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Blockchain Technology: Towards a Better economic, and environmental sustainability in Malaysian Freight Transportation Sector

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Abstract

Nowadays, maritime transport faces more challenges than at its beginning. Like any other industry, the maritime sector must adapt to the needs of the modern world and carry out its activities with respect for the environment. Continuous technological development and increased environmental awareness are the determining factors of changes in modern shipping. Therefore, one of the main challenges of maritime transport is to implement innovative solutions to protect the maritime environment. However, it is quite challenging to achieve both ecological and economic benefits at the same time. That is why it is very important to apply the win-win principle, which refers to the sustainable development of freight transportation. The paper provides an overview of applicable and promising technological solutions, and regulatory provisions towards a better economic, and environmental sustainability in Malaysian freight transportation sector, as well as importance of points to be considered in development of sustainable maritime.

Keywords: Blockchain Technology, Economic and Environmental Sustainability, Malaysian Freight Transportation, Maritime Industry

Introduction

The expansion of the freight transportation industry has caused environmental problems. Transportation already accounts for 20% of worldwide greenhouse gas emissions. In 2021, worldwide shipping contributed 2% of global CO2 emissions connected to energy. (IEA, 2023). As populations, economies, and the need for mobility continue to expand, GHG emissions from transportation might increase by up to 60% by 2050. Transporting freight in a sustainable manner is crucial for supporting equitable growth, extending access to important services, and combating climate change. (World Bank, 2023,). This study will examine how the implementation of blockchain technology might improve the Malaysian maritime industry's economic and environmental sustainability.

The global adoption of blockchain technology transcends industry and application barriers, with an expected economic effect. The market share of blockchain technology is anticipated to exceed USD 39 billion by 2025. (Vailshery, 2022). Blockchain provides many applications in the fields of management (Tandon et al. 2021), health (Tagde et al., 2021), IoT (Shammar et al. 2021), economics (Treiblmaier 2021), and supply chain operations (Tandon et al. 2021). (Wamba and Queiroz 2022). And surpass USD 3 trillion by 2030, and contribute USD 1.76 trillion to the world gross domestic product (GDP). (MOSTI, 2021) IBM predicted in 2018 that full digitization of the shipping business could save carriers as much as $38 billion annually. The blockchain technology sector in Malaysia is evolving in sync with global trends. The Ministry of Science, Technology, and Innovation (MOSTI) has developed the National Blockchain Roadmap 2021-2025 to boost Malaysia's leading position in blockchain technology for economic competitiveness and growth.

In a world of global supply chains and complicated industrial development processes, seaports and port operators play a vital role and function as a catalyst for the growth of the maritime industry and the national economy in general. (Wang et.al., 2020). Yet, maritime logistics businesses have paid less attention to using blockchain technology to improve the efficiency of their supply chains. (Shoaib et al., 2022). In the present-day shipping industry, automation is not yet widespread. The maritime sector still processes invoices, bills of lading, bank transfers, and manual checks, which are time-consuming and expensive. This conceptual study focuses on maritime businesses that have received little attention in previous research. According to Table 1, 58 percent of industry players are still unable to comprehend blockchain technology, and 23 percent have no blockchain technology understanding. This study will seek to explore the possible uses of blockchain technology for economic and environmental sustainability in the maritime shipping sector in light of these issues.

Table 1. Current knowledge on Blockchain technology in Malaysia

No		Academician (%)	Blockchain technology Implementer & community	Government & regulator	Industry	Technology providers	Others
1	Understand	58%	87%	20%	42%	53%	40%
2	Neither	27%	9%	38%	35%	19%	30%
3	Do not understand	16%	4%	42%	23%	38%	30%

Source : (MOSTI, 2022)

Although empirical evidence and previous studies have demonstrated that blockchain technology can improve economic and environmental sustainability (Pazaitis et al., 2017; Varsei et al., 2014), the existing literature is fragmented and frequently focuses on a specific aspect, such as the green supply chain (Varriale et al., 2020) or city management (Pazaitis et al., 2017). (Mora et al., 2021). In addition, several prior research have examined the relationship between blockchain technology and sustainable growth without concentrating on environmental challenges (Mora et al., 2021). While academics have stressed the beneficial effects of blockchain technology, less attention has been paid to the environmental issues posed by the widespread deployment of this technology. Traditional block chain systems, for instance,

necessitate the use of a great deal of energy, which has significant impacts on the natural environment; also, the hosting of huge servers necessitates bulky structures that can have a detrimental influence on the landscape. In order to fill this vacuum in the literature, we want to examine in depth the intricate interaction between block chain adoption and the natural environment.

Challenges To Sustaınabılıty In Shıppıng

A sustainable maritime transport and logistics system integrates economic, environmental, and social factors (Lee et al., 2019; Benamara et al., 2019). Interaction and overlap between the systems creates sustainability (Figure 1). On the one hand, the transport system impacts the operation of the other systems. On the other hand, the duties assigned to it are based on the requirements of the other systems.

Figure1: Interaction Of Sustaiable Maritime Shipping

Without a doubt, non-sustainable maritime transportation and logistics have a multitude of detrimental side consequences. Many scientific studies confirming this phenomenon have previously been conducted in this field (Jiang et al., 2022; von Weizsäcker et al., 2018). One of the negative effects is the emission of noxious fumes while maneuvering, cargo operations, and waiting at dock or anchorage. Yet, the formation of haze and the lack of clean air in ports are not the greatest effects of maritime pollution. Ships are responsible for 24,000 premature deaths in East Asia alone (Molina et al., 2020).

Since the first "Earth Summit" was held in Rio de Janeiro in 1992, all stakeholders' interest in the phenomena of sustainability for the development and management of maritime transport networks has increased (Lafferty & Meadowcroft, 2000). Thus, a sustainable maritime transport system must take into account social and environmental safety criteria as well as economic advantages. Yet, it may be rather challenging to simultaneously have a favorable influence on the environment and enjoy economic rewards. All shipping stakeholders are working to achieve globally sustainable maritime transport and logistics in order to deliver a shipping service that is both environmentally and socially responsible and commercially viable (Singh & Sengupta, 2020). This may be achievable with a comprehensive knowledge and application of the aspects that might alter the equilibrium between social, economic, and environmental goals. All three important factors must simultaneously achieve a level that is acceptable to all stakeholders. If

they are maintained in equilibrium, it is possible to construct a maritime transport and logistics system that is financially feasible and has no negative influence on the environment and human life (Fruth & Teuteberg, 2017).

Literature Review

Blockchain technology

Satoshi Nakamoto initially introduced blockchain technology for a peer-to-peer electronic currency transaction system. (Nakamoto, 2008) offers users with a platform to transmit and receive transactions without third-party intervention (Dasaklis et al. 2022). (Dasaklis et al. 2022). Blockchain technology comprises an immutable chain of blocks containing data connected chronologically using the hash function. This function protects blocks from tampering and simulates crucial functions in transaction verification (Pandey et al. 2022). Blockchain technology automates the operations, saves cost, and enhances the business model. Throughout the supply chain, blockchain technology provides the optimal option for transferring transactions and promotes network-wide traceability, transparency, security, and resource management. With the use of IoT components such as sensors, blockchain technology might enhance the traceability of supply chain activities. (Mobi, 2020). In a blockchain technology system, data recordings are called blocks, and distributed ledgers are called chains. Several blocks and chains are interconnected to form a blockchain computer network, and the ledger transactions are independently processed and validated using cryptography (Zhai et al., 2019). Logistics businesses utilize blockchain technology since it enhances openness and information exchange. Walmart and IBM partner to increase retail industry openness. IBM and Maersk employ this to reduce cross-border difficulties. (Queiroz & Wamba, 2019).

Even while blockchain technology enhances openness and information sharing, it is ideally suited for addressing supply chain difficulties since it can assure the validity and traceability of information during transmission and the security of transactions in an atmosphere of mistrust (Helo & Hao, 2019; Tijan et al., 2019). These features have a significant effect on supply chain management, influencing the design, structure, and operations of the supply chain (Hald & Kinra, 2019). Several researchers examined the blockchain technology-based supply chain in order to determine the potential of blockchain technology. Wang et al. (2019) did a literature study to establish the utility of blockchain technology for supply chain management in four areas: increased visibility and traceability, supply chain digitalization and disintermediation, enhanced data security, and smart contracts. Using expert interviews and case studies, Lim et al. (2019) identified possible uses of smart contracts in international and multi-mode supply chains. Even though there are some connected research, it should be acknowledged that these sorts of investigations are still in their infancy and that there are no successful academic publications in this area (Pournader et al., 2020).

In the food industry, Walmart has implemented a traceability system for mangoes that increases product traceability and reduces the time required to trace mangoes from farm to store from seven days to two seconds (Lim et al., 2020). Maersk and IBM collaborated in the trade business to employ blockchain technology to tackle challenges in cross-border supply chains since it promotes information transparency and facilitates information exchange among

trading partners (Zhang et al., 2020). Notwithstanding the above academic and practical issues, the influence of blockchain technology on supply chains is still little understood. This conceptual study examines publications connected to blockchain technology-based supply chains in order to better comprehend the value of blockchain technology, identify the present research material, and define a future research agenda. Several articles have conducted literature reviews on blockchain technology-based supply chains, focusing on maritime industry supply chains (Rana et al., 2019; Liu et al., 2021) the transportation field (Voorspuij & Becha, 2020; Pournader et al., 2020); and the logistics field (Antonucci et al., 2021; Wamba & Queiroz, 2020). These articles investigated the value, present trends, and future potential associated with blockchain technology's influence on supply chains. This conceptual study examines the difficulties, advantages, and practical implications of maritime industry. In addition, this conceptual study addresses the value that blockchain technology would bring to the maritime industry based on the content of current research works, which is of tremendous relevance for the technology in its infancy.

Challenges in Maritime industries

Based on the literature review, below are the Challenges in Maritime industries.

Inability to track

The ultimate difficulty is that a supply chain has several blind spots. If a transaction disagreement arises along the chain, it might take months to determine where the difference started because there is no real-time communication. Whether due to human mistake linked with manual operations or a system issue, these failures have resulted in inefficiencies throughout the whole supply chain, necessitating the participation of the relevant parties to resolve the issue. Due to the use of paper-based bunker delivery notes in the documentation procedure, the shipping sector is unable to provide traceability and assurance. This old practice led to fraud, deceiving shipowners, shippers, and charterers on the quantity and quality of fuels. The paper-based approach prevents stakeholders, such as insurers and regulators, from gaining access to information on fuel sources, combustion, and supply chain. (Green, et.al., 2020). While declaring harzadous commodities, shipping containers typically do not include information about their precise contents. In certain data systems, a product code may be scanned or tracked, however these data systems seldom share or interoperate with the systems of other stakeholders. And this may result in document modification. (Green, et.al., 2020).

Regarding insurance claims, the lack of paperwork also poses a difficulty. For instance, if shippers received tainted gasoline, insurers would not have access to data to verify compliance or that contaminated fuel was utilized. MacDonald (2018).

Fraud & Security

Under-invoicing in Bills of Lading to avoid taxes, bribery to gain contracts, scamming importers or exporters using fraudulently bought letters of credit are examples of prevalent fraud in the maritime business. It is believed that such fraudulent actions raise the cost of shipping operations by 10 percent. (DiGregorio & Nustad, 2017). Cybersecurity is an additional concern in the maritime industry, given the potential influence on vital sectors of the maritime industry,

such as cargo mishandling, mismanagement, and the shipping management system (Winebrake et al., 2020). Hackers are able to view the actual code executed by all nodes in blockchain technology-based systems such as Bitcoin and Ethereum due to their open-source codebases. Even if the code base is well-written and robust. Yet, the publishing of defects accidentally might allow for security vulnerabilities. (Orcutt, 2019). The maritime industry suffers persistent cybersecurity risks, such as the NotPetya ransomware outbreak that severely impacted Maersk Shipping Line in 2017 and cost the firm USD 200 million in damages. (DiGregorio & Nustad, 2017).

Time & Cost

In general, the supply chain processes in the maritime industry are sluggish, time-consuming, and costly. Transactions in the shipping business continue to rely on paper-based paperwork and documentation. Historically, the shipping sector has mainly relied on the physical transfer of paper papers. These documents must traverse a lengthy chain of procedures for approval, payment processing, and customs clearance. The entire procedure is susceptible to human mistake and unintended delays (Lam & Zhang 2019). The documentation expenditures were projected to account for 15% to 20% of the overall shipment cost (Longman, 2017). Several parties handling and managing documentation and the full supply chain process concurrently resulted in duplication and disruption of operations. (Ytterstrom & Lengerg, 2019). Bills of Lading are frequently delayed by banks and other middlemen and might take more than a week to arrive, meaning that goods can arrive at ports before the document. This resulted in system inefficiencies and increased cargo handling costs at ports. (Czachorowski et al., 2019).

Blockchain technology Benefits in Maritime Industry

Below are the Blockchain technology Benefits in maritime ındustry.

Trackability

Using a distributed ledger to store information and data gathered along the bunker fuel supply chain, blockchain technology-based technologies might address the difficulties by enhancing the tracking and traceability of fuel sources and quality. Thereafter, this data might be accessed by parties in the process of confirming compliance with legislation or insurance contracts. (Hastig & Sodhi, 2020).

Smart Contract

Smart contracts on the blockchain technology are able to reduce or remove the present obstacles and restrictions to fast, efficient, and effective maritime transactions. while permitting

records to be available to all relevant parties. In shipment validation and payments, smart contracts might enable players to enter into agreements on the blockchain technology platform stipulating that payment would only be released if all pertinent requirements are satisfied. Smart contracts provide rapid reaction in supply chains (Min, 2019; Li et al., 2019a).

Reducing Time and Cost

Nowadays, transactions between businesses are conducted through middlemen that charge extra fees for their services. The blockchain technology enables firms to conduct transactions directly between participants in order to reduce or eliminate transaction costs in the form of intermediary fees, time and processes, or other transaction costs associated with shipping-based activities. These transactions are conducted in a highly secure manner. The implementation of blockchain technology will reduce settlement delivery time and consolidate or eliminate superfluous settlement process processes. (Kamble, Gunasekaran & Sharma, 2020).

Environmental Friendly

Blockchain technology is environmentally friendly. The maritime sector requires a vast quantity of paper contracts and other documentation that might be replaced with blockchain technology, hence reducing paper consumption. Utilizing a smart contract or a paperless Bill of Lading enhanced transaction transfer, reduced transportation costs, and eliminated transportation-related pollutants, hence minimizing losses. The saved transaction costs can be used to the development of environmentally friendly technology, therefore boosting economic and environmental sustainability. (Czachorowski et.al, 2019).

Security

Blockchain technologys use digital signatures and strong cryptographic primitives to sign and verify the data submitted to the network. Each participant uses a private key to generate a signature for each transaction. This signature is used to confirm that the transaction came from the user and allows to verify its validity. The signature cannot be altered. (Tasca & Tessone, 2019).

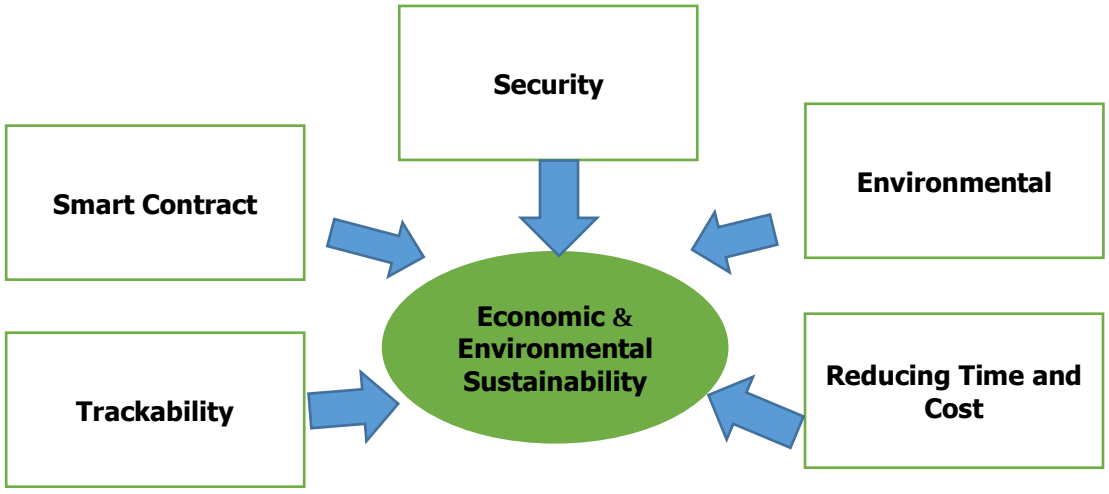

Figure 2. Proposed Conceptual Framework

Source: Develop for Research

Research Methods

Proposed Reserach Methodology

As the number of relevant studies has increased, literature reviews have increasingly become the primary focus of conceptual category research. Given that blockchain technology is in its infancy, conceptual techniques may be utilized to enhance the connection between blockchain technology and the maritime sector and to offer associated ideas. This qualitative study use the purposive sample technique to interview maritime experts with extensive experience and understanding of shipping. Participants are recruited if they have "direct and personal knowledge" (Sandelowski, 1995, as referenced by Gill, 2020) of the study issue and are able to discuss and reflect on the experience of interest. The targeted responders were Klang Valley and Johor port authorities. The port authority and shipping lines were determined by the Malaysian Ministry of Transport.

Being a government body that controls port and shipping operations in Malaysia, the Ministry of Transport, Malaysia will be selected as the source for the sample frame. Klang Valley and Johor were chosen as sampling locations because to their status as two of the world's twenty busiest ports in terms of yearly handling of twenty foot equivalent containers (TEUs). Port Klang, 13.74 million TEU in 2021, and Port Tanjung Pelepas, 11.2 million TEU in 2021 (Wee, the Star, 2022) are among the top four states in Malaysia in terms of economic expansion (Department of Statistics Malaysia, 2023). Prior to conducting the interview, it is necessary to seek consent from the respondents. All responders were guaranteed secrecy to ensure an open and unrestricted discussion. In addition to taking comprehensive notes, get permission to utilize a video and voice recorder throughout the interview. Hence, any research involving human subjects must be cognizant of the ethical difficulties that may arise from such encounters. (Orb, Eisenhauer & Wynaden, 2001)

Blockchain technology Practical Implications

Numerous blockchain technology-related flaws and risks can be found in maritime industry. There are scalability and performance difficulties with blockchain technology (Zheng et al., 2019). Yet, there are obstacles to be considered, including a lack of knowledge and comprehension, a lack of collaboration, security and privacy issues, and a lack of regulatory clarity and governance.

Lack of Awareness and Understanding

A lack of knowledge of the benefits of the blockchain technology and a broad misunderstanding of how blockchain technology operates is one of the most significant obstacles for organizations linked with blockchain technology, particularly small and medium-sized businesses. Many businesses do not comprehend what blockchain technology is or the benefits it may provide (Akram et al., 2020). This is largely attributable to the predominance of "technical" personnel in the blockchain technology region and their too technological attitude, which managers find difficult to comprehend. Before integrating blockchain technology in their organizational structure, managers should educate themselves on the issue in order to increase knowledge of blockchain technology (Yang et al., 2020). Before adopting a blockchain technology solution, the key questions that managers should ask themselves concern the application of blockchain technology and how it will change the organization and its culture, how to increase the level of understanding of the technology at all levels, and how it will change the way the organization interacts and collaborates (Alfa et al., 2021).

Lack of Cooperation

The issue with many existing techniques is that corporations are constructing their own blockchain technologies and apps to run on top of them, but there is presently no way to link them to other blockchain technology ecosystems. Several businesses adhering to different standards are developing opposing chains in various industries, which violates the goal of distributed ledgers, fails to leverage network effects, and can be less efficient than older alternatives (Sanka & Cheung, 2021).

A consortium of businesses might be a solution to improve the degree of collaboration between the organizations. A consortium is a collection of firms that collaborate on the construction and operation of fundamental blockchain technology infrastructure and services, which the participants then utilize to create their own range of services (Perboli et al., 2018). Global Shipping Business Network is an instance of a blockchain technology consortium in the maritime sector (GBSN). It contains some of the major maritime transport businesses, including CMA CGM, COSCO, Hapag-Lloyd, and OOCL (Ichimura et al., 2022).

Security and Privacy Challenges

Several blockchain technology-based applications require smart contracts and transactions to be irrefutably connected to known identities, which poses serious concerns about the privacy and security of the data stored and accessible on the distributed ledger. While blockchain technologies offer greater security than conventional computer systems, hackers may still

access blockchain technology -based apps, networks, and enterprises with sufficient effort (Ren et al., 2021). The solution to this problem requires more than simply government-regulated privacy protection. Allowing actors on blockchain technology to gather and manage their own data might aid in resolving security issues. While great progress is being made on some privacy methods, such as proof of zero knowledge, major effort is required to develop a new identity framework in order to overcome these difficulties (Shobanadevi et al., 2021).

Lack of Regulatory Clarity and Good Governance

Regulatory ambiguity over the underlying blockchain technology presents a substantial barrier to the widespread deployment of the blockchain technology. Even though this is the most common use case for Bitcoin Cash, there are currently no clear legal laws governing its usage as a platform for conducting transactions (Reyna et al., 2018). Other fields require regulatory backing as well, such as smart contracts. If smart contracts are not covered by legal restrictions, it might limit the adoption of blockchain technology and discourage future investment in the blockchain business. To overcome this challenge, governments, and heavily regulated sectors (such as the maritime industry and transport sector) may need to create regulations that could provide means of blockchain technology environment control to increase the levels of security and governance, which means that regulators in various countries and industries must understand what blockchain technology is and the impact it will have on the businesses and customers in their sector (Morkunas et al., 2019).

Results and Discussion

Reporting the findings of your study based upon the information gathered as a result of the methodology. Discussion is the part must explain the significance of the results of the work. (Font Tahoma 12, single spacing, 300-1000 words).

Conclusions

This conceptual study, to the best of the author's knowledge, considers the future of maritime industry players across the shipping sector, including port authorities, shipbuilders, operators, cargo owners, etc., should collaborate and adopt blockchain technology-based technology for economic and environmental sustainability. Additionally, this conceptual study enables researchers in the freight transportation supply chain to identify future research possibilities to overcome difficulties connected to the deployment of blockchain technology in the context of Malaysia's transportation sectors. And to search out various efforts to support decarbonisation solutions leading to zero emissions for shipping. There are two contributions made by this conceptual investigation. This study explains the value of blockchain technology for the maritime industry to the academic community and offers suggestions for future agendas. This study alleviates managers' concerns regarding the application of blockchain technology and the implementation of blockchain technology plans in the context of industry and individuals centered on practice. Even though a comprehensive literature review was undertaken, it is accepted that some relevant papers were overlooked. This study analyzed only scholarly journal articles; conference papers, novels, periodicals, and other sources were excluded. In the future, it will be necessary to undertake a literature review that overcomes these restrictions.

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