ARTIFICIAL INTELLIGENCE IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT ETHICAL IMPLICATIONS IN AUTOMATION, TRANSPARENCY & SUSTAINABILITY

Volume - I

Editors in Chief

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AI BASED GREEN SUPPLY CHAIN MANAGEMENT

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Abstract

This research aims to design an analytical framework to investigate the dimensions, factors, and key indicators affecting the green supply chain based on the innovative technology of Artificial Intelligence of Everything (AIoE). Understanding the cause-and-effect relationships of all actors in this smart and sustainable system is also one of the critical goals of this research. Also, examining the key features of AIoE technology as a new hybrid technology is one of this research's most essential features. This research provides a practical analysis of AIoE technology for the first time. The results strongly support the argument that hybrid AIoE technology can tremendously impact the sustainability and greenness of supply chain processes.

Keywords: *green supply chain, sustainable supply chain, AioE based supply chain.*

Introduction

Green Supply Chain Management (GSCM) involves integrating environmentally friendly practices into the traditional supply chain to achieve sustainable development (Nozari et al., 2021a). To increase the organization's social responsibility, it is necessary to change the traditional supply chain management method. Going green and trying to achieve the goals of a sustainable supply chain is the most critical solution in this field (Nazir et al., 2024). Many businesses have become aware of the importance of this integration to create a sustainable business strategy. They are looking for solutions and guidance on implementing a sustainable supply chain. Also, a sustainable supply chain is not exclusively about green issues but about creating efficiencies and cost containment. As organizations seek to define management to reduce their company's environmental footprint, supply chains have become their primary area of focus. However, it can be said that being green is one of the most critical components of sustainability. Therefore, special attention should be paid to it in supply chain processes (Nozari et al., 2021b).

In today's era, transformative technologies are developing more and more. These technologies have tremendous effects on business processes. So, businesses cannot create a competitive advantage without the presence and use of digital and smart technologies (Vaseei et al., 2024). Using these technologies, business processes, including supply chains, can be sustainable in all their elements. For example, using Internet of Things (IoT) technology, large amounts of data can be extracted and refined, which was impossible in the past. Data that is unstructured in many cases, and in many cases, other powerful technologies must be used to analyze them. Artificial Intelligence (AI) with the capability of learning analysis allows businesses to analyze big data that was impossible for them to analyze in the past (Nahr et al., 2021). Blockchain technology also provides data storage with decentralized management. This technology can guarantee the security and accuracy of data in many cases. Therefore, it can be observed that these technologies in the new era, by creating the ability to monitor and analyze in realtime, can ensure the stability of intelligent supply chain systems in all its dimensions from procurement, production, repair, and Ensure maintenance, distribution, marketing, and sales (Nozari et al., 2019).

Combining these technologies can provide multiple capabilities and power to the supply chain processes. Therefore, it has tried to achieve new technologies with different capabilities in recent years by optimally combining them. Artificial Intelligence of Everything (AIoE) is a technology that involves evaluating and analyzing all people and processes in addition to objects (Nozari, 2024a). By using this technology, timely distribution can be guaranteed. Production energy can be optimized, which is a critical step in the direction of the green development of the supply chain. Of course, it should be noted that due to the im- portance of this concept, the examination of the green supply chain has received attention in many types of research. Also, in many researches, the role of technologies in the sustainability of the supply chain has been considered. However, due to the development of technologies in the present era and the change of industrial generations, the role of using combined technologies simultaneously in developing green and sustainable supply chains has not been analyzed. Furthermore, in this research, the concept of AIoE and its effects on the supply chain's greenness has been investigated for the first time. For this reason, this research has tried to examine the dimensions, features, opportunities, and challenges created for the green and smart supply chain powered by AIoE. Moreover, the cause-and-effect relationships of all actors are presented in a conceptual frame work. Understanding this framework can provide deep insight into implementing green and smart systems, emphasizing this powerful hybrid technology.

IOT and Supply Chain Management

Today, the concept of the IoT has become much broader. It no longer involves just connecting things. Instead, it encompasses everything. So, in the new era, this concept has been renamed the Internet of Everything or IoE. Technically, IoE refers to the billions of devices and consumer products connected to the Internet under a smart network and can develop digital configurations. IoE is an intelligent set of connections between people, processing systems, data, and objects that can quickly move around our world (Nozari et al., 2021b). In such a network, billions of devices, such as sensors, are used to measure the environment, and their data are available through public or private networks. The four main pillars of the IoE are:

People: Today, most people are connected through social networks on through web.

Objects: Things here mean physical objects connected to the Internet and each other as a whole. These devices understand and collect more data, are aware of the environment and context, and provide a better experimental experience to help people and machines.

Processes: Processes happen between all the components (pillars) of the IoE. With the right processes in place, these connections become more valuable. They should convey the right information to the right person at the right time and in the most relevant way.

Data: Information produced by people and objects. Combined with data analytics, these data provide actionable information for people and machines. Better decisions are made, and better results are achieved.

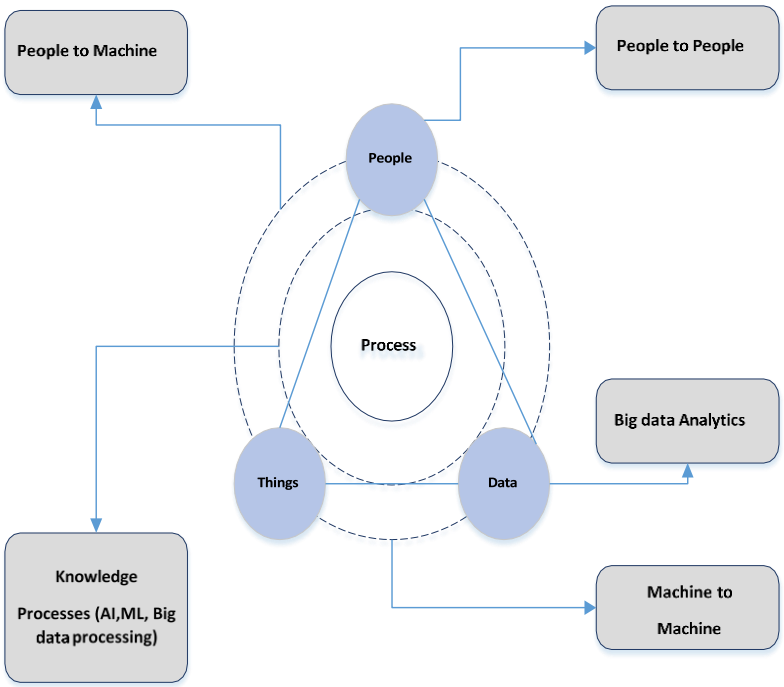

Figure 1. Structural framework of the Internet of Everything

Technologies can create significant opportunities for businesses, combining these technologies seems to lead to a major transformation in the supply chain. For example, IoE technology, with the help of devices and sensors, leads to an increase in the speed of receiving information on the status of the supply chain. However, big data analysis by processing this large volume of generated data brings pattern identification and trend prediction. This analysis can be based on other powerful technologies, such as AI. In collaboration with huge information analytics, IoE makes a difference in business change from being receptive to being proactive (Lerman et al., 2022). The concurrent utilization of these two innovations will increment the proficiency of the supply chain and hence pull in client fulfillment. Businesses that can utilize this innovation will end up in information-based commerce that can create choices based on genuine information, form opportune choices, and, for the most part, increase commerce efficiency. Therefore, it can be seen that IoE also moves in the direction of supply chain stability. The entire green IoE lifecycle should focus on green design, green production, green use, and green removal/recycling at the level of all processes so that there is no or very little impact on the environment. By monitoring all aspects of this technology and emphasizing big data in all dimensions, stability can be increased to a great extent. The most essential functions of the green IoE based supply chain (GIoESC) are shown in Figure 2.

Figure 2. Green Internet of Everything based supply chain components

Expert systems are used in IoT to add more value to IoT by better understanding data obtained from connected devices. As a group of connected devices collect and aggregate raw data, software programs with machine intelligence capabilities analyze the data. After a thorough review, the final result contains valuable information. In this manner, taking advantage of the combination of AI and IoT constitutes AIoT innovation, giving an exhaustive run of points of interest for businesses and shoppers, counting personalization of the client involvement and brilliantly mechanization.

IoE goes beyond the IoT and includes and connects all people, processes, and data in addition to things. Therefore, combining this technology with AI can create a super-advanced spring that adds great capabilities to business systems. These capabilities include collecting, refining, and analyzing big data in the shortest time, in the highest state of accuracy and security. Combining IoE technology with AI creates an advanced AIoT technology called AIoE.

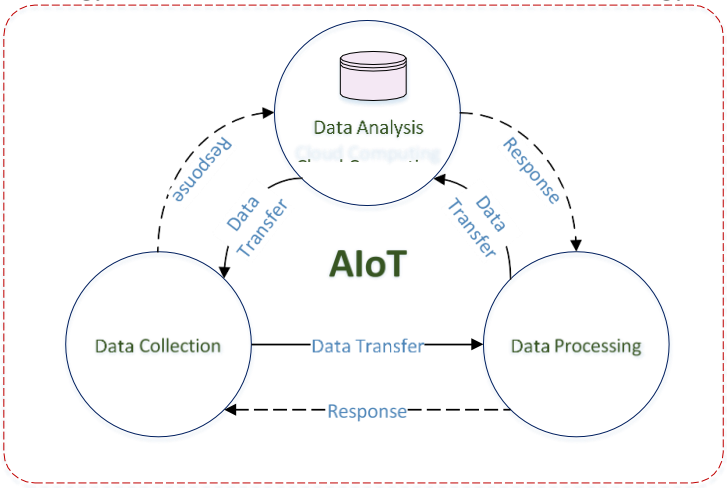

Figure 3. Artificial Intelligence of Things architecture

AIoE offers a unique opportunity to improve learning and personalization simultaneously These AI frameworks all work well with other AI frameworks. AIoE can analyze vast volumes of information sent and gotten through gadgets. Since the entire strategy is based on machine and computer programs, it can be completed without human intercession, killing the blunders caused by human botches and moving forward in precision.

As a result, the likelihood of misfortune is enormously decreased, since disappointment is recognized some time recently it breaks and harms another portion. This will, without a doubt, result in noteworthy fetched investment funds for giant companies and offer assistance to them in maintaining a strategic distance from trade issues. Before sending data from one device to another, the AIoE ecosystem analyzes and summarizes it. As a result, large amounts of data are compressed into a manageable size, enabling the connection of a large number of IoE devices. Overall, AIoE has the potential to provide you with the best solution for an enhanced system performance experience. You can improve your business by integrating AI and data received from IoT devices. Integrating two advanced technologies leads to intelligent devices that help companies make strategic decisions with zero error and maximum security. The framework of AIoE is shown in Figure 4.

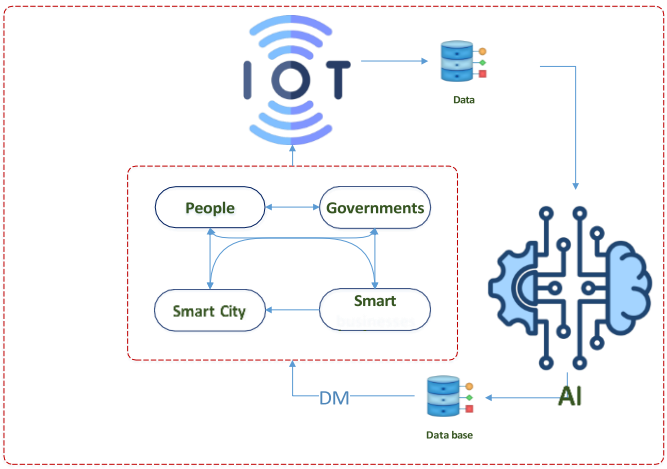

Figure 4. Framework of Artificial Intelligence of Everything

Although AI and IoE are two different technologies, their combination can improve various processes and applications more efficiently, intelligently, and effectively.

Green AIOE Based Supply Chain

With the growth and development of transformative technologies, the green development of these technologies is increasing every day. A green supply chain refers to a set of processes used during a product's design, production, distribution, consumption, and recycling to minimize the harmful effects on the environment and the consumption of non-renewable energy resources. This is why GSCM is considered a modern but necessary management model to protect the environment.

Green production: In many countries, it is known as clean production, during which the least pollution enters the environment.

Green consumption: choosing products and services that are produced with complete compatibility with the environment and not using products that can be harmful to the environment.

As a powerful technology that can extract data on all things, processes, and people, AIoE technology can support green and sustainable supply chains. IT technology can include all chain elements from procurement to sales and distribution. Continuous monitoring of supply to confirm sustainable and environmentally friendly raw materials is one of the most basic functions of this technology in the collection and learning analysis of data in the green development of processes. It is monitoring the production process with an emphasis on reducing energy consumption, monitoring and measuring the production of environmentally friendly products using IoE systems, comprehensive monitoring of the optimal performance of production systems and preventing destructive functions, and monitoring the health of employees by examining all aspects of the conditions. Health in the operating environment, timely distribution monitoring, and emphasis on environmentally friendly distribution processes are among the functions of the green AIoE system in the supply chain processes. Therefore, it can be easily seen that this powerful technology in supply chain processes has amazing green effects. Of course, this issue should also be considered, as it brings challenges. One of the most critical challenges is security and privacy. Of course, AIoE is defined as a technology that goes beyond the fifth industrial generation and is therefore considered a technology with high analytical power speed and maximum security.

Conclusion

Smart supply chain is an innovative approach to supply chain management that uses various IT methods to automate all parts of the process. In this way, it is possible to predict the necessary quantities of each product in the chain at all times, identify bottlenecks, and view data related to inventory and their correlation in real time. This facilitates the management of the entire chain, enabling companies to make informed decisions about managing their resources and react quickly to changes in demand or unexpected disruptions in the supply chain. The important point is that a truly "intelligent" supply chain is a self-healing and flexible system that can operate in an unpredictable environment. A smart sup- ply chain also involves seamless information sharing, a partial reliance on automation, and continuous optimization of workflows based on real-time data.

This research article tried to examine and evaluate a green supply chain's dimensions, components, and critical features, emphasizing the combined technology capabilities of AIoE. Furthermore, a conceptual framework for green supply chains based on AIoE has been presented by determining the causal relationships of all actors in green supply chain processes. The opinions of active experts in the field of industry and academic experts have been used to validate this framework. Experts have approved the final cut. Examining this framework can provide a detailed insight into understanding these smart, green, and sustainable systems.

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