EVALUATING THE OPPORTUNITIES AND OBSTACLES OF BLOCKCHAIN TECHNOLOGY IN SAUDI ARABIA: A CASE STUDY OF STC PAY IN MODERN APPLICATIONS

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ABSTRACT

Blockchain technology holds immense transformative potential; however, its adoption is accompanied by significant challenges. This research explores the opportunities and obstacles associated with blockchain, with a particular focus on its application within STC Pay in Saudi Arabia. Based on user feedback collected from a questionnaire distributed to 100 participants, the study delves into critical areas such as participant demographics, potential benefits, challenges encountered, proposed solutions, and general feedback. The findings emphasize the significance of blockchain in enhancing security, transparency, and efficiency while also identifying key barriers that must be addressed for its successful adoption. Key challenges, including scalability, privacy concerns, regulatory compliance, and interoperability, are highlighted as major hurdles to integrating blockchain technology effectively. Addressing these issues requires clear communication, adaptable policies, and targeted strategies that consider the unique needs of different stakeholders. By fostering collaboration among regulatory authorities, management teams, and users, the research proposes actionable solutions to overcome these obstacles. The study also underscores the importance of user feedback in shaping the adoption process. Perspectives from diverse groups, including IT professionals, management, and end-users, are crucial for aligning technological advancements with practical needs. The comprehensive analysis offers a balanced understanding of both opportunities and challenges, providing a roadmap for effective blockchain integration.In conclusion, this research provides valuable insights into blockchain's potential to revolutionize digital payments, particularly within STC Pay. By addressing existing challenges through strategic approaches, the findings contribute to advancing the adoption of blockchain technology while emphasizing its role in fostering innovation and driving efficiency in modern financial systems.

KEYWORDS

Blockchain Technology, Digital Payments, STC Pay, Saudi Arabia, Scalability, Privacy Concerns, Regulatory Compliance, Interoperability Challenges, Security, Transparency, Operational Efficiency

1. INTRODUCTION

Blockchain technology has emerged as a revolutionary innovation with the potential to transform various industries Originally developed as the foundational technology for Bitcoin, blockchain offers a decentralized, transparent, and secure mechanism for recording transactions. By leveraging distributed ledger technology, it ensures tamper-proof and reliable record-keeping, minimizing reliance on

intermediaries and fostering trust among stakeholders [15]. The versatility of blockchain has led to its adoption beyond cryptocurrencies, finding applications in sectors such as finance, supply chain management, healthcare, and more.

In recent years, blockchain technology has gained significant traction in Saudi Arabia, where the government and private sector are exploring its potential to drive digital transformation and economic growth. STC Pay, a leading digital payment platform in Saudi Arabia, is one such example of blockchain implementation in the financial sector. This research aims to explore the opportunities and challenges associated with blockchain technology, specifically focusing on its implementation within STC Pay. By examining STC Pay's experience, the study provides a deeper understanding of blockchain's potential in modern applications and its impact on the financial industry.

The study also delves into the principles of blockchain technology, highlighting its key features, such as decentralization, immutability, and transparency. These features contribute to the enhanced security and efficiency of blockchain-based systems. However, despite its numerous advantages, blockchain technology faces several challenges that need to be addressed for its successful adoption. These challenges encompass scalability limitations, regulatory concerns, and the necessity for broad acceptance and seamless integration into existing systems. To perform a comprehensive case study of STC Pay, user feedback was collected through a structured questionnaire distributed among participants.

A total of 100 participants responded to the questionnaire, providing valuable insights into their experiences and perceptions of blockchain technology. The analysis focuses on several factors, including participant information, opportunities of blockchain technology, obstacles and challenges, solutions and strategies, and general feedback.

This research provides valuable insights into how blockchain technology is transforming modern applications and the barriers that need to be addressed for successful adoption. The paper underscores significant challenges related to blockchain technology and suggests effective ways to enhance STC Pay. The results emphasize the importance of using clear communication and strategies to overcome these challenges and leverage the full potential of blockchain technology in the financial sector [8][8,17,24]

2. LITERATURE REVIEW

2.1. Overview of Blockchain Technology and its Evolution

Blockchain technology is a decentralized and distributed digital ledger system that records transactions across multiple computers. It was first conceptualized in 1991 by Stuart Haber and W. Scott Stornetta, who aimed to create a system for securing digital timestamps. However, blockchain gained prominence in 2008 when Satoshi Nakamoto introduced it as the underlying technology for Bitcoin, the first cryptocurrency.[26]

2.2. Evolution of Blockchain Technology

1. **Early Foundations (1991-2008)**: During the early foundations period (1991-2008), the initial concept of blockchain technology focused on securing digital documents with cryptographic timestamps. This led to the introduction of the idea of a chain of blocks to ensure data integrity.[16]
2. **Bitcoin and Cryptocurrencies (2008-2013)**:During the period of Bitcoin and cryptocurrencies (2008-2013), Satoshi Nakamoto's whitepaper introduced blockchain as

the backbone of Bitcoin. This period marked the rise of cryptocurrencies, showcasing blockchain's potential for secure and decentralized financial transactions.[16]

3. **Emergence of Smart Contracts (2013-2015)**:During the emergence of smart contracts (2013-2015), Ethereum, launched in 2015, expanded blockchain's capabilities by introducing smart contracts. Smart contracts are self-executing agreements with terms directly written into code, enabling automation and trustless transactions.[14]
4. **Enterprise Adoption and Diversification (2016-Present)**:Blockchain technology began to be adopted across various industries, including supply chain management, healthcare, and finance. Innovations such as Proof of Stake (PoS) and Layer 2 solutions have effectively tackled challenges related to scalability and energy efficiency.[15] PoS reduces computational demands by requiring validators to hold a stake rather than solve complex algorithms, while Layer 2 solutions enhance transaction throughput by offloading processes from the main blockchain). [14,16]
5. **Future Prospects**: Blockchain continues to evolve with advancements in interoperability, privacy, and regulatory frameworks. Emerging applications include decentralized finance (DeFi), non-fungible tokens (NFTs), and blockchain-based governance systems.[10]

Blockchain's journey from a niche concept to a transformative technology highlights its potential to revolutionize industries by enhancing security, transparency, and efficiency.

2.3. Key Benefits and Limitations of Blockchain as Identified in Previous Studies.

1. Enhanced Security: "Blockchain leverages advanced cryptographic methods and decentralized networks to securely safeguard data, ensuring resistance to fraud and unauthorized access. By distributing data across multiple nodes, blockchain creates a tamper-proof system that enhances both reliability and trust [17,24]
2. **Transparency**: Transactions are recorded on a distributed ledger, ensuring all participants have access to the same information, which promotes trust .[23,24]
3. **Traceability**: Blockchain creates an immutable audit trail, enabling the tracking of assets and their origins, which is particularly useful in supply chain management. [23,24]
4. **Efficiency and Cost Reduction**: By automating processes and eliminating intermediaries, blockchain reduces transaction costs and increases operational efficiency. [23,24]
5. **Decentralization**: Blockchain operates on a peer-to-peer network, removing the need for a central authority and enhancing trust among participants. [23,24]

2.4. Key Limitations of Blockchain Technology

1. **Scalability Issues:**Blockchain networks frequently encounter limitations in processing a high volume of transactions concurrently, which results in increased latency and slower transaction speeds. This challenge arises due to the inherent design of most blockchains, where all transactions are validated sequentially by the network's nodes to ensure security and consensus. [24,26]
2. **High Energy Consumption**: Consensus mechanisms like Proof of Work (PoW) require significant computational power, resulting in high energy usage. [24,26]
3. **Integration Complexity**: Integrating blockchain with existing systems can be challenging due to its technical complexity,[24,26]
4. **Privacy Concerns**: While blockchain ensures transparency, it may expose sensitive transaction details, raising privacy issues.[24,26]
5. **Regulatory Uncertainty**: The lack of clear regulations and standards for blockchain technology creates challenges for its adoption,[24,26]

These benefits and limitations highlight the transformative potential of blockchain technology while emphasizing the need to address its challenges for broader adoption.

2.5. Analysis of Case Studies and Real-World Examples of Blockchain Implementation

some case studies and real-world examples of blockchain implementation across various industries:

2.5.1. Case Studies

1. **Trust Your Supplier (Procurement)**

   - **Business Challenge**: Finding and onboarding reputable suppliers is time-consuming and expensive due to the difficulty in verifying and obtaining data from providers.
   - **Initiative**:Trust Your Supplier partnered with IBM to develop an open-source blockchain platform that enables businesses to securely and efficiently exchange data with authorized partners. This platform leverages blockchain's decentralized architecture to ensure transparency, data integrity, and enhanced collaboration among stakeholders (Dong et al., 2023).
   - **Results**: Reduced supplier onboarding duration by more than 70%, lessened the cost for data verification by 50%, and improved compliance by almost instantaneously checking international quality certificates.[26]

2. **Marco Polo Network (Trade Finance)**

   - **Business Challenge**: International trading can be risky for both exporters and importers. Traders often collaborate with third parties like banks to guarantee payment once goods are delivered.
   - **Initiative**: Marco Polo Network uses blockchain to provide a secure and transparent way to track the movement of goods and ensure payment.
   - **Results**: Enhanced transparency and reduced risks in international trade.[26]

2.5.2. Real-World Examples

1. **Walmart's Food Traceability System**

   - **Implementation**: Walmart uses blockchain technology to create a digital ledger of food products as they move through the supply chain. This system allows Walmart to track the origin and journey of each food item.
   - **Results**: Reduced the time it takes to trace a food product from weeks to seconds, ensuring greater transparency and safety across the entire supply chain.[25]

2. **Maersk's TradeLens Platform**

   - **Implementation**: Maersk's TradeLens platform is a blockchain-based platform that provides a secure and transparent way to track the movement of goods through the supply chain.
   - **Results**: Reduced the time it takes to process a shipment from days to minutes, improving efficiency and reducing costs.[27]

These examples highlight the transformative potential of blockchain technology in various sectors, from procurement and trade finance to supply chain management.

3. RESEARCH QUESTIONS

1. What are the potential opportunities for blockchain technology in the context of STC Pay?
2. What obstacles and challenges are faced by STC Pay in implementing blockchain technology?
3. How can STC Pay address these challenges to ensure successful adoption of blockchain technology?

4. HYPOTHESES

1. Integrating blockchain into STC Pay can enhance security, transparency, and efficiency, revolutionizing its operations.
2. The main obstacles faced by STC Pay in implementing blockchain technology include scalability issues, privacy andsecurity concerns, regulatory compliance, and interoperability challenges.
3. Developing effective strategies and solutions can overcome challenges and enable the successful adoption of blockchain technology in STC Pay.

5. METHODOLOGY

A questionnaire was designed to Evaluate the Opportunities and Obstacles of Blockchain Technology in Saudi Arabia: A Case Study of STC Pay. The questionnaire included various statements related to Opportunities and Obstacles of Blockchain Technology, which participants rated on a five-point Likert scale ranging

5.1. Participants

A total of 100 participants were recruited for the study. The participants included management, IT professionals, and users to ensure a diverse sample representing different perspectives.

5.2. Procedure

1. **Questionnaire Design:**

   The questionnaire was developed based on established Opportunities and Obstacles of Blockchain Technology metrics and guidelines.It included sections on Opportunities of Blockchain Technology, Potential Opportunities for Blockchain Technology, Obstacles and Challenges in Implementing Blockchain Technology, Solutions and Strategies to Address Blockchain Challenges, and General Feedback.

2. **Data Collection**: Surveys and interviews with key stakeholders at STC Pay, including management, IT professionals, and users.

3. **Case Study Analysis**: In-depth analysis of STC Pay's implementation of blockchain technology, focusing on the opportunities and challenges encountered.

4. **Data Analysis**

   The collected data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS), ensuring accurate and reliable results. Descriptive statistics, including mean scores and standard deviations, were calculated for each statement. Cronbach's Alpha was used to assess the reliability and internal consistency of the questionnaire. The Spearman Correlation Coefficient was calculated to determine the relationship between

Opportunities and Obstacles of Blockchain Technology and other factors. Furthermore, regression analysis was performed to evaluate the influence of various factors on the opportunities and challenges associated with implementing blockchain technology in STC Pay.

6. RESULTS

The analysis results provided insights into the Opportunities and Obstacles of Blockchain Technology in Saudi Arabia: A Case Study of STC Pay in Modern Applications, highlighting areas for improvement and the relationship between various factors and Opportunities and Obstacles of Blockchain Technology.

6.1. Opportunities of Blockchain Technology

The term "Opportunities of Blockchain Technology" refers to the various potential benefits and applications that blockchain technology can offer across different industries. Here are some key opportunities:

1. **Enhanced Security Operations**

Opportunity: Blockchain technology offers a decentralized and tamper-proof ledger, which enhances the security of transactions and data. The use of cryptographic algorithms ensures that data is secure and cannot be altered without consensus from the network participants.Blockchain can be used in financial services to secure transactions and prevent fraud. It can also be applied in cybersecurity to create secure and immutable records of data exchanges.[7]

2. **Enhanced Transparency of Operations**

Opportunity: Blockchain provides a transparent and verifiable record of transactions, which can be accessed by all authorized participants. This level of transparency fosters trust among stakeholders and minimizes the risks of both fraud and corruption.In supply chain management, blockchain can track the movement of goods from origin to destination, ensuring transparency and accountability. It can also be used in voting systems to ensure transparent and tamper-proof election processes. [13,21]

3. **Enhanced Efficiency of Operations**

Opportunity: By eliminating intermediaries and automating processes through smart contracts, blockchain can significantly improve the efficiency of operations. Transactions can be processed faster and with lower costs.In finance, blockchain can streamline cross-border payments, reducing the time and cost involved. In healthcare, blockchain can facilitate the secure and efficient sharing of patient records among healthcare providers.[1]

6.2. Obstacles and Challenges in Implementing Blockchain Technology

Implementing blockchain technology comes with several obstacles and challenges that need to be addressed for successful adoption. Here are some of the main challenges:

6.2.1. Scalability Issues

Scalability is the capacity of a blockchain network to efficiently process an increasing volume of transactions as demand grows. Most blockchain networks, such as Bitcoin and Ethereum, struggle with scalability due to their consensus mechanisms, which can lead to slow transaction times and high fees during peak demand periods.Scalability issues can hinder the widespread adoption of blockchain technology, as businesses and users may find it impractical for high-volume transactions.[6]

6.2.2. Privacy Concerns

Explanation: Blockchain's transparency, while beneficial for security, can raise privacy concerns.Public blockchains grant unrestricted access to transaction details, which may result in the disclosure of sensitive information. Ensuring data privacy while maintaining transparency is a significant challenge. Privacy concerns can deter businesses and individuals from adopting blockchain technology, especially in industries where data confidentiality is crucial.[4]

6.2.3. Regulatory Compliance

The regulatory framework for blockchain technology is still in a state of development, with clear guidelines and standards yet to be established. This creates uncertainty for businesses and can lead to legal and compliance challenges. Regulatory uncertainty can slow down the adoption of blockchain technology, as businesses may be hesitant to invest in a technology that could face future legal hurdles.[16]

6.2.4. Interoperability Issues

Interoperability is the capability of distinct blockchain networks to exchange information and interact seamlessly. Currently, most blockchain systems operate in isolation, making it difficult to transfer data and assets between them.Interoperability issues can limit the potential benefits of blockchain technology, as users and businesses may find it challenging to integrate different blockchain solutions.[5]

These obstacles highlight the complexities and efforts required to overcome the barriers to successful blockchain adoption. Addressing these challenges is crucial for realizing the full potential of blockchain technology in various industries.

6.3. Solutions and Strategies to Address Blockchain Challenges

Implementing blockchain technology comes with several challenges, but there are effective solutions and strategies to overcome them. Here are some key approaches:

6.3.1. Technological Advancements

Scalability Solutions: To address scalability issues, advancements such as Layer 2 protocols (e.g., Lightning Network), sharding, and optimized consensus mechanisms (e.g., Proof of Stake) can enhance transaction speeds and reduce costs.[12,13]

Privacy Enhancements: Technologies like zero-knowledge proofs (ZKPs) and confidential transactions can help maintain privacy while ensuring transparency.[13]

Interoperability Solutions: Cross-chain interoperability solutions like Polkadot and Cosmos enable different blockchain networks to communicate and share information seamlessly.[13]

6.3.2. Policy Measures

Regulatory Clarity: Governments and regulatory authorities must establish clear and comprehensive guidelines and standards to regulate blockchain technology effectively. This provides businesses with the confidence to invest in and adopt blockchain solutions. [11,7]

Agile Governance Models: Implementing adaptable and flexible policies is essential to keep pace with the continuously evolving technological landscape.This includes establishing governance structures that ensure compliance and security.[8]

Incentive Models: Implementing incentive models to encourage the adoption of blockchain technology can drive innovation and growth.[7]

6.3.3. Enhanced Training and Education

Blockchain Courses and Certifications: Offering comprehensive blockchain courses and certifications can help bridge the talent gap and equip professionals with the necessary skills. [3,9]

Workshops and Seminars: Conducting workshops and seminars to raise awareness and educate businesses and individuals about the potential of blockchain technology.[23]

Online Resources: Providing access to online resources and tutorials can help individuals learn about blockchain technology at their own pace[2]

6.3.4. Collaboration with Industry Experts

Partnerships with Blockchain Experts: Collaborating with blockchain experts and organizations can provide valuable insights and expertise to address complex challenges. [11,17]

Cross-Industry Collaboration: Encouraging collaboration between different industries can lead to innovative solutions and the development of interoperable blockchain systems.[11]

Community Engagement: Engaging with the blockchain community can foster knowledge sharing and drive collective progress.[11]

6.4.General Feedback

comments, insights, and observations collected from participants or stakeholders about the studied subject. This feedback provides a comprehensive overview of the participants' experiences, perceptions, and opinions, which can help identify common themes, areas of improvement, and overall satisfaction. Regarding blockchain technology and its implementation within STC Pay, general feedback would encompass user responses regarding their experiences with the technology, its perceived benefits, and any challenges they faced.

1. **User Experience**: Feedback was gathered on the system's ease of use, interface design, and overall user satisfaction with the blockchain-based platform.
2. **Performance**: Insights on the efficiency, speed, and reliability of transactions conducted using the blockchain technology.

3. **Security**: Feedback on the perceived security and trustworthiness of the blockchain system, including any concerns about data privacy and protection.
4. **Adoption**: Opinions on the ease or difficulty of adopting and integrating the blockchain technology into existing processes and systems.
5. **Suggestions for Improvement**: Participants' recommendations for enhancing the blockchain technology and addressing any identified issues or challenges.

General feedback is crucial for understanding how blockchain technology is being received by users and can guide further improvements and innovations.

Table 1: Cronbach's alpha value for the study variables

Reliability Statistics	
Cronbach's Alpha	N of Items
.619	15

The table presents the Cronbach's alpha value for the study variables, with an overall reliability score of 62%. This reflects a moderately acceptable level of reliability, indicating that the questionnaire sufficiently addresses key aspects of the study topic.

Table 2: descriptive statistics for the study variables

Variables	Mean	Median	Mode	Std. Deviation
How familiar are you with blockchain techology	2.86	3	3	.349
What potential opportunities do you see for blockchain technology in digital payment?	2.33	2	2	.697
How significantly do you believe that blockchain technology can improve security operations?	3.72	4	4	.697
How significant do you believe blockchain technology can be in enhancing the transparency of operations?	3.72	4	4	.697
What do you think are the main measures and challenges facing the implementation of blockchain technology?	1.15	1	1	.359
How challenging do you think scalability issues are for implementing blockchain technology?	3.72	4	4	.697
How challenging do you think privacy concerns are for blockchain implementation at STC Pay	2.00	2	2	.000
How challenging do you think regulatory compliance is for implementing blockchain?	3.00	3	3	.000
How challenging do you think interoperability issues are for blockchain implementation ?	2.00	2	2	.000
What strategies or solutions do you propose to address the identified challenges in implementing blockchain technology?	1.34	1	1	.714
How effective do you think technological advancements could be in addressing the challenges faced ?	3.72	4	4	.697
How effective do you think policy measures could be in addressing the challenges faced ?	3.72	4	4	.697
How effective do you think enhanced training and education could be in addressing the challenges faced by ?	4.58	5	5	1.046
How effective do you believe collaboration with industry experts is in addressing the challenges faced?	3.00	3.	3	.000

Do you have any additional comments or suggestions regarding the implementation of blockchain technology?	2.00	2	2	.000

The table 2 : provides descriptive statistics for the study variables, showing that measures of central tendency (mean) generally center around the value of 3, with slight deviations. The mode is observed at 3, 4, and 5, while the median clusters at 4 and 5. Dispersion values are minimal, suggesting limited variability in responses. Overall, the results indicate a tendency toward positive opinions, as reflected in the concentrated values and low variation across responses. This consistency highlights a uniform pattern in participants' perspectives within the study.

Present Analytical ResultsDetermine Hypothesis Outcome
Hypothesis 1: Integrating blockchain into STC Pay can enhance security, transparency, and efficiency, revolutionizing its operations.

1. How significant do you believe blockchain technology can enhance the security of STC Pay's operations?
2. How significant do you believe blockchain technology can enhance the transparency of STC Pay's operations?
3. How significant do you believe blockchain technology can enhance the efficiency of STC Pay's operations?

Table 3: supports the first hypothesis

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
How significantly do you believe that blockchain technology can improve security operations?	10.323	99	0.000	.720	.58	0.86
How significant do you believe blockchain technology can be in enhancing the transparency of operations?		99	0.000	.720	.58	0.86

The table 3: This reinforces the initial hypothesis, suggesting that blockchain technology can greatly improve the security, transparency, and efficiency of STC Pay's operations. Based on the One-Sample Test, a calculated test value of 10.323 was obtained, with a p-value of 0.000. Since the p-value is less than the significance level of 0.05, the results indicate a statistically significant difference, affirming the hypothesis. This demonstrates that blockchain technology holds considerable potential for optimizing STC Pay's operational processes.

Hypothesis 2: The main obstacles faced by STC Pay in implementing blockchain technology include scalability issues, privacy concerns, regulatory compliance, and interoperability challenges.

Table4: supports the second hypothesis

One-Sample Test	
	Test Value = 3

		df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
What do you think are the main measures and challenges facing the implementation of blockchain technology?	51.551	99	000	-1.850	-1.92	-1.78
How challenging do you think scalability issues are for implementing blockchain technology?	10.323	99	000	.720	.58	.86

The table 4 above examines the second hypothesis, suggesting that the primary obstacles faced by STC Pay in implementing blockchain technology include scalability issues, privacy concerns, regulatory compliance, and interoperability challenges. Using a One-Sample Test, the calculated test values of -51.551 and 10.323 were obtained, with a p-value of 0.000. As the p-value is less than the significance level of 0.05, the results demonstrate a statistically significant difference, affirming the hypothesis and highlighting the significance of addressing these challenges for successful blockchain adoption by STC Pay.

Hypothesis 3:Developing effective strategies and solutions can overcome challenges and enable the successful adoption of blockchain technology in STC Pay.

(i) What potential opportunities do you see for blockchain technology in digital payment Vs significantly do you believe that blockchain technology can improve security, transparency and efficiency operations

Table: 5 relationships between the variables

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	-0.930[a]	.865	.863	.25787
a. Predictors: (Constant), What potential opportunities do you see for blockchain technology in digital payment?				

The table 5 highlights the relationship between the variables: What potential opportunities do you envision for blockchain technology in digital payments? Additionally, how significant do you believe its impact could be on enhancing security, transparency, and operational efficiency? Key metrics such as correlation, coefficient of determination, adjusted R-square, and standard error of the estimate are utilized to deliver a thorough statistical analysis of the relationship. These values offer insights into the strength, predictive accuracy, and consistency of the connection between these factors, shedding light on blockchain's perceived impact in the context of digital payments.

Table 6: correlation

		What potential opportunities do you see for blockchain technology in digital payment?
significantly do you believe that blockchain technology can improve security ,transparency and efficiency operations?	Pearson Correlation	-0.930**
	p.value	0.000

The table 6: The analysis explores the relationship between two variables: 'What potential opportunities do you see for blockchain technology in digital payments?' and 'How significantly do you believe blockchain technology can enhance security, transparency, and operational efficiency?' Findings revealed a correlation value of -0.930 with a p-value of 0.000, indicating a very strong and statistically significant negative correlation. This suggests that as perceived opportunities for blockchain increase, expectations regarding its ability to improve security, transparency, and efficiency tend to decrease.

Table7: relationships between the main obstacles

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.726a	.528	.523	.48181
a. Predictors: (Constant), Main Obstetrical challenging do you think (scalability issues ,privacy concerns, regulatory compliance and interoperability issues)				

The table 7: Summarizes the relationship between key obstacles—such as scalability issues, privacy concerns, regulatory compliance, and interoperability challenges—and the dependent variable: 'How significantly do you believe blockchain technology can improve security, transparency, and operational efficiency?' It incorporates crucial statistical metrics, including correlation, coefficient of determination, adjusted R-square, and standard error of the estimate, providing a thorough analysis of these connections.

Table 8: correlation between the main obstacles

Correlations			Main Obstetrical challenging do you think (scalability issues ,privacy concerns, regulatory compliance and interoperability issues)
significantly do you believe that blockchain technology can improve security, transparency and efficiency operations?	Correlation	1	0.726**
	P P.value		.000
	N	100	100
**. Correlation is significant at the 0.01 level (2-tailed).			

The table 8 analyzes the correlation between the main obstacles (scalability issues, privacy concerns, regulatory compliance, and interoperability challenges) and the belief that blockchain

technology can significantly improve security, transparency, and efficiency in operations. The correlation value of 0.726, along with a p-value of 0.000, highlights a very strong and statistically significant positive relationship. This result suggests that as recognition of these obstacles increases, so does the belief in blockchain's potential to enhance operational aspects

(ii) Main Obstetrical challenging do you think (scalability issues ,privacy concerns, regulatory compliance and interoperability issues) Main Obstetrical challenging do you think (scalability issues ,privacy concerns, regulatory compliance and interoperability issues) Vs Position/Role

Table 9: results of an Analysis of Variance (ANOVA) test

ANOVA					
Main Obstetrical challenging do you think (scalability issues, privacy concerns, regulatory compliance and interoperability issues)					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.445	2	.722	23.346	.000
Within Groups	3.002	97	.031		
Total	4.447	99			

The table 9 presents the results of an Analysis of Variance (ANOVA) test, which evaluates the differences in opinions concerning the main obstacles to blockchain adoption, including scalability issues, privacy concerns, regulatory compliance, and interoperability challenges. These opinions were analyzed based on participants' Position/Role within the study. The analysis yielded a calculated F-value of 23.346 and a p-value of 0.000. Since the p-value is below the significance threshold of 0.05, the results indicate statistically significant differences in opinions among the various positions/roles, highlighting diverse perspectives regarding these challenges.

Table10: highlights the variance in opinions regarding the main challenges

Multiple Comparisons						
Dependent Variable: Main Obstetrical challenging do you think (scalability issues ,privacy concerns, regulatory compliance and interoperability issues)						
LSD						
(I) Position/Role	(J) Position/Role	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
IT Professional	Management	.07743	.06185	.214	-.0453	.2002
	User	.38551*	.05657	.000	.2732	.4978
Management	IT Professional	-.07743	.06185	.214	-.2002	.0453
	User	.30808*	.07907	.000	.1511	.4650
User	IT Professional	-.38551*	.05657	.000	-.4978	-.2732
	Management	-.30808*	.07907	.000	-.4650	-.1511
*. The mean difference is significant at the 0.05 level.						

The table10 highlights the variance in opinions regarding the main challenges—scalability issues, privacy concerns, regulatory compliance, and interoperability challenges—when analyzed by participants' Position/Role. The findings reveal similarities in perspectives among individuals in IT Professional and Management roles, suggesting aligned views on these challenges. Notable differences were observed in the responses from users, highlighting that their perceptions of these obstacles differ significantly from those in other roles. This indicates that job roles play a crucial role in shaping how challenges are viewed. While IT and management professionals often share

similar perspectives, users present a contrasting view regarding the significance and impact of these challenges. This variation emphasizes the importance of developing tailored strategies to effectively address these concerns across diverse groups.

7. COMPARISON WITH EXISTING LITERATURE AND FRAMEWORKS

A review of existing literature and frameworks highlights that blockchain technology has been widely analyzed for its transformative potential across diverse sectors. Research highlights its ability to enhance transparency, security, and efficiency, aligning with findings in this study. For instance, frameworks emphasize the importance of addressing scalability, privacy, and interoperability challenges, which are consistent with the obstacles identified here. Additionally, literature underscores the role of regulatory compliance and the adoption of advanced cryptographic techniques, further supporting the recommendations provided. This alignment demonstrates that the study's findings are well-grounded in existing research and contribute valuable insights to the evolving blockchain landscape.

8. RECOMMENDATIONS FOR IMPROVEMENT AND FUTURE RESEARCH

To optimize blockchain technology and ensure its effective implementation, the following recommendations are proposed:

8.1. Recommendations for Improvement:

1. **Scalability Enhancements**: Introduce Layer 2 solutions like sidechains or sharding to tackle scalability limitations and allow efficient handling of increased transaction volumes.
2. **Strengthen Privacy Protections**: Leverage advanced cryptographic techniques, such as zero-knowledge proofs, to improve data privacy and security.
3. **Ensure Regulatory Compliance**: Collaborate with regulators to create clear, flexible guidelines that support innovation while adhering to legal requirements.
4. **Enhance Interoperability**: Develop unified standards and protocols to enable seamless integration across diverse blockchain platforms and networks.
5. **Training and Awareness Campaigns**: Conduct workshops and provide training programs to enhance understanding and foster the adoption of blockchain technology.

8.2.Recommendations for Future Research

1. **Emerging Use Cases**: Examine the potential of blockchain in innovative applications such as decentralized finance (DeFi), non-fungible tokens (NFTs), and advanced governance models.
2. **Interoperability Studies**: Research frameworks and technologies to enable smooth interaction between different blockchain systems.
3. **Scaling Innovations**: Investigate emerging solutions, such as advanced consensus mechanisms and Layer 2 strategies, for overcoming scalability challenges.
4. **Privacy and Security Improvements**: Examine cutting-edge privacy-enhancing technologies like homomorphic encryption and multi-party computation.
5. **Impact of Regulation**: Analyze how evolving global regulatory frameworks influence blockchain adoption and implementation.
6. **Industry-Specific Strategies**: Study factors critical to blockchain success in specific industries (e.g., finance, healthcare, logistics) and regions.

These recommendations seek to overcome current challenges while fostering meaningful innovation and enabling the effective integration of blockchain technology across various sectors.

9. CONCLUSION

The analysis conducted in this study indicates that blockchain technology has significant potential to transform digital payments in Saudi Arabia, as highlighted through the case study of STC Pay. The findings show that blockchain can substantially improve security, transparency, and operational efficiency. Nonetheless, adopting this technology is accompanied by various challenges. Key obstacles, including scalability issues, privacy concerns, regulatory compliance, and interoperability challenges, have been identified as critical factors that affect the successful implementation of blockchain.The statistical evidence further emphasizes a strong relationship between addressing these obstacles and fully leveraging the benefits of blockchain. Additionally, differing perspectives among participants based on their roles underscore the need for targeted strategies that accommodate these varied viewpoints. This highlights the importance of a collaborative approach that involves IT professionals, management, users, and regulators.The study also offers actionable recommendations for overcoming these challenges. These include improvements in scalability, strengthened privacy measures, the creation of regulatory frameworks, and the development of interoperability standards. Furthermore, it points to future research opportunities to explore innovative applications, improve existing frameworks, and address industry-specific concerns.In summary, the successful integration of blockchain technology into modern applications, such as STC Pay, requires a careful balance between innovation and addressing inherent challenges. By focusing on these areas, Saudi Arabia can foster transformative advancements in the digital payment ecosystem.

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APPENDICES

Frequency Table

Position/Role					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	IT Profe	80	80.0	80.0	80.0
	Manageme	9	9.0	9.0	89.0
	user	11	11.0	11.0	100.0
	Total	100	100.0	100.0	

Department					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Custom	8	8.0	8.0	8.0
	IT	82	82.0	82.0	90.0
	Operat	10	10.0	10.0	100.0
	Total	100	100.0	100.0	

Years of Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	11..> years	82	82.0	82.0	82.0
	3-5 years	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

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How familiar are you with blockchain techology					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Familiar	14	14.0	14.0	14.0
	Moderately Familiar	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

What potential opportunities do you see for blockchain technology in digital payment?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Improved Transparency	80	80.0	80.0	80.0
	Increased Efficiency	7	7.0	7.0	87.0
	Cost Reduction	13	13.0	13.0	100.0
	Total	100	100.0	100.0	

How significantly do you believe that blockchain technology can improve security operations?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Significant	14	14.0	14.0	14.0
	Very Significant	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

How significant do you believe blockchain technology can be in enhancing the transparency of operations?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Significant	14	14.0	14.0	14.0
	Very Significant	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

What do you think are the main measures and challenges facing the implementation of blockchain technology?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Scalability Issues	85	85.0	85.0	85.0
	Privacy Concerns	15	15.0	15.0	100.0
	Total	100	100.0	100.0	

How challenging do you think scalability issues are for implementing blockchain technology?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Challenging	14	14.0	14.0	14.0
	Very Challenging	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

How challenging do you think privacy concerns are for blockchain implementation at STC Pay					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Challenging	100	100.0	100.0	100.0

How challenging do you think regulatory compliance is for implementing blockchain?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderately Challenging	100	100.0	100.0	100.0

How challenging do you think interoperability issues are for blockchain implementation ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Challenging	100	100.0	100.0	100.0

What strategies or solutions do you propose to address the identified challenges in implementing blockchain technology?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Technological Advancements	80	80.0	80.0	80.0
	Policy Measures	6	6.0	6.0	86.0
	Enhanced Training and Education	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

How effective do you think technological advancements could be in addressing the challenges faced ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Effective	14	14.0	14.0	14.0
	Very Effective	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

How effective do you think policy measures could be in addressing the challenges faced ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Effective	14	14.0	14.0	14.0
	Very Effective	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

How effective do you think enhanced training and education could be in addressing the challenges faced by ?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly Effective	14	14.0	14.0	14.0
	Extremely Effective	86	86.0	86.0	100.0
	Total	100	100.0	100.0	

How effective do you believe collaboration with industry experts is in addressing the challenges faced?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Moderately Effective	100	100.0	100.0	100.0

Do you have any additional comments or suggestions regarding the implementation of blockchain technology?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	100	100.0	100.0	100.0

The results from the tables above reveal the distribution of percentages and frequencies for the study variable. A key observation is that the responses are concentrated around specific choices, which is notable given the questionnaire was structured on a five-point scale. This clustering of responses may suggest a strong consensus or bias toward certain options, which could be further analyzed to understand the underlying reasons or patterns influencing participant choices. This highlights the importance of examining the design and interpretation of the scale to ensure it accurately captures the diversity of opinions.