

OVERVIEW OF SMART LOGISTICS AND BLOCKCHAIN TECHNOLOGIES

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ABSTRACT

Rapid advancements in information communication technologies have significantly affected supply chains and organizations at large. Organizations using smart logistics derive benefits from its values within a supply chain system, such as improving the performance, sustainability, and competitiveness of an organization or supply chain system, or unit. This paper proposes that the implementation of smart logistics is not enough for companies to derive any significant value from it. The paper proposes a three-tiered solution centered on the application of blockchain technologies, including leanness and agility, digitization, connectivity, network, culture, people, and implementation as crucial toward quality and value processes and outcomes in smart logistics.

KEYWORDS

Smart Logistics, Industry 4.0, Blockchain Technology, Supply Chain

1. INTRODUCTION

Logistics is an important element of supply chain management. The basic function of logistics in supply chain management is to increase the overall value of each delivery. Logistics must determine applicable strategies to reduce and optimize the available resources to deliver on value. Blockchain technologies are changing how the logistics sector and enterprise function impacts the future. As a developing technology, blockchain allows decentralized and immutable storage of verified data (Issaoui et al., 2019). A typical logistics system operates in a supply chain that is complex and sensitive, hence needs to be properly developed as it is a determinant of quality processes and outcomes.

Advancements in technology in multiple sectors, particularly in distribution and supply chain sectors that seek to promote efficiency and effectiveness, are increasingly adopting smart logistics (ElMesmary & Said, 2019). Smart logistics can be defined as solutions to improve transport and warehousing by facilitating interconnectivity between different logistics networks (ElMesmary & Said, 2019). Smart logistics has been made possible through widespread digitization, the proliferation of sensing, data communication, computer, and revolutionizing technologies that have created smart solutions (Shee et al. 2021). These advancements have aided in improving the quality of processes and outcomes for business organizations that have incorporated smart logistics. As one of the advancements, blockchain technology's features such as sharing of information, security, traceability, and immutability have a favorable and strong impact on the integration of the entire supply chain infrastructure (Santhi & Muthuswamy, 2022).

Blockchain technology is promising, particularly its impact on smart logistics, but it is new. As a new technology, its applicability in solving complex world problems has not yet been fully explored, hence the need to determine its application and how it can be improved to address real-world problems.

As business processes and outreach become more expansive and complicated such as through the integration of online and offline channels and the collaboration of international stakeholders, smart logistics is increasingly becoming important. For example, the spread of retail and e-commerce has cultivated significant challenges in the global logistics industry, with estimates indicating that 2020 saw an increase of 43.6 trillion packages increased by 8.7% in 2020 (Feng & Ye, 2021). In China, the stress caused by the increasing logistics volume cost accounted for 14.1 yuan, which is 6% higher than in 2019 (Feng & Ye, 2021). The increasing use of smart logistics globally is meant to promote better outcomes and minimize the costs involved in logistics. Incorporating blockchain technology enhances the smart logistics function by increasing the credibility and operational efficiency of the logistics blockchain by strengthening system identity management and access control (Tang, 2020). A good business should manage to perform the important logistic function and derive value from it. The following paper examines the concept of smart logistics and how integrating blockchain technologies can increase its efficacies or efficiencies. The paper also evaluates the opportunities and challenges that come with incorporating blockchain technology and offers recommendations on how smart logistics can be improved using blockchain to make the supply chain more efficient and effective.

2. CHARACTERISTICS OF SMART LOGISTICS

The overarching smart logistics characteristics include visualization, automation, controllability, intelligence, informatization, and networking, as noted by Wu et al. (2020) as follows

A. Visualization

Visualization is about conveying information by using electronic information to employees and customers to ensure they can observe the real-time events of logistics.

B. Automation

Automated logistics can facilitate important actions such as information detection, processing, analyzing, manipulating, and controlling that can reduce workloads and ensure better speeds.

C. Controllability

Controllability is about identifying risks, formulation, and evaluating control measures, or can be surmised as a business oversight process.

D. Intelligence

Intelligence in smart logistics means that logistics can use big data and the internet of things to enable the attainment of comprehensiveness and improvement of operational efficiency.

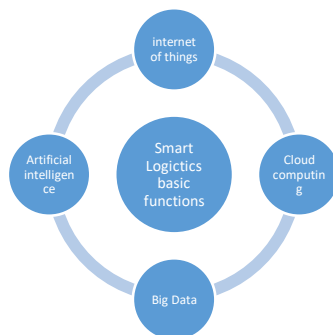


Figure 1. Basic functions of smart logistics

E. Informatization

Informatization is about integrating every researched object into a cloud database to facilitate better communication to assist in decision-making processes and outcomes.

F. Networking

Since logistics is about supervising and dispatching goods, the cloud services resulting from smart logistics can store, use, and track information to improve logistics and transportation.

3. THEORETICAL UNDERPINNINGS

The logistics sector faces growing challenges such as complexities, uncertainty, and other specific factors that result in supply or demand mismatch problems, excess inventories, stockouts, and delivery delays (Issaoui et al., 2019). Organizations facing these challenges need to be smarter and take advantage of the new industrial revolution called industry 4.0. Industry 4.0 takes full advantage of advancements in IT, telecommunication, electronics, and mechanical fields (Issaoui et al., 2021). Industry 4.0 should, therefore, be understood based on the competitiveness and framework that proposes to provide comprehensive solutions to important processes such as planning, implementing, and controlling procedures. Blockchain technology has a considerable impact on smart logistics because of its ability, reliability, traceability, the authenticity of the information, and intelligent contractual relationships that call for a major overhaul in the supply chain process (Santhi). The essence of blockchain is that it seeks to enhance the value of smart logistics at every value chain stage. A theoretical framework that can assist in a better understanding of how smart logistics works is the Magdeburg Logistics Model, which is noted to improve planning activities in smart logistics (Schmidtke et al., 2019). Therefore, planning is considered an important factor in smart logistics since it determines how the processes and outcomes will be carried out to demonstrate the greatest efficiency and effectiveness.

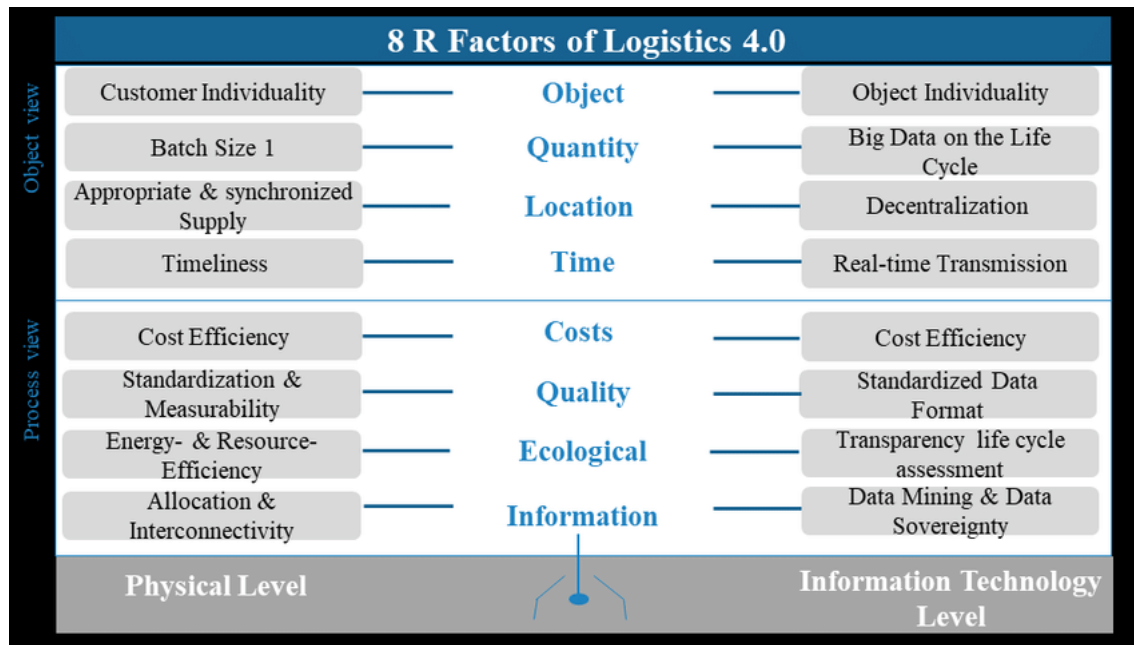


Figure 2. Schmidtke et al. (2019). Magdeburg logistics model – the smart logistics zone as a concept for enabling logistics 4.0 technologies. *Advanced Logistics System*, 13(1), 7-16.

4. OPPORTUNITIES FOR SMART LOGISTICS

The rapid pace of development that has affected every sphere of life has led to various developments in the recent past. Developments such as computer-aided design (CAD) and computer-aided manufacturing have also defined a significant part of development and logistics. For example, these developments have significantly influenced different industries in the form of product design, control, and physical manufacturing processes (Szymczak, 2019). Recent developments such as blockchain technology and smart logistics have significantly influenced the pace, operational efficiency, and effectiveness of business processes and outcomes. For example, blockchain technology has resulted in various opportunities in smart logistics that can be used to enhance its application within a specific context. These opportunities can be evaluated by examining an organization’s blockchain readiness check, as noted by (Pwc, 2020). The readiness check can include multiple parties sharing data by requiring views of common information. A second aspect is multiple parties updating data by taking actions that require data to be recorded and changed. This is followed by the requirement for verification, where participants need to trust that the recorded actions are valid. A fourth aspect is intermediaries add complexity, which is the removal of intermediaries to reduce costs and complexity. The fifth aspect is that time-sensitive interactions that can reduce delay have business benefits. The last aspect is transaction interaction, where transactions created by different participants depend on each other (Pwc, 2020). Various challenges in the supply chain affect the efficiency of smart logistics, hence the need to incorporate blockchain technologies to resolve the different challenges.

Smart logistics has created various opportunities in the field of supply chain management and for organizations as a whole. Blockchain technology and Smart Logistics have an important relationship. The former can significantly influence the latter’s operation mode and architectural system based on the trends in information, transport, finance, and management (Issaoui et al., 2020). The interrelationship between the two can be better understood by examining the following figure.

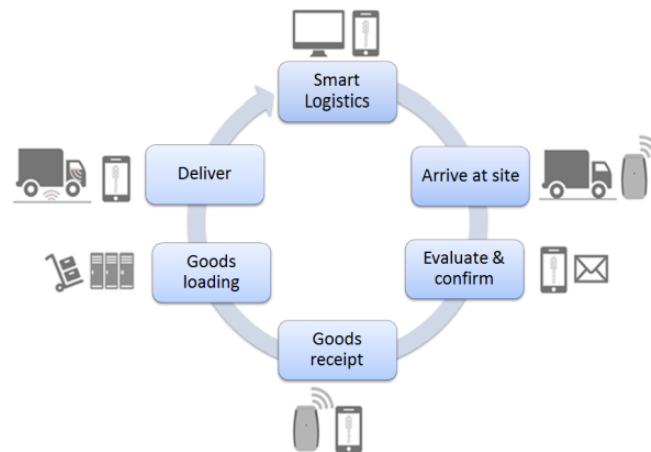


Figure 3. Interrelationship between Smart Logistics and Blockchain Technology (Issaoui et al. 2020).

The development of smart logistics is continuous, meaning that it will change over time as technology changes. As technology changes, data processing, networking, data capture, positioning, and sensing continuously emerge, indicating more possibilities for improving efficiencies (Szymczak, 2019). As a result, the use of smart logistics has obvious outcomes in improving operational processes and increasing the efficiency and effectiveness of outcomes. As technologies continue to evolve, it is expected that the smart logistics role in supply chain

management and organizations at large will increase significantly. Evolving technologies such as blockchain increase operational performance while also ensuring better reliability and security of shared information (Issaoui et al., 2020; Berneis et al., 2021).

Further, the following are some of the ways the adoption of blockchain technologies in smart logistics can enhance supply chains and assist organizations in fulfilling their potential, as noted by facilitating effective data collection and acquisition (Woshchank & Zsifkotvis, 2021; Wu et al., 2022). Smart logistics can assist supply chains and organizations to have enhanced control of the processes that are based on real-time information. Another point is that smart logistics is dynamic and situation-oriented to the extent that it can design adaptive and self-controlling systems. Smart logistics can also lead to better decision-making processes through data analyses. Smart logistics can also lead to the development of flexible and customized adaptation of products, services, and processes. Smart logistics can also assist supply chains and organizations in individualizing designs, configuring options, orders, planning procedures, and production processes, and providing opportunities for review. Smart logistics also leads to better human and machine interaction, improving work design and outcomes. Smart logistics applied together with blockchain technologies can enhance the transparency and traceability of the entire supply chain system by providing end-to-end transparency, monitoring performance, and increasing real-time visibility (Pwc, 2020). Blockchain can also enhance the security, immutability, and authenticity of logistics such as by authenticating data, detecting fraud, and preventing theft. Blockchain can also reduce process complexities in smart logistics by eliminating intermediaries, improving quality assurance, and increasing automation (Pwc, 2020). Blockchain technology can also improve operational efficiencies by improving compliance, reducing transaction costs, and reducing human error (Pwc, 2020). From the above, blockchain technologies have significant potential to improve the use and efficacies of smart logistics.

5. CHALLENGES OF SMART LOGISTICS

Smart logistics depends hugely on the availability and accessibility of information. Ding et al. (2020) contend that the more advanced information technologies available, the greater the chances of developing better communication technologies and management systems. Therefore, information availability, accessibility, and flow determine how well a smart logistics system operates. Any threat to the crucial information will affect the efficacy of smart logistics to deliver on its roles within a company or in the supply chain system. Making sure that all the necessary information is available will prevent any losses and increase the performance of the supply chain system and the organization at large. Since smart logistics is becoming increasingly complex, given that more parties are getting involved both directly and indirectly in supply chains, blockchain is emerging as a solution. As noted by Armugam et al. (2018), the following are some challenges, which include transparency, traceability, accountability, and liability, as explained below.

a. Transparency

Transparency is a fundamental element in supply chain management. Trust is a crucial element in smart logistics. Transparency can be better addressed using available information that should reach all stakeholders. The use of blockchain can develop trust in the use of smart logistics by storing decentralized and immutable storage of verified data (Issaoui et al., 2019). Blockchain provides end-to-end transparency that can resolve transparency issues.

b. Traceability

Traceability is about the ability to track goods across the entire supply chain. Traceability is not only a concern for the organizations but also for customers who would like to know the status of

their products. Blockchain addresses this challenge by offering full traceability, such as data analytics (Pwc, 2020).

c. Accountability and Liability

This is the information provided to the buyer regarding transportation, storage, insurance, customs, inspection, and other relevant logistics processes. Accountability and liability are making the smart logistics system of the best quality and ensuring that the users or customers get the best value. Blockchain offers verification platforms that can result in data documentation, such as in the form of a ledger.

6. RECOMMENDATIONS FOR USING SMART LOGISTICS

There is no doubt that the current Industry 4.0 is continuously transforming the supply chain and the organization in general. Many supply chains and organizations are increasingly adopting smart logistics as their preferred logistics method. For organizations keen on improving their processes and outcomes, the following are some strategies that they can adapt to ensure that their smart logistics are efficient and of better performance and competitiveness.

- Leanness and agility – Ensuring that the smart logistic is lean and agile. For example, ensuring that the process covers important logistics activities such as buffer stock, raw materials, and work in progress. Blockchain’s performance can increase leanness and agility, influencing smart logistics with optimization and tracking that can influence quality outcomes.
- Digitization, connectivity, and network – Investing in information communication technologies are important in smart logistics. However, these technologies are constantly changing, which may mean that a supply chain or organization uses outdated technologies. Supply chain units and organizations need to keep track of their technologies and check them against industry standards or innovate to stay ahead of the competitors, all of which can be enhanced using blockchain technologies.
- Culture, people, and implementation – A significant factor that drives successfully smart logistics implementation are the people. There is a continued need to have highly trained and qualified personnel to implement smart logistics daily. Organizations must then invest in highly skilled personnel to make the processes and outcomes as efficient and effective as possible. Blockchain can augment these features using its secured, verified, and validated platform.

7. CONCLUSIONS

This paper provides a primary analysis of smart logistics. The paper first introduces the concept of smart logistics and blockchain technologies, considers the theoretical underpinnings, the challenges and opportunities that exist in integrating blockchain technologies in smart logistics, and provides recommendations that relevant stakeholders can use. Also, this paper proposes an existing theoretical framework whose analysis can offer a better understanding of the use and impact of blockchain technologies in smart logistics in supply chains and organizations. The researcher believes that adopting the recommendations proposed can assist organizations in implementing smart logistics and how they derive value from it in the short-term and long-term.

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