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# Blockchain Technology for Sustainable Industry

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## Abstract

Blockchain technology was invented in 2008 after emergence of Bitcoin in order to provide a quick, safe and secure way transacting digitally through electronic devices. The system was later adopted by banks and other industries in the economy since it was safe and transparent. This study discusses blockchain technology and its role in enabling sustainability among industries. The study relies on secondary data from a comprehensive literature review of thesis publications, peer-reviewed articles and, journals. The research has five sections: introduction, literature review, methodology, discussion of findings and conclusion. Data and findings were derived from systematic literature review through qualitative synthesis to assess the themes and conclusions of each journal and article. The study concludes that blockchain technology facilitates sustainability through green logistics and transportation, IoT enabled energy management and smart business models such as social manufacturing and circular economy.

## Keywords
Blockchain, Technology, Sustainable Industry.

## 1. Introduction
Blockchain (BC) technology refers to an advanced database mechanism that is meant to facilitate the transparent flow of information within a business network. The technology helps in keeping records of transactions and sharing them with important stakeholders through the application. Companies use BC technology to streamline digital workflows, manage supply chains and improve distribution efficiencies. Offering benefits such as reduced operating costs, transparency, improved monitoring and oversight throughout the product lifecycle (Kumar et al., 2022) BC technology provides companies with sustainable strategies a smart contracts are used to implement applications outside of the negative environment This technology can be used. Ethical and environmentally friendly business ensures the sustainability of businesses by facilitating corporate social responsibility to maintain economic, ecological and social sustainability, which provide business activities increased longevity and resilience This project therefore seeks to define the role of blockchain technology in business sustainability.

## 2. Literature Review
Agarwal (2023) explores the use of BC technology that enables sustainable improvement in HR performance, especially in the era of Industry 4.0. The study seeks to assess the utility of these technologies in enabling sustainable HR performance. In particular, Agarwal, (2023) explores the use of blockchain technology in recruitment, pay scale management, talent acquisition, and personnel record keeping. The study highlights that major HR challenges such as poor personnel management can be eliminated through the adoption of BC technology in human resource operations. Agarwal (2023) used secondary data from various websites to evaluate the impact of BC technology on HR activities. Agarwal (2023) found a positive correlation between blockchain technology application and improved HR operations. The study found that there was more streamlined efficiency in managing employees' salaries and records in organizations that adopted BC technology in their HR practices.

Shoker (2021) discusses the role of BC technology while enabling sustainable development. The study highlights the technology as a novel computing model and ecosystem for robust digital services. Shoker (2021) explains the possible

impact of BC technology in enabling the shift towards sustainability in societies by investigating the rationale behind blockchain accounts, their main characteristics and how they function. The study also evaluates the main challenges pertinent in blockchain technology and existing gaps that require improvement for it to attain its full potential. According to Shoker (2021) blockchain technology has led to significant improvements through increased trust, decentralization, automation, resilience and immutability. The technology is a multidisciplinary enabler, since it brings together different operations of the firm. Shoker (2021) concludes that blockchain technology has facilitated the transition to a sustainable society, although there exist challenges that have hindered its full applicability to enable sustainable industries and societies.

Kumar et al., (2022) studies the role of BC technology while promoting sustainability and green economies. The research highlights that application of blockchain technology facilitates sustainability by enabling transparency systems in the markets. The use of technology in manufacturing and supply chain management improves the efficiency of economic activities, leading to more sustainable production and supply of goods and services Kumar et al., 2013 . (2022) cite IBM and Deloitte as perfect examples of sustainability. Regarding the green economy, the study uses the Lablaco-Mitsui case study to illustrate the use of BC technology when promoting a green economy. Kumar et al., (2022) emphasize the importance of BC technology and its importance in achieving sustainability. The study confirms that blockchain technology enables sustainability by creating transparent businesses and improving their marketability. The study also highlights that BC technology moves organizations into a green economy by achieving benefits, reducing operating costs and focusing on a culture of sustainability.

The study by Kumar et al., (2022) is backed by Khurshid et al., (2023) who investigate the relationship between circular economy and sustainable blockchain technology. The study also evaluates the role of the technology in information sharing and how it maximizes efficiency by providing fast, quick, accurate and timely data. Other benefits of blockchain technology include fighting fraud due to its encryption and sophisticated features meant to guarantee information security. According to Khurshid et al., (2023), the green economy main objectives is to restore, re-manufacture, reclamation and reprocess. The study also assesses the contribution of blockchain technology in various industries. For instance, in the banking sector, the technology ensures there is safety in transactions especially in the current digital era.

BC technology has enabled massive revolutionary shifts in the economy such as the health sector. This is because the BC technology compliments IoT, thus increasing efficiency in treatments and enabling flow of information in health organizations. Also, the technology has also reduced costs, irregularities, information discrepancies and mishandling of patients' files. Khurshid et al., (2023) concludes that blockchain technology has increased transparency and decentralization, thus, minimizing fraud. Once combined with circular economy, the two paradigms have brought revolutionary changes in the global economy.

## 3. Methodology

This study relies on secondary data from peer-reviewed articles, academic journals and thesis publication. The secondary data will be collected through a comprehensive literature review of journals and articles that relate to BC technology and sustainability in industries. These articles will be outsourced from the most reputable electronic databases such as PubMed, Google Scholar, JSTOOR and IEEE Explore. To ensure the data is reliable, the study will only consider peer-reviewed articles and journals. To ensure accuracy, the study will only use articles that discuss BC technology and its application in enabling sustainable industries. The journals and articles must have been published between 2010 and 2023 to ensure accurate records. The blockchain technology emerged in 2008 after the introduction of Bitcoin. Therefore, incorporating articles from 2010 provides a clear history since the time this technology took shape and got incorporated in sustainability objectives.

Data from the selected journals and articles will be analysed through qualitative synthesis to evaluate the integral findings and themes of each study. Qualitative synthesis enables a researcher to identify the trends, themes, findings and conclusions of each research in order to infer them as the results of the study in question. In this case, the selected papers will be used to determine the role of BC technology in enabling sustainability in industries. The themes and findings of each study are used in the discussion section of this study to help identify the role of BC technologies and their impact on sustainable infrastructure. Data from the selected papers will be used to further support the research theme and present the findings and conclusions of this study.

## 4. Discussion

Blockchain technology has tremendous potential to ensure sustainability in sectors as diverse as banking, healthcare, food and tourism. As technology provides security and encryption that enables secure, fast and agile transfer of information across multiple departments of the organization Khanfar et al., (2021) argues that one of the functions of BC technology is to facilitate productivity and supply chain operations have been simplified. Technology improves efficiency by providing tracking, transparency, security, and time sharing, thus enabling sustainable production Continuous improvement in manufacturing implies products that reduce carbon emissions and other environmental impacts and products that are safer for workers' health Khanfar et al., (2021) concluded Blockchain technology improved manufacturing by centralization of information, secure sharing of data files and seamless automation that enabled the operation. In terms of sustainability, the study concludes that the technology enables use of systems that conserve energy, reduce negative environmental impact and also increase consumers', communities' and employees' safety.

Esmaielian (2020) discuss the future of blockchain and its contribution to efficient supply chain activities in industry 4.0. The study identifies four major benefits of blockchain technology which are, enabling smart energy management through IoT, increasing the efficiency of delivery and transportation, facilitating smart money models by providing an avenue for monitoring and reporting performance and lastly, enhancing product visibility across its entire lifecycle. These findings align with Khanfar et al., (2021) who asserts that blockchain technology streamlines the manufacturing and supply chain activities of an organization. Besides its operational efficiency, blockchain technology contributes to social and environmental sustainability by enabling the implementation of circular economy which focuses on reprocess, recycling and re-manufacturing (Kumar et al, 2022). Therefore, blockchain technology facilitates sustainability through green logistics and transportation, IoT enabled energy management and smart business models such as social manufacturing and, sharing and circular economy.

Ko et al., (2018) assert that blockchain technology has enabled real-time transparency in the manufacturing industry as well as cost savings. Blockchain technology enables real-time sharing of data and information since information is centralized and can be accessed by authorized recipients through an application. Centralized information sharing makes it easy for the data to be viewed by different departments such as sales and marketing, warehouse and distribution, making it easy to monitor a product throughout its entire lifecycle. When the technology is applied appropriately, it reduces the verification costs and also minimizes distortion of quality of goods since they are monitored throughout each step. This study is backed by Schinckus (2020) who asserts that block chain ensures supply chain transparency and waste management through real-time information sharing to avoid oversupply and understocking in the organizations. Therefore, blockchain technology guarantees sustainability by ensuring real-time tracking of supplies and products thus saving on manufacturing and supply chain costs.

## 5. Conclusion

Blockchain technology has a significant impact in industries including sustainability and improvement of circular economy. The technology enables real-time sharing of data, transparency and easier manufacturing, thus saving on costs and reducing wastage in manufacturing and supply chain. Different studies indicate that blockchain technology has brought huge benefits in diverse sectors across the globe especially in banking, health, agriculture and manufacturing. When complimented with IoT, the technology provides a major boost in the manufacturing sector by enabling automation, which saves on time and cost in the production process. In terms of sustainability, the blockchain technology facilitates green logistics and transportation, IoT enabled energy management and smart business models such as social manufacturing and circular economy.

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