
Smart Contract for Payment of Public Construction Projects: Stakeholder's Perspectives

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ABSTRACT Smart contracts are self-executing computerized codes that execute the terms of contracts when the preset conditions are met. Smart contracts have gained significant attention globally for their potential to streamline processes and enhance transparency in various industries. This paper explores the perceptions of construction industry professionals regarding the effectiveness of smart contracts in overcoming the payment challenges of public projects. Using a structured questionnaire, data were collected from 41 respondents, including contractors, employers' representatives, project managers, engineers, architects, and quantity surveyors. The findings reveal moderate familiarity with smart contract technology among the respondents, with varying degrees of interaction and usage. While most respondents support the implementation of smart contracts for the payment of public projects, they also believe that government support and continuous awareness could significantly boost the adoption of smart contracts in the construction industry. However, some respondents remain skeptical about the ability of smart contracts to eliminate delayed payment due to the budgetary systems and bureaucratic nature of public projects. In conclusion, the research underscores the potential of smart contracts to revolutionize the traditional payment system through recommendations such as implementing strategic regulatory frameworks, technical training, and infrastructural investments. The study contributes valuable insights into the current state of smart contract adoption and sets the stage for future research and practical advancements in the field.

KEYWORDS: Smart contract, Payment, Construction Projects, Stakeholders' Perspectives.

I. INTRODUCTION

Smart contracts were introduced to curb the shortcomings and challenges associated with traditional contracts. Smart contracts revolutionize how contracts are administered, executed, and enforced through features such as the elimination of intermediaries, lower transaction costs, increased efficiency, improved transparency and security, and enhanced trust between parties (Stephany, 2023). Smart contracts and blockchain technology are at the forefront of technological advancement in the financial services industry and most industries globally. Smart contracts stored on blockchain networks are encrypted and transparent, ensuring that all parties involved in a transaction have access to the same information which minimizes the risk of manipulation; and because it does not require trusted third parties or human intervention in executing the contract terms, it offers autonomy and independence to the parties involved. Also, by reducing the need for paper-based contracts and manual processes, smart contracts contribute to environmental sustainability (Howell, 2023).

Globally, the adoption of smart contracts has seen significant growth, with the global smart contracts market size valued at USD 684.3 million in 2022 and expected to grow at a Compound Annual Growth Rate (CAGR) of 82.2% from 2023 to 2030 (Grandview Research, 2023). The increasing adoption of blockchain technology, technological innovation, increased efficiency, cost savings, and the growing demand for Decentralized Finance (DeFi) are driving this growth. North America has dominated the smart contracts industry, accounting for a revenue share of more than 50% in 2022. The presence of prominent smart contract providers, such as ScienceSoft USA Corporation, iTechArt, IBM, and Algorand, makes North America a promising market for smart contracts (Grandview Research, 2023). Smart contracts are also being increasingly employed to automate and streamline a wide array of business processes, such as supply chain management (Manohar, 2021). In Nigeria, significant progress has been recorded in the adoption of blockchain technology and smart contracts. In May 2023, Nigeria rolled out its national blockchain policy and has been ranked in the top 10 globally for

crypto adoption. The policy aims to strengthen Nigeria's digital economy, enhance public trust in governance, and promote citizen engagement. Additionally, Nigeria's 2023 Blockchain adoption strategy seeks to leverage block chain technology for innovation, economic growth, and job creation (Bain, & Dasila, 2023). The Central Bank of Nigeria (CBN) has expressed the need to adopt smart contracts and other blockchain technologies, citing their importance and potential use cases. Despite the low adoption rate of the naira, Nigeria is at the forefront of blockchain uptake and is well-prepared to shape the future of the global blockchain industry (Abiodun, 2023). With all the above statistics, the adoption of smart contracts for payment of construction projects is relatively poor, more so with public construction projects. This paper therefore assesses the perception of Nigerian construction professionals handling public sector projects about smart contracts. The study is significant in several ways, such as: in providing insights into the level of awareness and understanding of smart contracts among professionals in the public sector in Nigeria. This information will be useful in developing educational programs that can help bridge the knowledge gap and promote the adoption of smart contracts in Nigeria. Secondly, the study will identify the potential benefits and barriers to the adoption of smart contracts in Nigeria, which can inform policy decisions and regulatory frameworks. Additionally, the study will contribute to the existing literature on the use of smart contracts in the Nigerian public sector. Finally, the study will add to the growing body of knowledge on the perception and adoption of blockchain technology in Nigeria, which is a developing area.

II. RELATED WORKS

Although smart contract technologies have begun to receive more widespread attention from many industries and academia, there is a long history along the path from cryptocurrencies leading up to blockchain and smart contracts. In 1991, S. Haber and W.S. Stornetta proposed a hard-to-tamper system to timestamp digital documents. In their scheme, a digital document is issued a certificate that contains the date on which it was created and information about previously issued certificates for other digital documents. Therefore, it creates a link that can be used to retrieve and prove the date on which a document was created. In 1994, Nick Szabo introduced smart contracts, which are computer programs that replicate the actions described in physical/traditional contracts. Later in 1996, Szabo defined the following objectives of a smart contract: observability, verifiability, privacy, and enforceability. With its read-append property, Bitcoin and its script language showed that blockchain is a suitable platform to implement smart contracts. On a blockchain, a smart contract cannot be modified, it can be easily observed, verified, and self-enforced, and depending on the access mode of the blockchain, privacy can be achieved. Even though its script language only allows checking and validating transactions, Bitcoin can be considered the first implementation of a smart contract on the blockchain. Later in 2015, Vitalik Buterin created Ethereum, a blockchain platform that features a decentralized payment system and a Turing complete language, which allows for the development of a wide variety of smart contracts on a blockchain (Victor et al, 2020).

Later, in 2008, Satoshi Nakamoto proposed a decentralized payment system called Bitcoin, where the history of transactions is stored in a distributed ledger made of blocks. Each block contains a set of transactions, a nonce, a timestamp, and a hash to a preceding block, which is similar to the approach used. It is the idea of Satoshi Nakamoto's Bitcoin that sparked what we know today as blockchain. A blockchain is a distributed data structure made of blocks of data in which a block is linked to another block through its hash value. It has two basic operations: read (to read the content of blocks) and append (to append new blocks). Although an adversary might try to remove/modify some blocks, it requires extremely expensive computations, which makes them nonviable. The read-append property of blockchain has made it a suitable medium to develop different decentralized payment systems by removing the need for centralized institutions such as banks. Any user can transfer currencies to others and participate in the verification process of transactions. With the growth of Bitcoin, people have recognized that blockchain could be used to develop decentralized solutions in other domains, such as in the food industry, healthcare, etc. However, the Bitcoin architecture, which only supports scripts to check and validate currency transactions was not sufficient to support such applications. Therefore, the smart contract protocol was introduced into the blockchain. Smart contract is one facet of blockchain technologies, consisting of computer code programs spread across a network of nodes (Giancaspro, 2017; Wong et al., 2022; Wulandary et al., 2023). This application serves as a computerized transaction protocol that manages contract terms between multiple parties (Hiroki et al., 2016; Giancaspro, 2017). One of the significant benefits of implementing smart contracts in corporations is that, in addition to facilitating automatic payment for services deployed on the blockchain, they create a decentralized market mechanism by initiating transactions and payments between buyers and sellers without intermediaries (Wong et al., 2022; Zheng et al., 2020) identified the advantages of smart contract applications, including cost reduction in administration, savings in service costs, risk

reduction, and improved business process efficiency. Smart contracts hold great potential for a wide range of applications, spanning from the industrial Internet of Things (IoT) to financial services. Giancaspro (2017) asserted that smart contracts reduce legal and transaction costs, promising commercial efficiency, transparency, and anonymity in transactions. Ahmadisheykhsarmast and Sonmez (2020) found that, in addition to the system’s ability to mitigate organizational costs and the burdens of trusted intermediaries, it facilitates secure contract payments. These attributes make smart contract technology highly sought-after while also mitigating fraud and enhancing the quality of financial contracts (Halilbegovic and Ertem, 2020). This is achieved when contracts support stakeholders in cooperating and improving agreed contract clauses, supported by shared relevant information on the blockchain without the involvement of intermediaries (Negara et al., 2021b).

A. HOW SMART CONTRACT WORKS

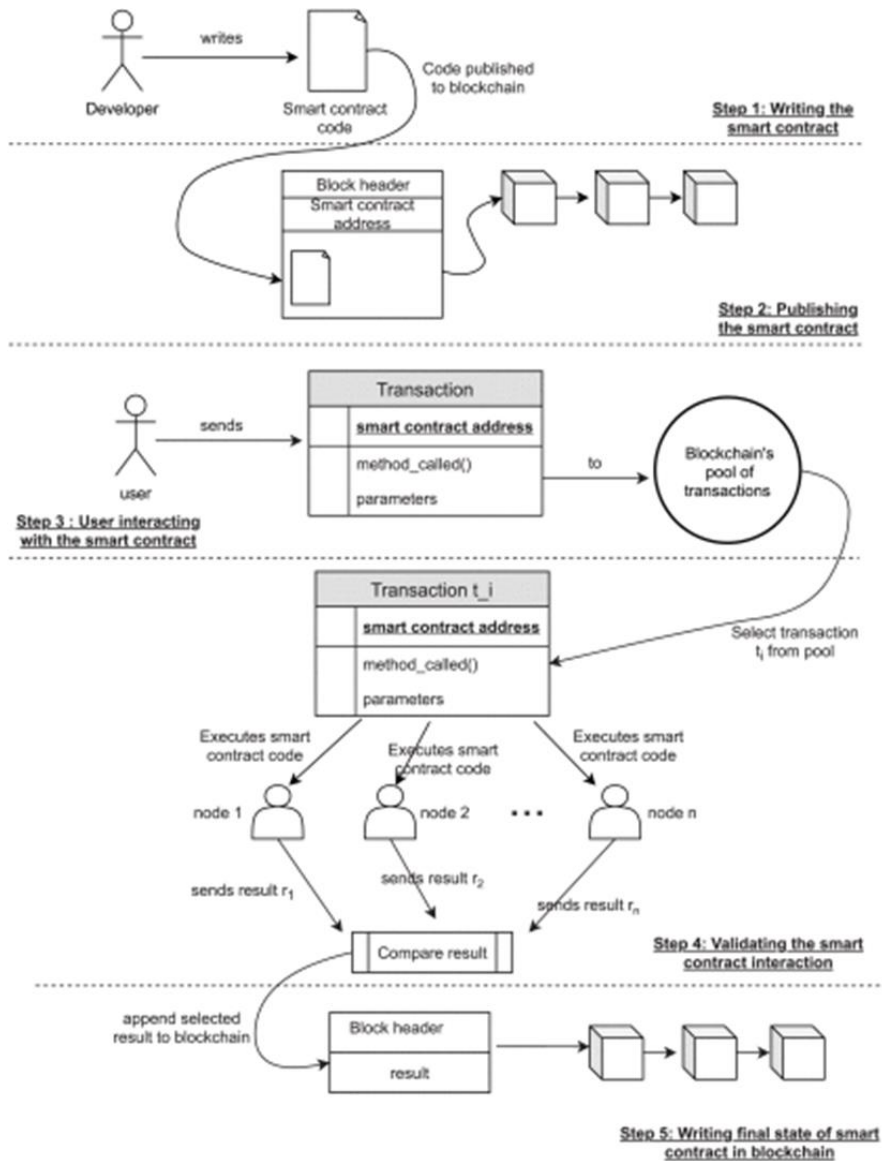


Figure 1: How Smart Contracts Work

The steps are discussed as follows:

Step 1: Developers write the logic for the contract in a programming language supported by the blockchain platform they wish to use. Then, using a specific compiler (usually provided by the blockchain platform), they compile the source code representing their smart contract and obtain a byte code.

Step 2: After obtaining the byte code, they will publish it to the blockchain platform where it will be stored on the blockchain. Depending on the platform used, once the smart contract program is published, it will be either read-only or modifiable. For instance, Ethereum does not allow smart contracts to be modified, whereas EOSIO allows overwriting through the uploading of a new byte code. In case it is read-only; to provide an update, the developers will need to publish a new version of the smart contract and redirect users to it. Once uploaded, the smart contract is in its initial state. The initial state represents the initial values of the internal variables of that smart contract.

Step 3: Access to a published smart contract program depends on the blockchain platform. In the case of Ethereum and Neo, the blockchain platform returns an address to the developers. The address will then be used to interact with the smart contract. In the case of EOSIO, the smart contract is published to an account (hosted on the blockchain platform) that was previously created by the developers. The identifier of the account will be used to access and interact with the smart contract. Once users obtain the address/identifier, they can begin sending transactions. Each transaction should contain the function of the smart contract that it wishes to utilize and the function's arguments. If an amount of platform currency is needed to start the function's execution, that amount will be transferred alongside the transaction. The transaction will be stored in the blockchain platform's pool of transactions that await execution and validation.

Step 4: From the pool of transactions, the blockchain platform will select a set of transactions to be executed and validated. During the execution phase, the functions of a smart contract that are specified in the transaction will be executed by a set of nodes. During the validation phase, the nodes that executed the transaction will compare their results and select the one to be kept according to a consensus protocol. Also, there is a proof-based consensus where instead of a group of nodes agreeing on a final answer, each node has to prove that it has executed a certain operation or has a certain value. The first node to present valid proof is elected as the leader and is allowed to attach the result of its execution to the blockchain. In addition, there are hybrid consensus protocols that are based on both BFT and proof-based protocols.

Step 5: Once the valid result has been selected, it will be inserted in a block that will be appended to the blockchain. Also, the initial state of each smart contract specified in set T will be updated, i.e., if a validated transaction alters the internal variables of a smart contract, those new values will now be considered as initial values by future transactions.

III. MATERIALS AND METHODS

The study adopted a quantitative research approach through the use of a questionnaire to gather relevant data. The E-questionnaire was distributed to professionals from various public organizations in Nigeria using the snowballing sampling method. This sampling method was used for the study because the population of public project participants could not be ascertained at the time of conducting this research. Hence, to assist the research participants in identifying other potential respondents, a snowballing sampling technique was used. The study employed a well-designed E-questionnaire as the research tool, which was distributed to the WhatsApp platforms and e-mail addresses of the various target levels. The questionnaire consisted of the following sections:

Section A: Contains information about the respondent's demographics. Section B: Examined professionals' level of awareness and understanding of smart contracts and respondents' knowledge of smart contracts. Section C: identified the challenges of integrating new technologies, specifically smart contracts and blockchain technology into the contract administration of the public sector. Section D: identified the factors that influence professionals' attitudes towards smart contracts and blockchain technology in the public sector contract administration process. The questionnaires were distributed via email addresses and to specific WhatsApp platforms of public project participants. Data collected from the source were analyzed using descriptive statistical methods to present and analyze data in a consistently error-free manner.

IV. RESULTS AND DISCUSSION

The questionnaire was presented in four sections: Section A: contained information about the respondent's demographics. Section B: Examined professionals' level of awareness, knowledge, and understanding of smart contracts. Section C: identified the challenges of integrating smart contracts and blockchain technology into the contract administration of the public sector. Section D: identified the factors that influenced professionals' attitudes towards smart contracts and blockchain technology in the public sector contract administration process. 41 responses were collected and analyzed.

4.1 RESPONDENT'S DEMOGRAPHICS

Table 1 Type of organization				
	Frequency	Percent	Valid Percent	Cumulative Percent
Federal/state ministry	8	19.5	19.5	19.5
Federal educational institution	10	24.4	24.4	43.9
Public company	23	56.1	56.1	100.0
Total	41	100.0	100.0	

Table 1 shows the distribution of the organizations of the respondents. A public company has 56.10% (23 respondents), a Federal educational institution has 24.40% (10 respondents) and a Federal/state ministry with 19.50% (8 respondents). This table proves that all respondents were involved in public projects.

Table 2 Type of project you have worked on				
	Frequency	Percent	Valid Percent	Cumulative Percent
Residential	15	36.6	36.6	36.6
Commercial	6	14.6	14.6	51.2
Industrial	4	9.8	9.8	61.0
Institutional	4	9.8	9.8	70.7
Civil engineering project	12	29.3	29.3	100.0
Total	41	100.0	100.0	

Table 2 shows the distribution of projects the respondents have worked on. Residential projects have 36.60% (15 respondents), Civil engineering projects have 29.30% (12 respondents), Commercial projects have 14.60% (6 respondents), and Industrial projects have 9.80% (4 respondents) while Institutional projects with 9.80% (4 respondents). This table reveals that the majority of the respondents have worked on many public projects, especially in residential and civil engineering projects.

4.2 DATA PRESENTATION AND DISCUSSION

This section presented the attributes, challenges, and benefits of smart contracts and blockchain technology as rated by the respondents' views and understanding. The results are presented in Tables 3 (attributes of the smart contract), 4 (challenges of the smart contract), and 5 (benefits of the smart contract) while the discussions followed afterward.

Table 3 Attributes of Smart Contract						
	N	Minimum	Maximum	Mean	Std. Deviation	Rank
Prompt payment	41	1.00	5.00	3.7073	1.18836	1
Cost saving	40	1.00	5.00	3.6500	1.27199	2
Security of payment	41	1.00	5.00	3.6341	1.27977	3
Transparent transaction	41	1.00	5.00	3.6341	1.31826	3

Automated payment	41	1.00	5.00	3.5366	1.32472	5
Increased efficiency of payment	41	1.00	5.00	3.4878	1.12076	6
Accurate payment	41	1.00	5.00	3.4878	1.41637	7
Decentralized network	41	1.00	5.00	3.4146	1.24450	8
Reduced dispute	41	1.00	5.00	3.3171	1.43943	9
Reliability of data	41	1.00	5.00	3.2683	1.18373	10
Valid N (listwise)	40					

Based on the attributes of smart contracts as indicated in Table 3 above, the results were analyzed based on the descriptive analyses showing the means from the highest to the lowest ranking. Prompt Payment had the highest mean score of 3.71 indicating that respondents generally perceived that smart contracts are effective in facilitating timely payments. Cost Saving had the second highest mean score of 3.65, which reveals that the respondents believe that smart contracts contribute to cost savings in construction projects. Security of Payment and Transparent Transaction both had a mean score of 3.63, suggesting that smart contracts are perceived as providing a secure payment mechanism and promoting transparent transactions. It is interesting to note that Automated Payment was ranked fifth with a mean score of 3.54. (Which would ordinarily have been thought to have the highest ranking). Increased Efficiency of Payment ranked sixth with an average score of 3.49. Accurate Payment ranked seventh as indicated by the mean score of 3.49. Decentralized Network ranked eighth with an average score of 3.41. Reduced Dispute ranked ninth with an average score of 3.32 while Reliability of Data ranked tenth with an average score of 3.27. Overall, the results suggest that respondents recognize various features and attributes associated with smart contracts, including efficiency, accuracy, security, and transparency in transactions. These findings indicate a positive perception of smart contracts and their potential to revolutionize contract management and payment systems.

Table 4 Challenges and Consideration of Smart Contract

	N	Minimum	Maximum	Mean	Std. Deviation
Regulations and legality regarding smart contract	41	2.00	5.00	3.7317	1.16242
Technical know-how	41	1.00	5.00	3.5854	1.30337
Initial high-cost	41	1.00	5.00	3.5854	1.18270
personnel attitude toward smart contract	41	1.00	5.00	3.4878	1.14285
Code vulnerability and security of data	41	1.00	5.00	3.4390	1.14124
Economic and Financial risks	41	1.00	5.00	3.3415	1.15347
Lack of necessary infrastructure	41	1.00	5.00	3.3171	1.23367
Immutability of records (cannot change data once coded)	40	1.00	5.00	3.2500	1.17124
Lack of competition due to the limited bargaining capabilities in the system	41	1.00	5.00	3.2195	1.33252
Cryptographic failures	41	1.00	5.00	3.0000	1.20416
Valid N (listwise)	40				

Based on the challenges and considerations of smart contracts as indicated in the table, Regulations and Legality Regarding Smart Contracts were perceived as the most significant challenge with smart contracts, with an average mean score of 3.73. This suggests concerns regarding compliance and the legal framework surrounding the implementation of smart contracts. Technical Know-how and Initial Cost both had a mean score of 3.59. This

highlights the importance of technical expertise in implementing and managing smart contract systems, as well as raising concerns about how cost considerations may act as a barrier to the adoption of smart contracts. The attitude of personnel towards smart contracts is equally perceived as a challenge, with respondents indicating an average mean score of 3.49. This underscores the importance of organizational buy-in and change management efforts. Code Vulnerability and Security of Data are identified as additional challenges, with respondents rating this challenge at a 3.44 mean score average. The Economic and Financial Risks associated with smart contracts are recognized as a concern, with an average mean score of 3.34. Respondents equally highlighted the lack of necessary infrastructure as a barrier to smart contract adoption, with a mean score of 3.32. This includes both technical infrastructure and regulatory frameworks. The Immutability of Record (inability to change data once coded) is flagged as a challenge, with a mean score of 3.25 on average. Lack of Competition due to Limited Bargaining Capabilities and Cryptographic Failures were identified as significant challenges hindering the adoption of smart contracts. In summary, these results highlight various challenges and considerations that organizations and stakeholders need to address when implementing smart contracts, including regulatory compliance, technical complexity, cost, security, and organizational readiness. Addressing these challenges effectively is crucial for the successful adoption and implementation of smart contract systems.

Table 5 Benefits of Smart Contract

	N	Minimum	Maximum	Mean	Std. Deviation	Rank
Transparency of transaction	41	1.00	5.00	4.0488	.97343	1
Accuracy of Payment	41	2.00	5.00	3.8780	1.02944	2
Eliminating intermediaries	41	1.00	5.00	3.8537	1.29540	3
Cost and time-saving	41	1.00	5.00	3.8293	1.11585	4
Trust (build trust between parties)	41	1.00	5.00	3.7317	1.24548	5
Automatic updates	41	1.00	5.00	3.7073	1.10100	6
Security (it is encrypted and runs on a blockchain, making it secure)	41	1.00	5.00	3.7073	1.10100	6
Autonomy (it is self-executing)	41	1.00	5.00	3.6585	1.21675	8
Prompt Payment	41	1.00	5.00	3.6098	1.24254	9
Valid N (litwise)	41					

The top five benefits of smart contracts based on the ranking in Table 5 are transparent transactions, the accuracy of payment, elimination of intermediaries, cost and time-saving, and automatic updates. Transparency of Transaction ranked first with a mean score of 4.05. This suggests that respondents perceive providing clear and visible transaction processes as an important benefit that the smart contract payment system offers. Accuracy of payment was the second-high-ranked benefit of smart contracts with a mean score of 3.88, indicating that smart contracts are perceived as reliable systems for ensuring accurate payment. Smart contracts' ability to eliminate third parties was the third high-ranked benefit with a mean score of 3.85. This implies that smart contracts streamline processes and reduce reliance on third-party intermediaries. Smart contracts also contribute to cost and time savings, as indicated with a mean score of 3.83 indicates that smart contracts are seen as efficient and cost-effective solutions. Smart contracts help build trust between parties involved in transactions, as represented by a mean score of 3.73. This suggests that smart contracts foster trust through their transparent and automated systems. Automatic Updates and security had a mean score of 3.71 indicating that smart contracts enable automatic updates in real-time without manual intervention. Consequently, the encryption of data contributes to their security. Smart contracts are autonomous and self-executing, according to respondents who rated this benefit at a 3.66 mean score. This suggests that smart contracts operate independently once deployed and lastly, smart contracts facilitate prompt payment, with a mean score of 3.61. This indicates that smart contracts help ensure timely and efficient payment processes. In summary, these results highlight the various benefits associated with smart contracts, including transparency, accuracy, efficiency, trust, security, autonomy, and prompt payment. These benefits contribute to the attractiveness and adoption of smart contracts in various industries and applications.

Table 6: Level of Conversance with Smart Contract

	N	Minimum	Maximum	Mean	Std. Deviation
How conversant are you with smart contract	41	1.00	5.00	3.0244	1.15082
How would you describe your level of knowledge of smart contract	41	1.00	5.00	2.9024	1.13589
Valid N (listwise)	41				

Based on the responses provided in Table 6, the Level of Conversance with Smart Contracts indicates a moderate level of familiarity or understanding among the respondents regarding smart contracts. Respondents described their level of knowledge of smart contracts with an average mean score of 2.90. This suggests that respondents perceive their knowledge level to be slightly lower than their level of conversance, indicating some uncertainty or variability in their understanding of the technology. This highlights the importance of ongoing education and training to enhance understanding and proficiency in smart contract technology.

Table 7 Level of Interaction with Smart Contract Payment System

	Frequency	Percent	Valid Percent	Cumulative Percent
I have heard of it	8	19.5	19.5	19.5
I did not hear of it	5	12.2	12.2	31.7
I have heard about it but I did not use it	15	36.6	36.6	68.3
I have heard it and used it	11	26.8	26.8	95.1
I barely know it	2	4.9	4.9	100.0
Total	41	100.0	100.0	

Based on the responses provided in Table 7 above, 19.5% (3) of respondents indicated that they have heard of smart contract payment systems but have not used them. Similarly, 12.2% (5) of respondents stated that they had not heard of smart contract payment systems. 15 respondents (36.6%) on the other hand reported that they had heard about smart contract payment systems but had not used them. 11 (26.8%) of respondents mentioned that they had heard of smart contract payment systems and had used them. A small percentage (4.9%) of 2 respondents indicated that they barely know about smart contract payment systems. Overall, the responses suggest that while a significant portion of respondents have heard about smart contract payment systems, a smaller proportion have used them. This indicates some level of awareness and adoption of the technology, but there may be room for further education and exploration of smart contract payment systems among respondents. 37 (90.2%) respondents believe that smart contract payment systems should be used for payment of public projects. This majority suggests strong support for the adoption of smart contract payment systems in public projects. Reasons for endorsing smart contracts in public projects could include transparency, efficiency, security, and cost-effectiveness. However, 4 (9.8%) respondents do not believe that smart contract payment systems should be used for public projects. This minority indicates some hesitation or skepticism regarding the suitability or viability of smart contracts in the context of public projects.

Table 8 Perception of smart contract payment system for public projects

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	37	90.2	90.2	90.2
No	4	9.8	9.8	100.0
Total	41	100.0	100.0	

The reasons for opposing the use of smart contracts in public projects could include concerns about complexity, regulatory issues, or the need for human oversight. Overall, the overwhelming majority of respondents support the implementation of smart contract payment systems in public projects. This suggests recognition of the potential benefits that smart contracts can offer in enhancing transparency, efficiency, and accountability in the management of public funds and projects.

Table 9 Government support in the adoption of smart contracts for public projects

	Frequency	Percent	Valid Percent	Cumulative Percent
	35	85.4	85.4	85.4
Yes	6	14.6	14.6	100.0
No	41	100.0	100.0	
Total				

35 (85.4%) respondents believe that government support will improve the adoption of smart contracts in public projects. This majority suggests a strong belief among respondents that government backing is crucial for the widespread adoption of smart contracts in public projects. Government support can include initiatives such as policy frameworks, funding incentives, regulatory guidance, and pilot projects aimed at promoting the use of smart contracts. Nevertheless, 6 (14.6%) respondents do not think that government support will improve the adoption of smart contracts in public projects. This minority indicates some skepticism or uncertainty regarding the effectiveness of government intervention in promoting the adoption of smart contracts. Reasons for this viewpoint could include concerns about government bureaucracy, lack of understanding of emerging technologies, or doubts about the feasibility of implementation. Overall, while the majority of respondents believe that government support is essential for advancing the use of smart contracts in public projects, there is a smaller segment that remains skeptical about the impact of such support. This highlights the importance of effective government policies and initiatives in fostering innovation and adoption of new technologies in the public sector.

Table 10 Smart contract ability to eliminate delay of payment in public projects

	Frequency	Percent	Valid Percent	Cumulative Percent
Strongly disagree	1	2.4	2.4	2.4
Disagree	3	7.3	7.3	9.8
Neither Agree or Disagree	8	19.5	19.5	29.3
Agree	11	26.8	26.8	56.1
Strongly Agree	18	43.9	43.9	100.0
Total	41	100.0	100.0	

Only 1 (2.4%) respondent strongly disagreed that smart contracts could eliminate delayed payment for public projects. This indicates a small minority of respondents who hold a firm belief that smart contracts are not effective in addressing payment delays. 3 (7.3%) of respondents disagree that smart contracts can eliminate delays in payment for public projects. This suggests that another small portion of respondents hold the opinion that smart contracts may not eliminate payment delays, although they may still have some positive impact. 8 (19.5%) respondents neither agree nor disagree regarding the ability of smart contracts to eliminate payment delays. This indicates uncertainty or indecision among a significant portion of respondents regarding the effectiveness of smart contracts in addressing payment delays. 11 (26.8%) respondents agree that smart contracts can eliminate delays in payment for public projects. This suggests that a considerable portion of respondents believe in the potential of smart contracts to mitigate or eliminate payment delays in public projects. 18 (43.9%) respondents strongly agree that smart contracts can eliminate delays in payment for public projects. This indicates a strong consensus among

a significant majority of respondents regarding the efficacy of smart contracts in addressing payment delays. In conclusion, the majority of respondents agreed that smart contracts have the potential to eliminate delays in

payment for public projects. This suggests optimism about the ability of smart contracts to improve payment processes and reduce inefficiencies in public project management.

V. CONCLUSION

The findings of this study shed light on the perceptions of professionals within Nigeria's public sector regarding smart contracts, revealing both opportunities and challenges in the adoption of this transformative technology. Among the most significant attributes of smart contracts identified by respondents were prompt payment, cost-saving potential, security of payment, transparent transactions, and automated payment processes. These attributes underscore the potential benefits that smart contracts hold for enhancing efficiency, transparency, and accountability within public sector projects. While the study indicates a high level of awareness among professionals within the Nigerian public sector regarding the concept of smart contracts and their potential applications, with an impressive percentage of 82.60%, there remains a gap in comprehension regarding their functionality. Only 26.80% of respondents demonstrated a sufficient understanding of smart contract functionality, indicating a need for targeted education and training initiatives to bridge this gap and ensure effective utilization of the technology. Despite the comprehension challenges, the study highlights a strong belief among professionals (with an overwhelming 70.70%) agreeing that smart contracts can eliminate delayed payments common with public projects. This presents a significant opportunity for leveraging smart contracts to improve prompt payment, project delivery, and execution of public projects. Based on the obtained results from the research, it is crucial to conduct longitudinal studies to track changes in awareness, comprehension, and readiness to adopt smart contracts among professionals within the Nigerian public sector over time. This would provide valuable insights into the dynamics of attitudes and behaviors toward emerging technologies.

REFERENCES

- [1] Allmang, A. (2023, November 15). *Smart contracts VS Traditional contracts* | Linedata. www.linedata.com. <https://www.linedata.com/smart-contracts-vs-traditional-contracts>
- [2] Abiodun, B. (2023). *Nigeria's CBN has dreams for stablecoins, smart contracts, and ICOs; here's what they could look like*. Techpoint Africa. <https://techpoint.africa/2023/01/19/cbns-plan-for-stablecoins-smartcontracts-and-icos/>
- [3] Agnisetty, G. (2022). *Smart Contracts: Pros and Cons*. CodeGlo Journal. <https://www.codeglo.com/blog/smart-contracts-pros-and-cons/>
- [4] Bain, M. (2023). *Nigeria's National Blockchain Policy and Adoption of Web3 Technology*. www.linkedin.com. <https://www.linkedin.com/pulse/nigerias-national-blockchain-policy-adoption-web3-technology-bain>
- [5] Biswas, B., & Gupta, R. (2019). Analysis of barriers to implementing blockchain in industry and service sectors. *Computers & Industrial Engineering*, 136, 225–241.
- [6] Budayan, C., & Okudan, O. (2023). Assessment of Barriers to the Implementation of Smart Contracts in Construction Projects-Evidence from Turkey. *BUILDINGS*, 13(8), 2084. <https://doi.org/10.3390/buildings13082084>
- [7] Frankenfield, J. (2023, February 9). *Smart Contracts*. Investopedia. <https://www.investopedia.com/terms/s/smart-contracts.asp>
- [8] Grand View Research. (2023). *Smart Contracts Market Size, Share, & Trends [2023 Report]*. www.grandviewresearch.com. <https://www.grandviewresearch.com/industry-analysis/smart-contracts-market-report>
- [9] Hedera. (2023). *Smart Contract Advantages*. Hedera. <https://hedera.com/learning/smart-contracts/smart-contract-advantages>
- [10] Ho F (2016). Interview: Richard Saxon Negara E S, Hidayanto A N, Andryani R, Syaputra R (2021b). Survey of smart contract framework and its application. *Information*, 12(7): 257–266
- [11] Howell, J. (2023). *10 Advantages of Using Smart Contracts*. 101 Blockchains. <https://101blockchains.com/advantages-of-smart-contracts/>
- [12] KÜNKÜ, H., Koc, K., Gurgun, A. P., & DAGOU, H. H. (2023). Operational Barriers against the Use of Smart Contracts in Construction Projects. *Operational Barriers against the Use of Smart Contracts in Construction Projects*, 2023 81-106, Paper 747. <https://doi.org/10.18400/tjce.1322972>
- [13] Liu S, Xie B, Tivendal L, Liu C (2015). Critical barriers to BIM implementation in the AEC industry. *International Journal of Marketing Studies*, 7(6): 162–171
- [14] Luu L, Chu D H, Olickel H, Saxena P, Hobor A (2016). Making smart contracts smarter. In: *Proceedings of the ACM SIGSAC Conference on Computer and Communications Security*. Vienna: ACM, 254–269
- [15] Manohar, M. (2021, June 21). *Council Post: Smart Contracts: The Linchpin To Enterprise Blockchain Adoption*. Forbes. <https://www.forbes.com/sites/forbestechcouncil/2023/06/21/smart-contracts-the-linchpin-to-enterprise-blockchain-adoption/?sh=49e06ea12cba>
- [16] Ojo, O., & Nwaokike, U. (2018). Disruptive Technology and the Fintech Industry in Nigeria:
- [17] Imperatives for Legal and Policy Responses (SSRN Scholarly Paper No. ID 3306164). Retrieved from Social Science Research Network website: <https://papers.ssrn.com/abstract=3306164>
- [18] Sawhney, A., Riley, M. and Irizarry, J. (2020), *Construction 4.0: An Innovation Platform for the Built Environment*, Taylor & Francis (Routledge), London.
- [19] Smith, C. (2023). *Testing smart contracts*. Ethereum.org. <https://ethereum.org/en/developers/docs/smart-contracts/testing/>
- [20] Stefany, G. (2023). *The Blockchain Smart Contract Potential*. SDLC Corp. <https://sdllcorp.com/post/the-blockchains-smart-contract-potential/>
- [21] Wang, H., Zheng, Z., Xie, S., Dai, H. N., & Chen, X. (2018). Blockchain challenges and opportunities: a survey. *International Journal of Web and Grid Services*, 14(4), 352.

-
- [22] Wang, j., Wu, p., Wang, x., & Shou, w. (2017). The outlook of blockchain technology for construction engineering management. *Frontiers of Engineering Management*, 4(1), 67.
- [23] Washbourne, M. (2018). Africa embraces blockchain. *Australia's Paydirt*, 1(265), 26.
- [24] Wong PF, Chia F C, Kiu M S, Lou E C W (2022). Potential integration of blockchain technology
- [25] Wolfson, R. (2022). The future of smart contract adoption for enterprises. *Cointelegraph*. <https://cointelegraph.com/news/the-future-of-smart-contract-adoption-for-enterprises>
- [26] Into smart sustainable city (SSC) developments: A systematic review. *Smart and Sustainable Built Environment*, 11(3): 559–574
- [27] Zhang, S., Rong, X., Bakhtawar, B., Tariq, S., & Zayed, T. (2021). Assessment of Feasibility, Challenges, and Critical Success Factors of MiC Projects in Hong Kong. *Journal of Architectural Engineering*, 27(1), 04020047.
- [28] Zheng Z, Xie S, Dai H N, Chen W, Chen X, Weng J, Imran M (2020). An overview of smart Contracts: Challenges, advances, and platforms. *Future Generation Computer Systems*, 105: 475–491
- [29] Zhong, B., Wu, H., Ding, L., Luo, H., Luo, Y., & Pan, X. (2020). Hyperledger fabric-based consortium blockchain for construction quality information management. *Frontiers of Engineering Management*.
- [30] Zou W, Lo D, Kochhar P S, Le X B D, Xia X, Feng Y, Chen Z, Xu B (2021). Smart contract development: Challenges and opportunities. *IEEE Transactions on Software Engineering*, 47(10): 2084–2106