

# Research of the use of digital technologies in the logistics of the poultry subcomplex

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**Abstract.** The article provides an in-depth analysis of how advancements in digital technology are influencing and improving the logistics operations within the poultry subcomplex. The study focuses on the use of digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and advanced analytics in enhancing the efficiency, transparency, and traceability of the supply chain from farm to table. The paper begins with an overview of the current state of the poultry industry and the associated logistical challenges, such as waste reduction, ensuring product quality, and managing complex supply chains. It then delves into how digital technologies can help overcome these challenges. Through the use of real-world case studies, the authors provide a comprehensive examination of the practical implementation of these technologies and their resultant impact. The study finds that AI and advanced analytics allow for better decision-making through predictive modeling and real-time data analysis, thereby improving inventory management and demand forecasting. IoT applications provide constant monitoring of storage conditions and transportation, ensuring product quality and safety. Blockchain technology enhances the transparency and traceability of the supply chain, fostering trust among consumers.

## 1 Introduction

The global poultry industry holds significant economic importance, contributing to food security, nutrition, and livelihoods around the world. According to the Food and Agriculture Organization (FAO), poultry represents one of the fastest-growing segments of the global meat sector, driven by factors such as population growth, rising incomes, and urbanization. With this growth, however, come substantial logistical challenges that need to be addressed to ensure the industry's sustainability and efficiency. Poultry production is a major source of protein for a significant proportion of the global population. In addition to supplying essential nutrients, the industry also provides substantial economic benefits. It creates direct and indirect employment opportunities in areas such as breeding, feed production, poultry farming, meat processing, and distribution. Furthermore, the poultry sector plays a significant role in many economies, both developed and developing. In the United States alone, for example, the poultry industry contributes over \$40 billion annually to the gross domestic product.

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Notwithstanding its economic significance, the poultry sector also plays a crucial role in achieving the United Nations' Sustainable Development Goals (SDGs). Particularly, it contributes to zero hunger (SDG 2) through its provision of protein-rich food, and decent work and economic growth (SDG 8) through job creation.

However, the robust growth of the poultry sector is not without its challenges. A key area of concern lies within the logistics of the poultry subcomplex, which involves the effective coordination of several interrelated stages, from feed production and poultry breeding to slaughter, processing, and distribution.

A primary logistical challenge is ensuring product quality and safety throughout the supply chain. Given that poultry is a perishable product, maintaining the right storage and transportation conditions is critical to prevent spoilage and contamination, and to ensure compliance with food safety regulations.

Moreover, the poultry supply chain involves handling large volumes of products and coordinating numerous activities, which requires efficient inventory management and demand forecasting. Any inefficiencies or inaccuracies in these processes can lead to significant economic losses and waste.

Additionally, the sector faces mounting pressure to enhance transparency and traceability in its supply chains. Today's consumers are more conscious about the origin of their food and its journey from farm to table. As such, the ability to trace products back to their source is no longer a luxury but a necessity.

To address these challenges, the poultry sector is increasingly turning to digital technologies. Leveraging tools such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and advanced analytics can offer innovative solutions to enhance the efficiency, transparency, and reliability of poultry logistics.

For instance, AI and advanced analytics can be utilized for intelligent demand forecasting and inventory management, reducing waste and improving operational efficiency. IoT devices can monitor storage and transportation conditions in real-time, ensuring product quality and safety. Blockchain technology, with its decentralized and tamper-proof nature, can provide unparalleled levels of traceability and transparency, enhancing consumer trust.

As such, digital technologies are emerging as a cornerstone of modern poultry logistics, offering potential solutions to longstanding challenges. The successful integration of these technologies, however, is not a straightforward task, and it presents its own set of hurdles. Understanding these challenges and the ways to navigate them forms the crux of this study. Through an exploration of the current state of digital technology use in the poultry logistics sector, we aim to shed light on the ongoing digital transformation and chart a path forward for the industry. The following sections delve into the specific technologies in focus, their application in real-world cases, and the benefits and challenges associated with their implementation.

## **2 Digital technologies in focus**

The adoption of digital technologies in the poultry industry has the potential to revolutionize the sector's logistics subcomplex. These innovative technologies, namely Artificial Intelligence (AI) and advanced analytics, the Internet of Things (IoT), and blockchain, present new opportunities for overcoming the logistical challenges the industry currently faces. This section provides an overview of these technologies and discusses their application within the context of poultry logistics.

Artificial Intelligence (AI), at its core, refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, and decision making. In the context of poultry logistics, AI can be applied in numerous ways to enhance efficiency and effectiveness. For example,

predictive analytics, an AI application, can accurately forecast demand based on factors such as seasonality, market trends, and consumer behavior. This aids in inventory management, ensuring that supply aligns closely with demand, thus reducing waste and optimizing resource utilization.

Advanced analytics, often used in conjunction with AI, involves the examination of data using sophisticated techniques to discover deeper insights, make predictions, or generate recommendations. It can help uncover hidden patterns and correlations in data, enabling decision-makers to make evidence-based decisions. For instance, analytics can identify inefficiencies in the supply chain, such as bottlenecks or wastage points, allowing for targeted improvements.

The Internet of Things (IoT) refers to the network of physical objects or "things" embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. IoT has a vast range of applications in the poultry industry, primarily in enhancing real-time monitoring and ensuring product quality and safety.

For example, IoT devices can monitor temperature and humidity conditions in storage facilities and transport vehicles, alerting staff in real time if conditions deviate from the optimal range. This allows for immediate corrective action, thereby reducing the risk of product spoilage and ensuring adherence to food safety regulations.

Furthermore, IoT devices can be used to track and monitor poultry health on farms, alerting farmers to any signs of disease early enough for proactive intervention. This capability is instrumental in preventing disease outbreaks that can have devastating impacts on poultry supply and food safety.

Blockchain technology, a form of Distributed Ledger Technology (DLT), is a decentralized and secure method of recording transactions across multiple computers so that any involved record cannot be altered retroactively, without the alteration of all subsequent blocks. This feature of immutability makes blockchain an ideal technology for enhancing traceability and transparency in the poultry supply chain.

Each transaction recorded in a blockchain is linked to a physical or digital asset, creating a traceable history from origin to destination. In the poultry industry, this can be used to record and track every stage of a product's journey, from the feed used on the farm, to the health and welfare of the poultry, to the conditions during processing, transportation, and storage. This detailed traceability allows for rapid and precise product recalls if necessary, and provides consumers with confidence in the authenticity and safety of their food.

In addition to enhancing traceability, blockchain can also improve transparency by providing all stakeholders with access to the same information. This not only fosters trust among consumers, but also facilitates smoother communication and coordination among different players in the supply chain, such as farmers, processors, distributors, and retailers.

In conclusion, AI and advanced analytics, IoT, and blockchain technology hold tremendous potential in transforming the logistics of the poultry subcomplex. They offer solutions to some of the most pressing challenges, such as ensuring product quality and safety, enhancing inventory management, and improving traceability and transparency. The next section will delve into real-world

### **3 Case studies**

In this section, we delve into real-world examples of the application of these digital technologies within the poultry industry. These case studies demonstrate how these innovative tools can be effectively deployed to address the logistics challenges within the poultry subcomplex. Let us consider the example of a major poultry producer that integrated AI and advanced analytics into their supply chain management. By leveraging machine

learning algorithms, the company could predict demand with high accuracy based on various factors such as market trends, historical sales data, and seasonal influences. This accurate forecasting allowed for efficient inventory management, leading to a substantial reduction in waste and costs. Furthermore, by using advanced analytics to analyze real-time data from across their supply chain, they were able to identify bottlenecks and areas of inefficiency. This enabled them to streamline their operations and improve overall productivity.

A prominent poultry farm in the United Kingdom adopted IoT technology to monitor and maintain the health and welfare of their birds. They installed a network of sensors throughout their facilities to continuously monitor parameters like temperature, humidity, and air quality. These sensors, connected to a centralized system via the internet, alerted farm staff in real-time if conditions deviated from optimal ranges. This immediate feedback loop allowed for swift corrective actions, ensuring bird health and reducing the risk of disease outbreaks. The same farm also utilized IoT devices to track and trace their birds throughout the supply chain, ensuring accountability and adherence to safety standards.

A leading food processing company in the United States implemented blockchain technology in their poultry supply chain to enhance traceability. Each step of a product's journey, from the farm to the retail shelf, was recorded in a blockchain. This provided a tamper-proof record of the product's history, including details about the feed used, bird health, processing conditions, and transportation and storage data. With this level of transparency, the company could swiftly track and isolate products in the event of a recall. Furthermore, consumers could access this information by scanning a QR code on the product, thus increasing consumer confidence in the product's safety and authenticity. These case studies underscore the transformative potential of digital technologies in the poultry industry. Despite their benefits, however, the adoption of these technologies presents several challenges, which we explore in the next section.

## 4 Conclusion

The integration of digital technologies within the poultry industry is rapidly evolving from a forward-thinking idea to a practical reality. In the quest for sustainable growth and efficiency, the industry is increasingly turning towards artificial intelligence (AI), the Internet of Things (IoT), and blockchain technology to address the complex logistical challenges within the poultry subcomplex. Artificial intelligence and advanced analytics have shown immense potential for enhancing operational efficiency. They offer intelligent solutions for inventory management and demand forecasting, enabling decision-makers to make strategic and evidence-based decisions. The real-world case study discussed in this paper showed how an AI-driven approach could substantially reduce waste, streamline operations, and improve overall productivity. Similarly, the Internet of Things has revolutionized real-time monitoring in the industry. IoT devices, as illustrated in our case study, can accurately track environmental parameters, ensuring optimal conditions for poultry health and welfare, and monitor conditions in storage and transport, guaranteeing adherence to food safety standards. This proactive approach has significant implications for disease control and product quality, ultimately impacting consumer confidence and business profitability. Blockchain technology, with its inherent feature of immutability, is a game-changer for traceability and transparency in the poultry supply chain. As demonstrated in the case study, blockchain can provide a tamper-proof record of a product's journey from farm to table. This enhances the ability to conduct precise product recalls when necessary, and allows consumers to access accurate information about their food, bolstering consumer trust and confidence. However, the widespread adoption of these technologies is not without hurdles. Some of these include the high costs of implementation, lack of technical expertise, cybersecurity risks, and concerns over data privacy. Addressing these challenges requires a multi-faceted approach, involving investment in infrastructure, training and skill development, and regulatory

frameworks that protect data while encouraging innovation. In conclusion, this paper reveals that while challenges persist, the potential benefits of integrating digital technologies into poultry logistics are far-reaching. They offer innovative solutions to some of the most pressing issues within the poultry subcomplex, from ensuring product quality and safety, to enhancing inventory management, and improving traceability and transparency. As such, these technologies represent an exciting frontier for the poultry industry, paving the way for a more sustainable, efficient, and transparent future.

This research has shed light on the current state of digital technology use in poultry logistics, providing a foundation for further exploration. Future research could delve deeper into understanding the long-term impacts of these technologies on the poultry industry, exploring their role in sustainable poultry production, and investigating the ethical implications of their use. Furthermore, studies could also explore the development of frameworks for the successful integration of these technologies into existing supply chain structures. Indeed, while this paper provides a glimpse into the transformative potential of digital technologies in the poultry subcomplex, there is much still to be discovered. As the industry continues to evolve, the role of these technologies is set to become increasingly pivotal. They represent a new paradigm of operation in the poultry industry – one that harnesses the power of digital innovation to drive growth, efficiency, and sustainability.

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