LEVERAGING BLOCKCHAIN TECHNOLOGY FOR TRANSPARENT TRACKING OF CRUDE OIL MOVEMENT

BY

KEHINDE GOODNESS ODERINDE
DENNIS EDIDI MERCIFUL
NWOBA PAUL KING JULES
AZEEZ ADESINA
STEPHEN IRERE

NIGERIA

A CAPSTONE PROJECT
SUBMITTED TO THE FACULTY OF BLOCKCHAIN STUDIES AND ARTIFICIAL INTELLIGENCE
AT THE ALTHASH UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE COLLEGIATE OF SCIENCE IN DECENTRALIZED APPLICATIONS

CHICAGO, ILLINOIS

ABSTRACT

The petroleum industry plays a crucial role in global energy supply, making efficient and secure management of its supply chain essential. Blockchain technology has emerged as a promising solution for enhancing transparency, traceability, and security in various industries. This project aims to explore the application of blockchain technology in monitoring the movement of petroleum from extraction to the end consumer, thereby revolutionizing the petroleum supply chain. The findings and recommendations can serve as a foundation for real-world implementations and pave the way for a more accountable petroleum industry.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

Background and Significance of Blockchain Technology for Transparent Tracking of Crude Oil Movement.

Blockchain technology has gained a lot of attention in recent years due to its potential to provide secure and transparent transactions.

Its application in the oil and gas industry has the potential to revolutionize the way crude oil is tracked and transported, providing a more efficient and secure system.

The oil and gas industry is a complex and highly regulated industry, with crude oil being transported across various stages of the supply chain, from exploration to production, refining, and distribution.

The movement of crude oil involves multiple parties, including producers, shippers, pipeline operators, and traders. The lack of transparency in the movement of crude oil can lead to inefficiencies and increase the risk of fraud, theft, and corruption.

Blockchain technology's decentralized, tamper-proof system provides greater transparency and security, reducing the risk of fraud, theft, and corruption.

By using a blockchain platform, all parties involved in the crude oil movement can have access to a single source of truth, reducing the risk of disputes and errors.

The benefits include cost savings, improved efficiency, and greater visibility into environmental impact.

CHAPTER TWO

PROBLEM STATEMENT

Before we dive into the statement problem, let's quickly look at an Overview of the Petroleum Supply Chain.

PETROLEUM INDUSTRY SUPPLY CHAIN: AN OVERVIEW

The petroleum industry supply chain is known for its complexity and inflexibility, presenting significant challenges in its management. With each stage posing its own set of difficulties, the logistics network of the petroleum industry is limited by factors such as crude oil suppliers' production capabilities, long transportation lead times, and transportation limitations. Addressing the inflexibility and complexity of the supply chain is further complicated by cultural reorientation, information systems and sharing, integrated process management, and organizational restructuring. The petroleum industry supply chain can be divided into two main operations: upstream and downstream. The upstream supply chain involves the exploration, production, and transportation of crude oil and gas to refineries, while the downstream supply chain focuses on refining crude oil into end products and distributing them to consumers. This article primarily focuses on the upstream operations of the petroleum supply chain, with a specific emphasis on mitigating risks associated with these operations. The petroleum supply chain is inherently risky, with various factors contributing to uncertainties and potential impacts on financial performance and competitiveness. Risks include geological and production risk, market risk, technological risk, country risk, price fluctuations, cost factors, and government actions. Traditional risks also encompass government regulations, financial risks in different countries, currency

fluctuations, and political and social disturbances. Emerging risks include corporate governance issues, intellectual property theft, terrorist attacks, and security threats. Uncertainties and risks are inherent in the petroleum industry supply chain, encompassing oil reserves, exploration, crude prices, supply and demand dynamics, and product prices. Global risks, such as political, legal, commercial, and environmental factors, as well as element risks, including construction, operation, financing, and revenue generation, impact both upstream and downstream supply chain operations. Effective risk management is crucial in the petroleum industry supply chain to ensure the commercial viability of oil and gas projects, address the high-risk nature of upstream operations, and overcome downstream challenges related to crude supply and product marketing.

Here are some problems that has been identified in the the crude oil industry.

- Exploration and Extraction Processes
- Refining and Distribution Processes
- Transportation and Storage Logistics

1. Exploration and Extraction Processes:

One of the primary challenges in tracking crude oil movement lies in the exploration and extraction processes. These processes involve identifying and extracting oil from remote locations, making it difficult to maintain accurate records of production quantities and origins. Traditional tracking methods often rely on manual documentation and paper-based systems, leading to potential inaccuracies, data manipulation, and fraudulent activities. Additionally, the involvement of multiple

stakeholders, such as oilfield operators, subcontractors, and regulatory bodies, further complicates the tracking process and introduces opportunities for data discrepancies.

2. Refining and Distribution Processes:

Once crude oil is extracted, it undergoes refining processes before being distributed to various destinations. Tracking the movement of crude oil during refining and distribution poses its own set of challenges. The complexity arises from the involvement of multiple refineries, blending facilities, storage tanks, and transportation networks. Coordinating these diverse entities often relies on fragmented information systems, resulting in data silos and limited visibility across the supply chain. Lack of real-time data sharing and transparency can lead to delays, errors in inventory management, and difficulties in ensuring compliance with quality standards and regulations.

3. Transportation and Storage Logistics:

Transporting and storing crude oil involves intricate logistics and numerous handoffs between different parties. Traditional tracking methods for transportation and storage often lack visibility, making it challenging to monitor the exact location, conditions, and custody transfers of crude oil shipments. This lack of transparency can result in delays, theft, tampering, and unauthorized diversions of crude oil, impacting the overall efficiency and security of the supply chain. Additionally, manual record-keeping and reliance on physical documents introduce the risk of data loss, manipulation, or fraud.

CHAPTER THREE

SOLUTION TO PROBLEM

Several problems are limiting the efficient operations of the oil and gas industry, which can be addressed using blockchain technology. As expressed in the statement of problem, the oil and gas industry is plagued by several challenges such as lack of operational transparency, poor traceability, inefficient supply system, fraud, and corruption. Further, the exploration/extraction, transportation, refining, and distribution are largely centralized, manual, and highly disintegrated which makes them vulnerable to manipulation and the single point of failure problem. In this section, we will take a closer look at how the application of blockchain technology solves these problems.

Application of Blockchain Technology in Crude Oil Supply Chain

Blockchain as a distributed ledger technology can be used to create a digital ledger of all transactions involving crude oil. This ledger would be distributed across a network of computers, making it tamper-proof, transparent, and auditable for tracking crude oil movement. Each transaction would be recorded on the ledger, including the date, time, quantity, and location of the oil. The ledger is immutable and holds records of every transaction that happens throughout the supply chain. Every stage of the supply chain, including extraction, transportation, storage, and refining, can be promptly recorded on the blockchain. Each transaction would be recorded as a block on the chain, and the records of transactions would be verified by a network of nodes before being added to the chain. This process ensures that every transaction is transparent and cannot be altered. By recording each process step on a blockchain network, operators can ensure that the oil is transported and processed responsibly and sustainably.

Here are some ways blockchain technology can be used in the monitoring of crude oil movement:

1. Tracking the Quality of Crude Oil

Blockchain technology can be used in monitoring and tracking the quality of crude oil from the point of extraction to the refinery and finally distribution to the end-users. Thus, ensuring that the quality of products conforms to international standards and is not contaminated.

2. Improving Data Security

Data on the blockchain is encrypted and tamper-proof, ensuring the security and privacy of data and preventing cyber-attacks. This enhances the confidentiality, integrity, and availability of data making it possible to prevent data fraud and cybercrime. For example, blockchain can be used to store and secure sensitive data, such as financial information and intellectual property. The distributed nature of the ledger (blockchain) makes it very difficult to hack or tamper with.

3. Identification and Tagging of Petroleum Shipments

Blockchain technology can enable the identification and tagging of petroleum shipments by creating a tamper-proof and immutable record of every step of the shipment process. This can be achieved through the use of smart contracts, which are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code.

4. Use of Smart Contract Automation

As stated above smart contracts are self-executing contracts that operate on the

blockchain. These contracts can automate numerous procedures and provide greater transparency. It can automate the tracking process, which is mainly a manual process thereby ensuring that all parties in the supply chain follow an agreed set of rules and regulations.

Smart contracts can integrate with IoT sensors that are attached to crude oil containers and delivery trucks or trains as they move through the supply chain. These sensors can provide data on the temperature, location, and other parameters that can be recorded onto the blockchain network. With the power of smart contracts and IoT devices, the oil supply chain can have the ability of provenance and security. This will greatly help to detect malpractices and accidents by trains delivering petroleum products.

5. Ensuring Compliance with Regulations

Blockchain technology can help ensure that regulatory requirements and international agreements and laws are met by automating compliance checks and providing accurate, auditable records of transactions and activities. For example, blockchain could be used to track the origin of oil to ensure that it is not from conflict zones or sold by terrorists.

CHAPTER FOUR

VISION STATEMENTS

Our vision is to revolutionize the crude oil industry by leveraging blockchain technology to facilitate transparent tracking of crude oil movement from extraction to final delivery. We envision a future where all stakeholders in the crude oil supply chain have access to comprehensive and real-time data on the movement of crude oil. This will ensure greater accountability, transparency, and efficiency in the industry, ultimately leading to a more sustainable and prosperous future. Our commitment is to create a system that empowers all stakeholders by providing a secure and reliable platform that delivers transparent, auditable, and tamper-proof records in the crude oil supply chain. We believe that this vision will create a more equitable and just future for all.

MISSION STATEMENT

Our mission is to leverage blockchain technology to create a trusted, transparent, and traceable system for tracking the movement of crude oil. We are committed to transforming the crude oil industry by providing a secure, tamper-proof, and efficient platform that facilitates the flow of information between all stakeholders. We strive to create a system that reduces the risk of fraud and error, increases accountability, and improves efficiency in the industry and to create a sustainable and profitable future for all by empowering the industry to operate in a transparent and trustworthy manner.

GOALS

The primary goal is to use blockchain technology to create a transparent system for tracking the movement of crude oil, ensuring its secure and traceable transportation

from its source to its final destination by building a decentralized system that offers real-time visibility into the movement of crude oil, enabling all players in the crude oil supply chain to make informed decisions that lead to better outcomes for all.

OBJECTIVES

1. Create a secure, tamper-proof, and efficient platform for tracking the movement of crude oil using blockchain technology.

2. Enhance transparency and real-time visibility in the crude oil supply chain by leveraging blockchain technology.

3. Establish a trusted, decentralized system that facilitates seamless flow of information between all stakeholders in the crude oil industry.

4. Enable crude oil producers, shippers, traders, and end-users to make informed decisions based on reliable data generated by the blockchain-based tracking system.

5. Reduce the risk of fraud, errors, and discrepancies associated with crude oil movement in the supply chain.

6. Increase accountability of all participants in the crude oil supply chain by leveraging blockchain technology to provide a transparent audit trail.

7. Improve the overall efficiency and profitability of the crude oil industry by reducing operational costs and enhancing operational efficiency.

8. Promote sustainability and environmental responsibility by enabling the tracking of crude oil movement from source to end-users.

9. Support regulatory compliance in the crude oil industry by enabling transparency and

traceability in the supply chain using blockchain technology.

10. Drive innovation and foster collaboration among industry players by introducing a blockchain-based tracking system for crude oil movement that is scalable and adaptable to the needs of the industry.

CHAPTER FIVE

Token name: Crude Oil Tracking System (COTS)

The tracking of crude oil movement in the petroleum industry supply chain is crucial for ensuring transparency, accountability, and efficiency. Traditional methods often face challenges, including data discrepancies, fraudulent activities, and limited visibility. However, the adoption of blockchain technology, coupled with the use of the COTS token (Crude Oil Tracking System), offers a promising solution. We would be exploring the utility of COTS token in leveraging blockchain technology for transparent crude oil tracking, focusing on data collection, encryption techniques, traceability, and decentralization.

- **Data Collection and Encryption Techniques**

The COTS token leverages blockchain technology to collect and store vital data about transportation, such as tanker identification codes (ID). Through blockchain's decentralized and immutable ledger, this data becomes transparent and auditable, ensuring the accuracy and integrity of information. Additionally, integrated proxy encryption techniques enable stakeholders to encrypt and decrypt messages securely. By using public and secret keys, the authenticity and integrity of the data are maintained, preventing unauthorized alterations and ensuring the privacy of sensitive information.

- **Traceability and Data Management**

One of the key features of the COTS token is its traceability capabilities. Participants in the crude oil supply chain can use the token to identify, verify, monitor, record, and effectively manage data related to their operations and outcomes during oil and gas-

based product shipments. This traceability enhances accountability and allows for real-time monitoring of oil products, reducing the risk of fraud and ensuring compliance with regulations. Furthermore, by establishing a comprehensive record of data provenance, the COTS token helps identify fraudulent activities and maintain the integrity of the oil and gas-based product supply chain.

- **Decentralization and Smart Contracts**

The decentralized nature of blockchain technology ensures that the COTS token is resistant to external modifications or manipulations. As oil and gas-based products are shipped and ownership changes occur, the blockchain records and updates these transactions immediately, creating an unmodifiable audit trail. This enables the verification of data authenticity and prevents unauthorized alterations. Moreover, the collected data can be analyzed to propose smart contracts, which can assist stakeholders in updating the reputation scores of oil producers based on the quality of supplied oil and gas-based products. Smart contracts automate and enforce agreements, providing greater transparency and reliability within the supply chain.

CHAPTER SIX

Token Ticker: **COTS**

The token ticker "COTS" is a best fit for the project for several reasons.

COTS (Crude Oil Tracking System) is a blockchain-based token designed to revolutionize the tracking of crude oil movement in the petroleum industry supply chain. With its decentralized and transparent ledger, COTS ensures the accuracy and integrity of data collected, including tanker identification codes (ID). The token enables participants to trace, verify, and monitor oil products, reducing fraud risks and ensuring compliance. Through smart contracts, COTS facilitates reputation score updates for oil producers based on product quality. With COTS, stakeholders can leverage blockchain technology to enhance transparency, accountability, and efficiency in the crude oil tracking process.

CHAPTER SEVEN

Token Supply: 1 000 000 000 COTS

We consider the token supply of 1 billion COTS. This number can be adjusted based on factors such as the expected user base, adoption rate, and overall tokenomics strategy. The chosen supply should strike a balance between providing enough tokens to accommodate the needs of the project and incentivize participation.

CHAPTER EIGHT

Budget Allocation:

Development and infrastructure: 40%

Marketing and Adoption: 30%

Operations and Administration: 15%

Reserve and Contingency: 10%

Team and Advisors: 5%

1. Development and Infrastructure (40%): A significant portion of the budget should be allocated to the development and infrastructure of the Crude Oil Tracking System. This includes hiring a skilled development team, conducting thorough research, and building a robust blockchain infrastructure to ensure efficient and secure tracking of crude oil.

2. Marketing and Adoption (30%): To ensure widespread adoption, a substantial allocation should be made towards marketing and promotional efforts. This includes creating awareness through targeted marketing campaigns, attending industry conferences and events, and establishing partnerships with key players in the crude oil industry.

3. Operations and Administration (15%): Allocating a portion of the budget to cover operational and administrative expenses is crucial for the smooth running of the project. This includes costs related to legal compliance, regulatory requirements, administrative staff, office space, and other overhead expenses.

4. Reserve and Contingency (10%): Setting aside a portion of the budget as a reserve and contingency fund is essential for handling unforeseen circumstances or future expansion. This reserve can provide financial stability during challenging times or be used for future development and enhancement of the tracking system.

5. Team and Advisors (5%): Allocating a small percentage of the budget for the project team and advisors recognizes their contributions and incentivizes their continued involvement.

CHAPTER NINE

Slogan: Unlocking the Power of Transparency: COTS - Revolutionizing Crude Oil Tracking with Blockchain Technology!

The slogan, "Unlocking the Power of Transparency: COTS - Revolutionizing Crude Oil Tracking with Blockchain Technology!" encapsulates the core message of the project succinctly. It emphasizes the transformative impact of leveraging blockchain technology to bring transparency to the crude oil industry. The slogan communicates the notion that COTS is not just another token, but a catalyst for change, revolutionizing how crude oil is tracked and managed. By highlighting the power of transparency, the slogan conveys the project's commitment to accountability, integrity, and efficiency in the tracking process.

CHAPTER TEN

Proposed launch date: 10/06/2026

We proposed setting the launch date of the COTS token on June 10, 2026. This date provides a specific target for the project team to work towards and allows for ample time to develop and refine the necessary infrastructure, conduct thorough testing, and build momentum leading up to the launch. It also offers the advantage of being in the future, providing ample time for marketing and promotional activities to generate awareness and attract potential users, investors, and stakeholders. By setting a clear launch date, the project can effectively plan and execute all the necessary steps to ensure a successful and impactful introduction of the COTS token to the market.

CHAPTER ELEVEN

TOKEN LOGO

The logo above features a unique design that incorporates elements of crude oil. The primary colors used in the logo are black and gold, which symbolize stability, transparency and security.

CHAPTER TWELVE

CONCLUSION:

In conclusion, the application of blockchain technology in the petroleum industry has the potential to revolutionize the supply chain and address crucial challenges related to transparency, traceability, and security. By exploring the use of blockchain technology in monitoring the movement of petroleum from extraction to the end consumer, this project aims to lay the foundation for real-world implementations and contribute to a more accountable petroleum industry. The findings and recommendations from this project highlight the benefits of blockchain technology in enhancing transparency, reducing fraud, and improving efficiency in the petroleum supply chain. The use of a decentralized and tamper-proof system provides a single source of truth for all parties involved, reducing the risk of disputes and errors. This technology also offers cost savings, improved efficiency, and greater visibility into the environmental impact of the petroleum industry. The vision of revolutionizing the crude oil industry through blockchain technology is driven by a mission to create a trusted, transparent, and traceable system for tracking crude oil movement. The objectives outlined focus on creating a secure platform, enhancing transparency and accountability, reducing fraud and errors, improving efficiency, and promoting sustainability and regulatory compliance. The proposed COTS token serves as a tool to leverage blockchain technology, facilitating transparent crude oil tracking and enabling data collection, encryption, traceability, and decentralization. With a maximum token supply, a well-allocated budget, a compelling slogan, and a proposed launch date, this project demonstrates a comprehensive plan for implementing blockchain technology in the

petroleum industry. By embracing the power of transparency and revolutionizing crude oil tracking, the project aims to create a more accountable, efficient, and sustainable future for all stakeholders in the petroleum supply chain.