecasts, enabling companies to better align their production and distribution.
- **Customer Service:** AI can operate chatbots that respond to customer inquiries and complaints, improving customer expertise and enhancing interaction within the supply chain.

- **Inventory Management:** AI helps companies determine weaknesses in inventory levels by forecasting demand and proposing restocking strategies, thereby enhancing warehouse inventory management.
- **Route Optimization:** AI analyzes operational patterns, delivery schedules, weather conditions, and more to recommend optimal transportation routes.
- **Supply Chain Flexibility:** AI improves supply chain flexibility by determining weak points and suggesting immediate contingency plans. (SHIPA, 2023)
- **Improved Operational Efficiency:** AI boosts efficiency through automation (such as smart robots for loading and unloading containers) and big data analytics (enhancing traffic and storage management), accelerating processes, reducing human error, increasing productivity, and lowering costs by reducing the need for manual labor.
- **Big Data Management and Analysis:** With growing global trade, big data presents both challenges and opportunities. AI analyzes this data quickly and accurately, supporting real-time decision-making. For instance, AI can track ship movements and predict potential issues like congestion or breakdowns, enabling proactive measures to reduce negative effects. (Al-Khobouli, 2024, p. 188)
- **Reduced Waiting Times:** AI reduces waiting times for ships and containers by predicting ship movements, decreasing congestion, and enhancing time usage.
- **Enhanced Operational Safety:** AI enhances safety in ports through smart monitoring systems, encompassing intelligent cameras and sensors that continuously track ship and container movements.
- **Environmental Sustainability:** AI contributes to environmental sustainability by reducing carbon emissions from logistics operations and optimizing the use of renewable energy via intelligent environmental data analysis.
- **Increased Competitiveness:** Ports that adopt AI technologies reveal greater competitiveness in global markets by reducing operating costs and increasing efficiency compared to those that do not.
- **Enhanced Security and Safety:** AI fosters maritime port security through smart surveillance systems that detect risks such as suspicious activities or potential leaks more quickly and accurately. AI algorithms analyze images and videos from security cameras to enhance early threat detection.
- **Predictive Maintenance and Preventive Care:** AI enables ports to predict equipment and infrastructure failures, allowing for preventive maintenance before actual breakdowns. This reduces unplanned downtime and enhances operational efficiency. (Al-Khobouli, 2024, p. 188)

4. 2 Negative Effects of Artificial Intelligence on the Logistics Sector:

Implementing artificial intelligence in the logistics sector presents several challenges, complexities, and negative impacts, the most prominent of which are:

- **High Costs:** Adopting and developing AI may require considerable capital investment in infrastructure and hiring experts, which leads to increased costs.
- **Raising Cultural Awareness:** The implementation of AI requires raising the cultural and technical awareness of employees within organizations to align work methods with the AI solutions being employed.
- **Data Quality:** Organizations face difficulties in ensuring the quality, integrity, and comprehensiveness of data generated by AI (especially content generation), despite AI's ability to produce large volumes of data.
- **Data Security:** Companies utilizing AI rely heavily on digital systems and data sharing, which compels them to prioritize the security of sensitive information.
- **Integration Process:** Companies may struggle to integrate AI solutions into their deeply rooted traditional systems and operations.
- **Regulatory and Compliance Issues:** It is challenging for companies to ensure that AI solutions comply with regulatory requirements and standards in the logistics sector.
- **Scalability and Flexibility:** Companies face difficulties finding AI solutions that fit their size and needs, necessitating flexible solutions that can adapt as their operations evolve.
- **Job Loss:** With the appearance of autonomous systems and robots, various jobs currently performed by humans (such as truck and lorry driving) are expected to be replaced, potentially leading to a deterioration of human skills in certain areas.

5. Studying the Impact of Artificial Intelligence on Logistics Services: Cases of Some Global Companies:

a. The Case of Amazon: Streamlining Logistics Operations Using Artificial Intelligence :

Amazon is regarded as a pioneer in applying artificial intelligence in the domain of logistics services, contributing to improved operational efficiency and supply chain performance. One of its most notable achievements is the KIVA robotic system, which automates the order-picking process in warehouses, reducing order processing time to only a few minutes and significantly lowering inventory error rates. Furthermore, artificial intelligence is employed to analyze demand data in real time, allowing Amazon to optimize inventory levels and ensure product availability grounded in market demand. This not only reduces inventory costs but also enhances the customer experience through faster and more accurate delivery times.

b. The Case of DHL: Using Artificial Intelligence to Enhance the Supply Chain :

DHL has employed artificial intelligence in managing its supply chain to improve the accuracy of inventory forecasting, increasing demand prediction accuracy by 35% and reducing operating costs by up to 25%. Moreover, DHL's AI systems optimize the management of its delivery fleet by analyzing real-time data associated with traffic conditions, weather, and other influencing factors, ensuring that goods are delivered on time. This enables DHL not only to reduce costs but also to promote customer satisfaction with its international shipping services.

c. The Case of Tesla and Autonomous Vehicles: A Revolution in the Logistics Sector:

Tesla is revolutionizing the logistics sector by applying artificial intelligence to autonomous vehicles. The Tesla Semi truck is equipped with an advanced AI system capable of analyzing road conditions, predicting potential risks, and optimizing fuel consumption. Thanks to this technology, the Tesla Semi truck significantly reduces operating costs compared with traditional trucks while enhancing safety during long-distance transportation. The use of artificial intelligence in autonomous vehicles not only improves supply chain efficiency but also opens new prospects in the logistics sector, with the potential to revolutionize freight transportation in the future.

d. The Case of Viettel Post: Digital Transformation through Artificial Intelligence :

Viettel Post is one of the leading logistics companies in Vietnam that has implemented artificial intelligence in its operational systems. According to Finance Magazine (2024), Viettel Post has employed AI to enhance delivery operations, warehouse management, and chatbot programs for customer support. Consequently, the on-time delivery rate increased by 15% compared with previous years, contributing to fostering the company's competitiveness in the logistics services market.

In addition, according to AkaBot (2024), numerous Vietnamese logistics companies utilize artificial intelligence to enhance their operational efficiency. The benefits of AI-powered chatbots are not limited to helping customers track their orders; they also contribute to reducing the workload of call center employees by 40%, improving service quality, and optimizing staffing costs. According to Harvard Business Review Vietnam (2024), artificial intelligence plays a crucial role in enhancing the accuracy of demand forecasting through the analysis of big data and machine learning algorithms, thanks to its ability to process massive amounts of data. AI technologies help Vietnamese companies accurately predict consumption trends, thereby improving production planning and inventory management while reducing the risks of surplus or shortages of goods. Furthermore, AI technologies enable the early detection of supply chain risks, such as disruptions caused by natural disasters, fluctuations in commodity prices, or logistics congestion. By leveraging predictive analytics models, AI technologies can offer rapid solutions, helping Vietnamese companies proactively adjust their operational strategies and minimize potential losses (Thao & Lan Thanh, 2025, p. 114).

e. The Case of Western Digital

Western Digital utilizes a digital assistant called Logibot to provide supply chain partners with relevant information. After comparing its online store with those of its competitors, logistics managers at Western Digital identified three main objectives: responding to inquiries around the clock, collecting and responding to customer feedback, and processing most inquiries automatically so that customer service staff can focus only on the most critical issues. The company's ultimate goal is to track all interactions between Logibot and users, identify the number of successful and unsuccessful interactions, and use this data to enhance operational efficiency and ultimately deliver better customer services. Western Digital also plans to expand the use of Logibot to include planning, procurement, and manufacturing, in addition to logistics (Lindquist, 2024). The case studies addressed above indicate that artificial intelligence is increasingly becoming a fundamental component in the logistics services sector, as it helps improve operations, reduce costs, and improve performance. Global companies such as Amazon, DHL, Tesla, Viettel Post, and Western Digital reveal the significant role of artificial intelligence in enhancing logistics services and fulfilling competitive advantages.

6. Conclusion:

Since its inception, artificial intelligence has made tremendous progress and has played a crucial role in enhancing quality of life, contributing to applied research, and advancing societies on a wide scale. It helps preserve accumulated human expertise, assists in diagnosing diseases and prescribing medications, offers legal and professional consultations, supports decision-making, and contributes to fulfilling several sustainable development goals (Goals 7, 13, 14, and 15). AI has contributed to the development of numerous agricultural, industrial, and service sectors, encompassing the logistics sector.

This sector has undergone considerable advancements due to its significant importance. It helps meet customer demands (by creating better value and ensuring their satisfaction), reduce costs and enhance efficiency, and improve foreign trade.

However, despite its importance, the sector encounters many challenges, particularly in developing countries. Among these are high transportation costs, inadequate infrastructure, shortage of skilled personnel, increased pollution, cyberattacks and breaches, and other challenges.

Artificial intelligence addresses some of these issues by contributing to the development of the logistics sector through demand forecasting, better customer service, enhanced inventory management, improved decision-making, analysis of ship movements to reduce waiting times, improved environmental sustainability, reduced container waiting times, and more.

Nevertheless, despite AI's positive impact on the logistics sector, several challenges remain to be addressed, including high costs, difficulties in ensuring data quality, challenges in integrating AI solutions into traditional systems, and regulatory issues.

Recommendations:

Based on this study, the following recommendations are proposed:

- Training and qualifying human resources in the logistics sector to effectively use AI tools.
- Establishing legislation, laws, and fundamental regulatory frameworks to govern AI technologies.
- Increasing budgets for research and development to help and encourage innovation in AI for logistics sector development.
- Adhering to the highest standards of security and privacy when utilizing data and AI in the supply chain.
- Logistics service providers should analyze their needs and problems to be solved through AI tools.
- Investing in digital infrastructure and fostering cooperation among various ports.

In conclusion, artificial intelligence is a powerful enabling tool, but not a magical solution. It does not replace strategies, particularly commercial ones; rather, it improves them by transforming global trade from a reactive challenge into a proactive, data-driven advantage.

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