

Blockchain in Petroleum Industry

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Abstract: *Blockchain technology has been developed for more than ten years and has become a trend in various industries. As the oil and gas industry is gradually shifting toward intelligence and digitalization, many large oil and gas companies were working on blockchain technology in the past two years because of it can significantly improve the management level, efficiency, and data security of the oil and gas Industry. This paper aims to let more people in the oil and gas industry understand the blockchain and lead more thinking about how to apply the blockchain technology. To the best of our knowledge, this is one of the earliest papers on the review of the blockchain system in the oil and gas industry. This paper first presents the relevant theories and core technologies of the blockchain, and then describes how the blockchain is applied to the oil & gas industry from four aspects: trading, management and decision making, supervision, and cyber security. Finally, the application status, the understanding level of the blockchain in the oil and gas industry, opportunities, challenges, and risks and development trends are analysed.*

Keywords: Blockchain technology.

I. INTRODUCTION

With the advancement of science and technology, the importance of oil and gas resources in promoting global economic and social progress is increasing. According to the “BP Statistical Review of World Energy” released by BP in June 2018, oil and natural gas account for 57% of total energy consumption. Moreover, global oil consumption increased by 1.8%, exceeding the average growth rate. With the advancement of science and technology, the importance of oil and gas resources in promoting global economic and social progress is increasing. According to the “BP Statistical Review of World Energy” released by BP in June 2018 [1], oil and natural gas account for 57% of total energy consumption. Moreover, global oil consumption increased by 1.8%, exceeding the average growth rate.

With the advancement of science and technology, the importance of oil and gas resources in promoting global economic and social progress is increasing. According to the BP Statistical Review of World Energy” released by BP in June 2018, oil and natural gas account for 57% of total energy consumption. Moreover, global oil consumption increased by 1.8%, exceeding the average growth rate of 1.2% for three consecutive years, while the consumption of natural gas has increased by 96 billion cubic meters, reaching the fastest growth rate after 2010. However, according to BP Energy Outlook 2019 edition, although the world is vigorously promoting the development of new energy, oil and gas will still occupy half of the world’s energy by 2040. Besides, the report also pointed out that with the continuous expansion of liquified natural gas (LNG) trade, LNG will account for 15% of total natural gas demand in 2040. There-fore, oil and natural gas will continue to dominate the global energy market in the next 20-30 years. As oil and gas resources play an essential role in the energy field, the technologies of the oil and gas industry have also developed rapidly in recent years, such as intelligent drilling technology, intelligent oil and gas fields, and marine digital platforms. It can be seen that the oil and gas industry is gradually developing towards the direction of intellectualization, digitalization, and automation. However, its management mode is relatively old, and it has the characteristics of low efficiency, high cost, long period and high risk. Oil and gas industry can be divided into three sections according to the market division: upstream, midstream and downstream. The upstream refers to the exploration and development of oil and gas, the midstream refers to the transportation of oil and gas, and the downstream refers to the storage and sales.

II. LITERATURE SURVEY

Today's systems, approaches, and technologies leveraged for managing oil and gas offer chain operations come short in providing operational transparency, traceability, audit, security, and trusty knowledge place of origin options. Also, an outsized portion of the present systems is centralized, manual, and extremely disintegrated that build them liable to manipulation and therefore the single purpose of failure drawback. During this survey, we tend to explore the potential opportunities and applications of blockchain technology in managing the exploration, production, and provide chain and supplying operations within the oil and gas trade because it offers traceability, changelessness, transparency, and audit options in a very decentralized, trusted, and secure manner. We tend to discuss progressive blockchain-based schemes, analysis comes, business initiatives, and case studies to focus on the utility of blockchain within the oil and gas trade. We tend to gift the potential opportunities caused by blockchain technology in varied use cases and application eventualities. We tend to introduce many systems that leverage blockchain-based sensible contracts to modify the necessary services in terms of chase and tracing of crude merchandise, protection of international trade documents, and coordination of buying and bidding activities for granting oil exploration rights to crude exploration and development corporations. Finally, we tend to gift open challenges acting as future analysis directions.[1]

Blockchain technology has been developed for quite 10 years and has become a trend in numerous industries. Because the oil and gas trade is bit by bit shifting toward intelligence and medical aid, several massive oil and gas firms are performing on blockchain technology within the past 2 years as a result of it will considerably improve the management level, potency and knowledge security of the oil and gas trade. This paper aims to let a lot of individuals within the oil and gas trade perceive the blockchain and lead a lot of puzzling over the way to apply the blockchain technology. To the most effective of author's data, this is often one in every of the earliest papers on the review of the blockchain system within the oil and gas trade. [2]

The potential of blockchain has been extensively mentioned within the literature and media primarily in finance and payment business. One comparatively recent trend is at the enterprise-level, wherever blockchain is the infrastructure for net security and changelessness. Rising application domains embody business four.0 and Industrial net of Things (IoT). Therefore, during this paper, we tend to comprehensively review existing blockchain applications in business and IoT settings. Specifically, we tend to gift the present analysis trends in every of the connected industrial sectors, also as winning industrial implementations of blockchain in these relevant sectors. We tend to additionally discuss industry-specific challenges for the implementation of blockchain in every sector. Further, we tend to gift presently open problems within the adoption of the blockchain technology in business four.0 and discuss newer application areas. We tend to hope that our findings pave the method for empowering and facilitating analysis during this domain, and assist decision-makers in their blockchain adoption and investment in business and IoT house.[3]

III. IMPLEMENTATION

The explanations of blockchain in different works of literature are not entirely uniform. Essentially, blockchain is a kind of mode to realize and manage transaction processing through transparent and trustworthy rules to construct non-forgeable, non-tampering and traceable blockchain data structure in peer-to-peer (P2P) network environment. It is a new application mode combining computer technologies such as distributed data storage, consensus mechanisms, peer-to-peer transmission, and encryption algorithms. The biggest innovation of blockchain technology is that transactions are no longer stored in the central database, but are distributed to all participants.

Peer-to-peer means that the computers in each node in the network have equal status, each node has the same network power, and there is no centralized server. All nodes share some resources or information through specific protocols. In the traditional transaction model, transactions depend on the central authority, and transaction data is mainly stored by the central authority. In the blockchain transaction model, transactions can be con-ducted directly between the two parties without third party intervention, and all transaction data are stored in the distributed blockchain, and all relevant information is stored in each participant. Therefore, the blockchain can well eliminate the influence of third parties. However, if the central authority is removed, then how to verify the transaction and ensure the integrity of the ledger becomes a challenge. It requires a suitable verification process, a process called consensus algorithm.



If a person agrees to complete a transaction with another person (Step 1), they use the transaction-related data as a variable and combine with other transactions in the same period to form a new data block (Step 2). Each transaction is encrypted and distributed to multiple computers in a P2P manner. Network members use algorithms to validate transactions stored on individual computers. The algorithm appends a unique hash value to each block. If any information related to the transaction is tampered with, the correct hash value cannot be generated, and an error is reported (Step 3). When this block is successfully verified, it is combined with the block that was previously verified to form a blockchain. (Step 4). Finally, both parties confirm the transaction, which means the transaction is successful

IV. BLOCKCHAIN IN OTHER INDUSTRIES

4.1 Smart Contract

Smart contract is a kind of contract that records terms with computer language instead of legal language, and it is one of the most important concepts in Ethereum. Ethereum supports the development of smart contracts through Turing complete languages.

4.2 Transaction

In the environment of oil price fluctuation, many oil and gas enterprises are facing tremendous pressure to reduce costs and improve productivity, to maintain an acceptable profit margin. In the oil and gas trading, the traditional way makes the transaction inevitably produce errors, and the transaction is prone to fraud and compromise. Blockchain technology can solve the problem well. It can also make the transaction more transparent.

4.3 Management

The blockchain can simplify the management process and make the management method more scientific. As we all know, oil and gas pipeline networks occupy a vital position in oil and gas systems, and the pipeline network is complicated and difficult to manage, especially regarding resource allocation.

4.4 Tracking

Globally, many oil and gas products are stored, ordered, transported and distributed through various channels such as producers, suppliers, contractors, subcontractors, oil and gas refiners and retailers. Once there are slips, productivity and production level will decline, and serious cases may occur such as loss of goods. The blockchain not only tracks products in the oil and gas supply chain, but also provides audit trails of equipment used throughout the lifecycle, making all aspects of the supply chain more transparent, saving logistics costs and improving operational efficiency, this is also the most essential function of the blockchain to solve the oil and gas industry chain management.

V. CONCLUSION

This paper does a systematic review to discuss the application prospects of blockchain technology in the oil and gas industry, and the main purpose of this paper is to expand the influence of blockchain technology in the oil and gas industry. In summary, blockchain technology has excellent potential in the oil and gas industry, but since it has just started in the last two years, there are many opportunities, challenges, and risks. Specifically, this paper first introduces the core theory of blockchain technology in Section III, including the consensus algorithm of the blockchain, data record model and distributed storage system. Secondly, this paper demonstrates the possible application modes and scenarios of blockchain in the oil and gas industry from four aspects in Section IV: trading, management and decision making, supervision and cyber security. Finally, this paper discusses the application status, opportunities, challenges and risks of blockchain technology in the oil and gas industry, and also analyzes the future development trends in Section V. The following conclusions were drawn:

- Europe and Asia are the most powerful in promoting the blockchain in the oil and gas industry, and BP and Shell are pioneers in this field.
- At present, the application of blockchain in the oil and gas industry is still in the experimental stage, and many people in the oil and gas industry do not understand enough.
- Blockchain technology can bring many opportunities to the oil and gas industry, such as reducing transaction costs and increasing transparency. However, it also faces many challenges and needs to address many technical and regulatory issues.
- Blockchains may have operational, legal, and cyber risks in the oil and gas industry.
- In order to meet market and management needs, the blockchain will move toward the hybrid blockchain architecture, cross-chain, and hybrid consensus mechanism in the oil and gas industry.

VI. SUMMARY

This section will discuss issues such as the application status, opportunities, challenges, risks and development trends of blockchain technology in the oil and gas industry.

In the past two years, blockchain technology has begun to emerge in the oil and gas industry. Many energy giants have begun to invest in the development of this technology. Among them, BP and Shell are pioneers in blockchain application technology in the oil and gas industry. Due to the decentralization and transparency of the blockchain, it can bring many opportunities to the oil and gas industry. However, a new technology will inevitably encounter many challenges when it is first applied.

Although the blockchain technology has many advantages, the current operating system is still not perfect, and there are many risks. Risks can be divided into operational risks, cyber risks, and legal risks. Operational risk means that if the blockchain is applied to the oil and gas industry, technical or social problems may produce bad results. It may be reflected in:

- Loss of data and identity.
- The transaction costs of the public blockchain are high.
- Lack of recipients and users.
- Lack of long-term experience leads to imperfect management.
- Initial applications may have technical problems.
- Lack of a standardized mode of operation, function and security deficiencies. Cyber risk refers to bad behaviour such as fraud due to insufficient security or design flaws, it is reflected in:
 - There may be fraud in the interface between the real world and the blockchain world.
 - The exchange may be attacked by hackers, and the user's password may be hacked and funds transferred.
 - The hard fork of the block will cause the trust of the entire network system to be questioned. Legal risk refers to some illegal acts that may occur in the operation of block chains, it is reflected in:
 - Tax evasion may be triggered.
 - Illegal use of information.
 - Blockchains are used for illegal transactions.

REFERENCES

- [1]. BP Statistical Review of World Energy, 67th ed., Brit. Petroleum, London, U.K., Jun. 2018. [Online]. Available: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf>
- [2]. BP Energy Outlook, Brit. Petroleum, London, U.K., Feb. 2019.[Online]. Available:<https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/energy-outlook/bp-energy-outlook-2019.pdf>
- [3]. https://www.researchgate.net/publication/332048415_Blockchain_Technology_in_the_Oil_and_Gas_Industry_A_Review_of_Applications_Opportunities_Challenges_and_Risks
- [4]. M. S. Fraser, T. Anastaselos, and R. Ravikumar, “The disruption in oil and gas upstream business by industry 4.0,” Infosys, Bengaluru, India, WhitePaper, 2018. [Online]. Available: <https://www.infosys.com/engineering-services/white-papers/Documents/disruption-oil-gas-upstream.pdf>
- [5]. Oil and Gas Industry—Blockchain, the Disruptive Force of the 21st Century, Infosys, Bengaluru, India, 2018. [Online]. Available:<https://www.infosys.com/industries/oil-and-gas/features-opinions/Documents/blockchain-disruptive-force.pdf>
- [6]. Blockchain Adoption in Oil & Gas: A Framework to Assess Your Company’s Readiness, Tata Consultancy Services, Mumbai, India, 2018.[Online]. Available: <https://www.tcs.com/blockchain-oil-gas>
- [7]. A. H. Mohsin et al., “Blockchain authentication of network applications: Taxonomy, classification, capabilities, open challenges, motivations, recommendations and future directions,” Comput. Standards Interfaces, vol. 64, pp. 41–60, May 2019.
- [8]. Deloitte’s 2018 Global Blockchain Survey, Deloitte, Phoenix, AZ, USA, 2018. [Online]. Available: <https://www2.deloitte.com/content/dam/Deloitte/cz/Documents/financial-services/cz-2018-deloitte-global-blockchain-survey.pdf>
- [9]. Blockchain Technology in the Oil and Gas Industry: A Review of Applications, Opportunities, Challenges, and Risks (researchgate.net)
- [10]. Blockchain in Oil and Gas Industry: Applications, Challenges, and Future Trends (researchgate.net)