International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 5, Sep-Oct 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Smart Logistics

Matthew N. O. Sadiku[1], Paul A. Adekunte[2], Janet O. Sadiku[3]

[1]Roy G. Perry College of Engineering, Prairie View A&M University, Prairie View, TX, USA
[2]International Institute of Professional Security, Lagos, Nigeria
[3]Juliana King University, Houston, TX, USA

ABSTRACT

In the bustling realm of modern business, logistics stands as the backbone, orchestrating the flow of goods from point A to point B. As we advance through the digital age, the traditional logistics systems are rapidly evolving into "smart logistics." Smart logistics forms one of the fundamental pillar of the fourth industrial revolution "industry 4.0." It refers to the use of advanced technologies to enhance the efficiency, accuracy, and speed of logistics and supply chain operations. It encompasses all processes, from sourcing raw materials, warehousing, transportation, distribution, to final delivery of goods to customers. Smart logistics positions businesses at the forefront of industry advancements, propelling them into a new era of success. Smart logistics means less waste, fewer errors, and better service, making it a core part of logistics management today. This paper introduces the meaning of smart logistics and provides real-world applications driving its adoption.

KEYWORDS: *smart technologies, smart cities, smart logistics.*

How to cite this paper: Matthew N. O. Sadiku | Paul A. Adekunte | Janet O. Sadiku "Smart Logistics" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-5, October 2025, pp.17-25, URL: www.ijtsrd.com/papers/ijtsrd97425.pdf

IJTSRD97425

INTRODUCTION

Logistics constitutes the heart of the operation of modern transport systems**.** Modern economy depends on logistics to support the flow of goods. Logistics and transport activities are well known to have a major impact on the environment. Logistics is the integrated management of all the activities required to move products through the supply chain. The activities include the forward and reverse flows of products, information and services between the point of origin and the point of consumption. These activities are coordinated in a such as way that meets customer requirements at minimum cost. They play a critical role in enabling manufacturers, distribution channels, and retailers to work in harmony [1].

Logistics involves concepts related to the production, distribution, consumption, and disposal. It may be regarded as a tool for moving raw materials, goods and people to the right place at the desired time. But traditional logistics activities consume a lot of resources and cause much pollution. It cannot meet the requirements of modern society due to huge impact on the environment. To develop modern logistics, environment concerns should be given priority. Traditional supply chains are not enough anymore, and companies need to come up with smart solutions to achieve supply chain competitiveness. Smart logistics is an effective way to meet the challenges of fast-changing customer expectations, take opportunities brought by new technologies, and facilitate new business models. Smart logistics system refers to a smarter way to manage the supply chain operations.

WHAT IS SMART LOGISTICS?

The word "smart" means clever, sophisticated, or intelligent. In modern society, it is also used to refer to high performance. It is used in the field of logistics as the expression "smart logistics." Smart logistics is a system that aims to improve the efficiency of logistics by introducing IT for the first time or combining it with existing systems. Smart logistics was born as a new form of logistics that uses IT to address various logistics challenges and work to improve efficiency [2].

Smart logistics refers to the integration of advanced technologies, such as IoT, AI, robotics, drones, and big data, into logistics operations to enhance efficiency, visibility, and responsiveness across the

supply chain. It leverages information technology for comprehensive analysis, timely processing, and self-adjustment across all facets of logistic, including transportation, warehousing, packaging, loading and unloading, distribution processing, and information services. Some logistics operations may include the use of radio-frequency identification. Smart logistics leverages real-time data, predictive analytics, and automated processes to enhance your logistics operations, keeping you in control at every step. It uses IT and automation to boost efficiency in supply chains [3]. Technologies used in smart logistics include AI, IoT, robotics, drones, 5G, and edge computing. Figure 1 is a representation of smart logistics [4].

Smart logistics is essential for companies aiming to remain competitive in today's fast-paced market. By using technologies like IoT and predictive analytics, businesses can reduce inefficiencies, improve response times, and deliver a better customer experience. It plays a crucial role in modern supply chain management, leveraging advanced technologies to enhance efficiency, visibility, and decision-making across various aspects of the logistic process. More and more companies are using smart logistics solutions that include scalable, flexible, and future-oriented technologies to make operations more efficient, effective, and smarter.

PLAYERS IN SMART LOGISTICS

Many prominent companies are already utilizing smart logistics solutions to reduce costs, decrease fuel consumption, and enhance delivery accuracy. Several companies lead the way in smart logistics, including the following [5-7]:

- *JUSDA* stands out as a pioneer in smart logistics. The company emphasizes efficiency and sustainability through innovative solutions. By leveraging cutting-edge technology, JUSDA redefines the logistics landscape. They offer new services, like regular freight trains in Europe and smart warehouse management. Their focus on efficiency and smart logistics helps customers do better in supply chain management..
- *Amazon*, as one of the world's retail giants, has taken its logistics to an advanced level of digitization. The use of robots in warehouses, advanced predictive algorithms for demand forecasting, and fast drone delivery systems are among the company's innovative actions. Automated systems pick, pack, and sort items with high precision. This speeds up order fulfillment and reduces errors.
- *DHL* invests heavily in AI-driven supply chain management software. These systems optimize routes and improve delivery times. One of the smart solutions for logistics DHL is using smart trucks with sensors, which allow the company to know where the cargo is in real-time, besides regulating temperature.
- *UPS* explores autonomous vehicles for package delivery. Self-driving trucks and drones enhance efficiency and reduce operational costs.
- *Carrefour*, a European retailer, is using blockchain to track its iconic chicken product. With this technology, the company tracks and traces stock cuts and labor costs reduces waste, and keeps supply information in real-time.
- *WeWork* faced growing challenges in managing freight and mail across its flexible office spaces. Manual intake processes slowed down operations and made tracking unreliable. As volume increased, the company needed a solution that could scale without overloading staff or adding expensive infrastructure.
- *Maersk,* one of the largest shipping lines globally, uses blockchain technology for transparency in the maritime supply chain. This technology has reduced customs clearance times and cut office costs.

APPLICATIONS OF SMART LOGISTICS

Smart Logistics emerges as the linchpin for seamless and efficient supply chain operations. Internet of things applications in supply chain management and logistics has a vast range of applications. Common real-world applications driving the adoption of smart logistics include the following [8-10]:

- *Real-time Tracking:* Smart logistics tracking starts with sensors. For logistics operations, real-time tracking of goods and shipments is one of its crucial applications IoT facilitates the tracking and monitoring of goods, brings more transparency to the communication process, and supports planning precision. Tracking in smart logistic involves the use of advanced technologies to monitor and trace the movement and status of products, assets, and shipments throughout the entire supply chain. It extends beyond product movement to include assets such as vehicles, containers, and equipment. Supply chain managers can attach interconnected IoT devices to products or storage containers. The GPS satellites pick up location information transmitted by IoT devices. It makes tracking the movement of goods and shipments easier. Also, timely intervention by managers helps avoid delays or loss of goods. The fusion of RFID and IoT has birthed a paradigm shift in asset tracking and

management, offering unparalleled precision. Figure 2 shows real-asset tracking [11].

- *Smart Warehouse:* Robotics play a crucial role in modern warehousing. Companies now view warehousing and distribution as organizational priorities. A smart warehouse uses machines and computers to complete everyday operations like shifting racks, labeling, and more. It was something humans previously performed. Space optimization is a hallmark of smart logistic warehouses. The technologies employed help in better organizing the warehouse layout, maximizing storage capacity, and improving overall spatial efficiency. For example, Amazon uses robots to perform all tasks that require rushing around and lifting heavy loads. Figure 3 shows a smart warehouse [12].
- *Smart Transportation:* Transportation remains a pivotal element in the logistics equation, and smart logistics revolutionizes this component through innovative technologies. From autonomous vehicles to drone deliveries, the landscape of transportation is undergoing a significant transformation. Self-driving trucks and delivery vehicles are at the forefront of modern logistics advancements. Smart transportation is not just about new gadgets; it is also about utilizing real-time data to optimize routes, manage fleets, and ensure vehicles operate at peak efficiency. Smart trucks will be able to transport goods accurately and in less time without human intervention. Major companies like Tesla and Volvo are currently testing such technologies. Figure 4 shows a truck for transportation [13], while Figure 5 shows some ships for transportation [14].
- *Monitoring Storage*: Smart logistics systems incorporate sensors to monitor environmental conditions during transportation and storage. This includes temperature, humidity, and other relevant factors. Environmental factors are one of IoT's most important applications in the supply chain. It would include temperature, light intensity, pressure, humidity, exposure to the atmosphere, and much more. Supply chain managers help monitor and maintain the required environmental thresholds within the shipment and other storage facilities like warehouses.
- *Predictive Analytics:* Smart logistics is shifting from reactive to predictive. Predictive analytics play a crucial role in smart logistics. It helps optimize equipment maintenance by using sensors, AI, and data science. It minimizes the maintenance costs and maximizes uptime. Smart logistics systems use predictive analytics to optimize inventory levels. By analyzing historical data and market trends, managers can forecast demand more accurately, preventing stockouts or overstock situations. Retailers leverage big data and predictive algorithms to optimize package shipment, while advanced technologies like autonomous drones revolutionize last-mile deliveries. Predictive analytics help forecast demand spikes during holidays.
- *E-commerce*: Efficient logistics is the backbone of e-commerce, encompassing the entire process from manufacturers and wholesalers to fulfillment centers and end customers. Smart logistics infrastructure plays a crucial role in the success of e-commerce, ensuring smooth operations and timely delivery throughout the supply chain. To achieve operational excellence, e-commerce retailers combine cutting-edge technologies with cost-effective operations. Emerging technologies, including IoT, drones, and autonomous vehicles, have the potential to improve logistics operations further, ensuring faster and more precise deliveries. Figure 6 shows how employees arrange packages at a Chinese e-commerce company's warehouse in Mlolongo, Kenya [15].
- *Autonomous Vehicles and Drones:* Autonomous vehicles and drones are revolutionizing smart logistics. Self-driving trucks transport goods without human intervention. This reduces the risk of accidents and delays. Drones deliver packages to remote areas quickly. They bypass traffic and reach customers faster. Drone delivery is shown in Figure 7 [9].

BENEFITS

There are many benefits one can get from using smart logistics. The primary benefits include increased operational efficiency, cost savings, customer satisfaction, enhanced transparency, automation, warehouse sortation, better control over operations, etc. Smart logistic empowers businesses to navigate the complexities of inventory management, ensuring increased productivity and customer satisfaction. Smart logistics connects supply, tracking, and operations into one unified network. It is a way to gain a competitive advantage. Other benefits include the following [16,17]:

- *Automation*: Automated systems replaced some manual processes. This shift improved efficiency. Automation helped cut down on labor costs. Smart logistics introduce automation technologies, minimizing manual intervention and optimizing warehouse processes. This leads to improved organization and management of stored

products, reducing the chances of human errors. Smart logistics solutions help businesses automate the most time-consuming and complicated documentation tasks. Warehouse automation is another considerable benefit of IoT for the supply chain management. It reduces human effort and errors while enhancing the efficiency and accuracy of operations. For example, Amazon uses robotics extensively in its warehouses. Figure 8 shows the use of robots in a warehouse [12].

- *Cost Reduction:* Smart logistics help cut costs. Freight smart logistics platforms lower fuel use and route miles. Automation reduces the need for manual labor. This lowers payroll expenses. AI-driven systems minimize errors in order processing. Fewer mistakes mean less money spent on corrections. Companies save on repair costs and avoid downtime. Overall, smart logistics make operations more cost-effective. Businesses using smart move logistics systems have cut transport costs significantly, based on internal fleet optimization data.
- *Quality Product:* Companies need to make sure that product damage is avoided. While there is always a percentage of damaged products, your goal is to make this number a minimum. A company needs to ensure that its production processes run smoothly and needs to prevent defective parts or products from being assembled. However, if a company deals with sensitive products that may break or deteriorate over time or when not kept at a specific temperature, for example, it needs to be extra careful.
- *Detecting Delivery Shortages*: Another major benefit of using smart solutions logistics is related to detecting delivery shortages. The truth is that many materials take a lot of time to arrive at the production site. There are always some blind spots along this route where you do not have any information regarding these materials. Although this happens when materials are transported by land, if they are transported by sea the problems can be even bigger. The worst part of this all is that it may take you a lot of time, even weeks, to discover what is going on and to fix it. Naturally, this causes disruptions in production. Using smart logistics solutions, you can better control your materials and keep track of your current stocks and where the materials you ordered are in real-time.
- *Delivery Reliability*: Another big benefit is reliability. There is no question that delivery delays cause a lot of financial damage to a company. This is another reason why you should consider using smart logistics. After all, it will help you answer many questions such as how reliable is your supplier. Expedited shipping providers prioritize your freight, so it gets the attention and care it deserves during transit.
- *Customer Satisfaction:* Smart logistics contribute to better customer satisfaction by providing accurate and transparent information about order status, delivery times, and product availability. Smart logistics tracking and same-day delivery options drive higher satisfaction. This improved customer experience positively impacts brand loyalty and reputation. A seamless smart logistics system not only optimizes operations but also enhances customer interactions. By combining advanced technologies, cost-effective operations, and a trained workforce, retailers can ensure prompt and cost-effective delivery to customers. The smooth functioning of supply chains results in the managers meeting their end customer expectations in terms of the time and quality of deliveries. Further, they can even monitor shipments and products in real-time and accurately estimate the delivery time. By identifying delivery issues early, they can take corrective measures. They can also make alternate delivery arrangements to meet service-level agreements.
- *Sustainability:* Smart logistics also helps the environment. Using data to plan routes and manage inventory saves fuel and cuts pollution. This matters as more companies want to be eco-friendly. Sustainability becomes a priority in logistics. Companies adopt green practices to reduce environmental impact. Electric vehicles replace traditional delivery trucks. Solar-powered warehouses cut energy consumption.
- *Reduced Risks:* Smart logistics minimize operational risks by reducing human intervention in specific tasks. This, in turn, lowers the occurrence of accidents, such as collisions or spillage of hazardous products, promoting employee safety and preserving product quality.
- *Improved Productivity:* The combination of process automation, time savings, and enhanced control and precision results in improved overall productivity. Smart logistics contribute to higher profits for warehouse owners by streamlining operations and reducing costs.
- *Collaborative:* Smart supply chains also emphasize collaboration. Platforms that enable real-time communication between suppliers,

manufacturers, and retailers are integral in creating a synchronized and agile supply chain that responds swiftly to market changes.

CHALLENGES

There are some challenges in smart logistics. Labor shortage in the logistics industry is becoming a serious problem. In the logistics industry, there are still many inefficient manual processes. It is hard to connect new systems to old ones. More devices mean more risks for data safety and privacy. Other challenges include the following [7,16,17]:

- *High Initial Costs*: Setting up smart infrastructures such as sensors, tracking systems, analytical software, and staff training requires a significant initial investment. This may be a serious barrier for small and medium-sized companies.
- *Data Security and Privacy:* Data security remains a top concern in AI integration. Protecting sensitive information is vital. Companies must implement strong cybersecurity measures. Encryption and secure access controls safeguard data from breaches. Employees should receive training on data protection practices. Smart logistics and supply chain management depend on constant data flow. Without strong protections, that data is vulnerable. IoT sensors, in particular, can expose weak points if not properly secured. The use of smart technologies involves storing and transferring large volumes of data. If this data is not adequately protected, it may be exposed to security threats. Therefore, cybersecurity plays a crucial role in the success of this process.
- *Trust*: Trust is the final key to boosting your business, and it is one that you will find difficult to boost. When you work with suppliers and customers, you need to trust their integrity. This means that you need to perform due diligence on each party, as well as be confident in your decision-making.
- *Collaboration*: As IoT-based solutions use cloud and data analytics capabilities, they break the data silos giving one version of the truth to all teams across the value chain. It enhances collaboration between the teams and in turn, facilitates quick resolution of issues.
- *Regulatory Compliance:* Businesses need to comply with required local legal and compliance requirements. IoT helps businesses adhere to regulatory compliance and litigation prevention in terms of managing mandatory paperwork and complying with legislation.
- *Labor Shortage:* The labor shortage in the logistics industry, which is becoming more serious, is not only a matter of absolute numbers, such as the declining birthrate and the shrinking labor force, but also stems from the working environment. For example, in the transportation sector, long working hours and excessive work are seen as problems, leading to a labor shortage. Shifting to smart logistics systems means teams need new skills. Not everyone is ready for that. Without focused training, even the best systems fall short.
- *Resistance to Change:* Many logistics teams are used to familiar workflows. When new systems are introduced, they often face skepticism. This hesitation can slow down adoption and reduce early results.
- *Legacy Systems*: Older software and hardware often cannot connect with smart logistics systems. These gaps can limit visibility and disrupt logistics operations. Upgrading them takes time, money, and planning.
- *Scalability*: As your business grows, your logistics needs will evolve. Partner with a provider that can scale their services to match your new business demands.

CONCLUSION

Smart logistics means using advanced tools, like AI, IoT, sensors, and data, to make freight and cargo moves smoother and smarter. It refers to a smarter way to manage the supply chain operations. It is attracting attention in the logistics industry, and its adoption is progressing. Smart supply chain and logistics tools connect factories, trucks, and inventory systems without gaps. Smart logistics sensors and trackers can now determine what is wrong and what comes next [6]. Using smart logistics operations is non-negotiable if you want to stay competitive.

Smart logistics is very important for businesses today. It represents the future of supply chain management. The future for smart logistics is bright. As technology gets better, more companies will use these tools to compete. Forward-looking organizations leverage IoT devices to transform complex supply chains into fully connected networks. Those who fail to adopt these innovations will fall behind. More information on smart logistics is available from the books in [18-25] and the following related journals:

- Smart Cities
- International Journal of Logistics Research and Applications

REFERENCES

[1] M. N. O. Sadiku, S. R. Nelatury, and S.M. Musa, "Green logistics: A primer," *Journal of Scientific and Engineering Research,* vol. 6, no. 3, 2019, pp. 11-14.

[2] "What is smart logistics? What will change with the fusion of IT and logistics? Introducing the meaning and representative examples," https://www.penguinsolutions.com/en-us/resources/blog/smart-logisticsfusion-of-it-and-logistics

[3] "What is smart logistics?" https://www.buske.com/what-is/smart-logistics

[4] "Smart logistics key for competitiveness improvement in Vietnam: Experts," August 2025, https://logistics.gov.vn/smart-logistics-key-for-competitiveness-improvement-in-vietnam-experts

[5] Sancia, "The path to 2030: AI and robotics as catalysts for next-generation supply chain solutions," July 2024, https://www.jusdaglobal.com/en/article/future-smart-logistics-robotics-ai-transforming-supply-chains-20301/

[6] "Why multi-tenant properties need smart logistics platforms?" June 2025**,** https://packagex.io/blog/smart-logistics-solutions

[7] "Smart logistics: A transformation in global transportation industry," https://irsalogistics.com/smart-logistics-a-transformation-in-global-transportation/

[8] "IoT in supply chain and logistics: Role, benefits & use cases," January 2023, https://www.rishabhsoft.com/blog/iot-in-scm-and-logistics

[9] "Smart logistics for efficiency & innovation," https://dmsventures.sa/smart-logistics-for-efficiency-innovation-in-saudi-arabias-market/

[10] "Smart logistics for seamless shipping and tracking," https://qodenext.com/blog/smart-logistics/

[11] "Smart logistics," https://www.atlantikelektronik.com/en/solutions/smart-logistics/technical-solutions-for-smart-logistics

[12] "Malaysia's transformative vision in logistics: The smart logistics complex," https://www.mida.gov.my/malaysias-transformative-vision-in-logistics-the-smart-logistics-complex/

[13] "Smart logistics: Shaping the future of urban deliveries in India," https://sktranslines.com/smart-logistics-future-of-urban-deliveries/

[14] https://smarlog.com/

[15] F. Feifei, "Smart logistics help Chinese firms stay ahead of curve," September 2024, https://www.chinadailyhk.com/hk/article/593128

[16] "Smart logistics: Benefits, solutions and strategies," https://aims.education/smart-logistics-and-smart-logistics-solutions/

[17] "What is smart logistics? Explained simply," https://www.jspinsider.com/what-is-smart-logistics-explained-simply/

[18] M. N. O. Sadiku, *Emerging Smart Technologies.* Author House, 2021.

[19] Z. Cui and X. Wang, *Smart Logistics & Supply Chain Information Platforms.* Royal Collins Publishing Company, 2022.

[20] P. Golinska-Dawson, K. Tsai, and M. Kosacka-Olejnik (eds.), *Smart and Sustainable Supply Chain and Logistics – Trends, Challenges, Methods and Best Practices: Volume 1 (EcoProduction).* Springer, 2020.

[21] H. Yu (ed.), *Smart Logistics in Industry 5.0.* Boca Raton, FL: CRC Press, 2025.

[22] A. Carter, *Logistics and Ocean Shipping in Supply Chain Management: Optimizing Global Trade with Smart Logistics, Ocean Shipping, and Supply Chain Strategies for ... Sustainability, and Competitive Advantage.* Independently published, 2025.

[23] A. Juan et al.(eds.), *Sustainable Transportation and Smart Logistics Decision-Making Models and Solutions.* Elsevier, 2018.

[24] A. Hlali (ed.), *Emerging Trends in Smart Logistics Technologies.* IGI Global Scientific Publishing, 2025.

[25] J. P. Nieves, *Smart Urban Logistics: Improving Delivery Services by Computational Intelligence.* Springer, 2022.

Figure 1 A representation of smart logistics [4].

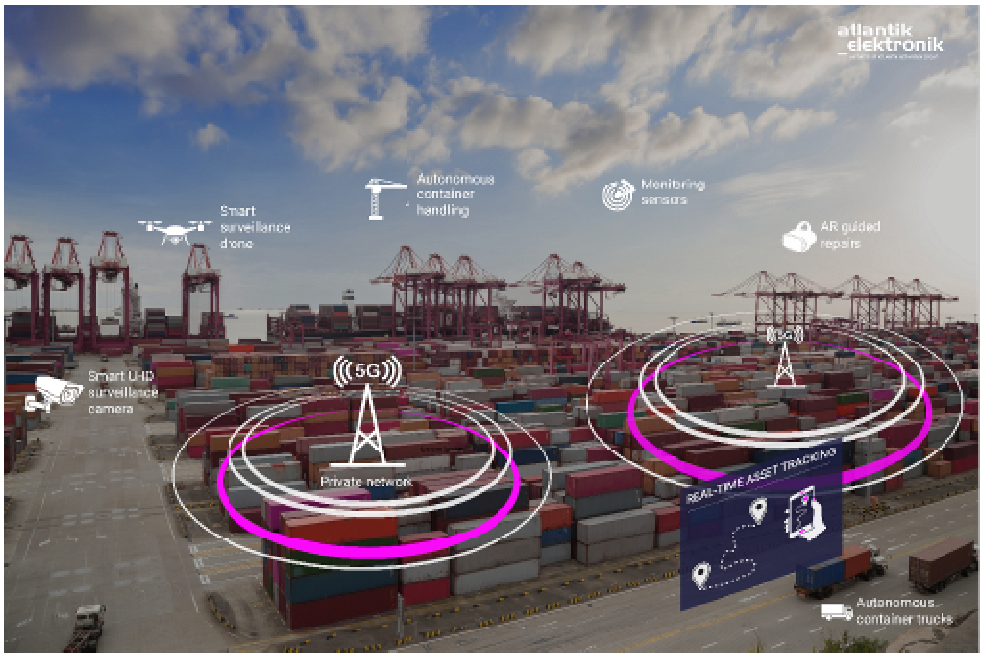

Figure 2 Real-asset tracking [11].

Figure 3 A smart warehouse [12].

Figure 4 A truck for transportation [13].

Figure 5 Some ships for transportation [14].

Figure 6 Employees arrange packages at a company's warehouse in Kenya [15].

Figure 7 Drone delivery [9].

Figure 8 Use of robots in a warehouse [12].