

Chapter 28

Enhancing Supply Chain Traceability and Transparency Through Machine Learning Implementation

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ABSTRACT

The application of machine learning techniques to increase supply chain traceability and transparency is examined in this study. Recently, traceability systems have been created as useful tools for enhancing “supply chain (SC) transparency and accessibility”, particularly in industries with high stakes for consumer health and safety, including food and medicines. “Blockchain-related SC traceability” research has drawn a lot of interest in recent years, and it's safe to say that this technology is now the most promising option for offering services connected to traceability in SC networks. The many technical implementation facets of SC traceability systems powered by blockchain are thoroughly reviewed in this study. In a competitive global market, machine learning is helpful for data analysis, predicting disruptions, including verifying product authenticity. Its transformative potential can be seen in real-world applications including Walmart's rapid food traceability, Nestle's sustainable procurement, and Procter & Gamble's supplier risk management.

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I. INTRODUCTION

The contemporary global economy (Muralidhar, L. B. et al., 2024) has led to supply networks that are becoming more sophisticated as a result of this. These networks attract participation from a wide range of diverse stakeholders and extend their reach to several different geographical regions. The requirement to ensure that there is traceability and transparency within the supply chains is one of the issues that comes along with this level of complexity. This is necessary to guarantee that the items are legitimate, of high quality, and come from an ethical source. (Abbas, K. et al., 2020) presented, the implementation of machine learning (Deepa, R. et al., 2022), which is often referred to as ML, has emerged as a potent technology that can be utilized to address challenges of this sort. This opens the door to the prospect of enhancing supply chain traceability and preserving transparency. One of the subfields of artificial intelligence (Gupta, R. et al., 2023), machine learning, has emerged as a strong technology that has the potential to transform the operations of supply chain management. This is because machine learning (Pandey, B. K. et al., 2024c) is a subfield of artificial intelligence. To achieve these objectives, the purpose of this essay is to study the application of machine learning techniques. These techniques will be supported by empirical evidence that illustrates the revolutionary impact that machine learning has on supply chains (JayaLakshmi, G. et al., 2024).

In the setting of “supplier and consumer alliances and networks,” which is a more comprehensive context, SC management is regarded as a key strategy for constructing a competitive advantage among firms. This is especially true in the context of broader contexts. According to (Dasaklis, T. K. et al., 2022), SC management places a great emphasis on the interconnection of organizations, with companies working together to achieve the effectiveness of SC. This is something that has been observed during the study. Over the past few years, the rise of SCs has been driven by the multiple expectations of customers, which include enhanced flexibility, velocity, information, and product traceability (Tareke, S. A. et al., 2022). These requirements have been the driving force behind the expansion of SCs. This occurrence can be explained by a few different variables depending on the circumstances. (Cao, S. et al., 2021) explain the globalization of trade, which enables customers to obtain products more quickly; the acceleration of technological (Pandey, D. et al., 2024) imaginative thinking, which enhances the achievement of system and process goals; and the commitment to the environment, which compels customers to inquire about the long-term viability of their purchases are some of the factors that contribute to this phenomenon. Supply chain (Malhotra, P. et al., 2021) networks have become increasingly intricate as a result of a variety of variables, including globalization, fluctuating customer needs, expanding product lines, the unpredictability of supplier performance, and a host of other factors. Because of this, there has been a growth in the production of goods and commodities as well as the movement of those goods and commodities between geographically distant regions.

Traceability systems allow it to complete the needs of the law, interact with and comprehend the many SC actors upstream, educate consumers on the provenance and origin of products, generate confidence in customers, and fulfill the requirements of customers. All of these things are accomplished via the utilization of traceability systems. When traceability is put into practice, it has the potential to have a good impact on the market, decrease risks, prevent liability claims and litigation, and protect the process of SC networks operating appropriately. SC traceability systems are said to provide significant operational benefits. This is especially true if a product is made available for recall. If businesses gather and analyze data (Ekong, M. O. et al., 2023) on SC performance measurements more comprehensively, they have the potential to discover opportunities for enhancements throughout the entire SC, identify and

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