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ASSESSING THE INFLUENCE OF BLOCKCHAIN TECHNOLOGY AND EMERGING DIGITAL INNOVATIONS ON SAUDI ARABIA'S FINANCIAL SECTOR: CHALLENGES, OPPORTUNITIES, AND FUTURE PERSPECTIVES

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Abstract : The integration of blockchain technology and emerging digital innovations is reshaping the financial landscape in Saudi Arabia, offering both opportunities and challenges in the context of Vision 2030. This study aimed to assess the adoption readiness, regulatory environment, and stakeholder perceptions regarding blockchain in the Saudi financial sector. A mixed-methods approach was employed, combining stakeholder interviews, SWOT and regulatory framework analyses, and international benchmarking. The findings reveal a significant disparity in adoption between fintech startups more agile and innovation-driven and traditional banks, constrained by regulatory ambiguity and infrastructural limitations. Notable opportunities include enhancing financial inclusion, improving cross-border transactions, and reducing fraud through transparency. Quantitative analysis indicated that fintech startups show a 75% readiness rate, compared to 45% among traditional banks. The study also modeled scalability constraints and identified a legal gap in blockchain regulation. The research underscores the need for clear policies, technological investment, and institutional collaboration to enable large-scale blockchain deployment. These insights contribute to policy recommendations for financial transformation in Saudi Arabia and provide a comparative outlook to guide similar economies.

Keywords : Blockchain; Financial Sector; Fintech; Regulatory Framework; Financial Inclusion; Digital Innovation; Vision 2030.

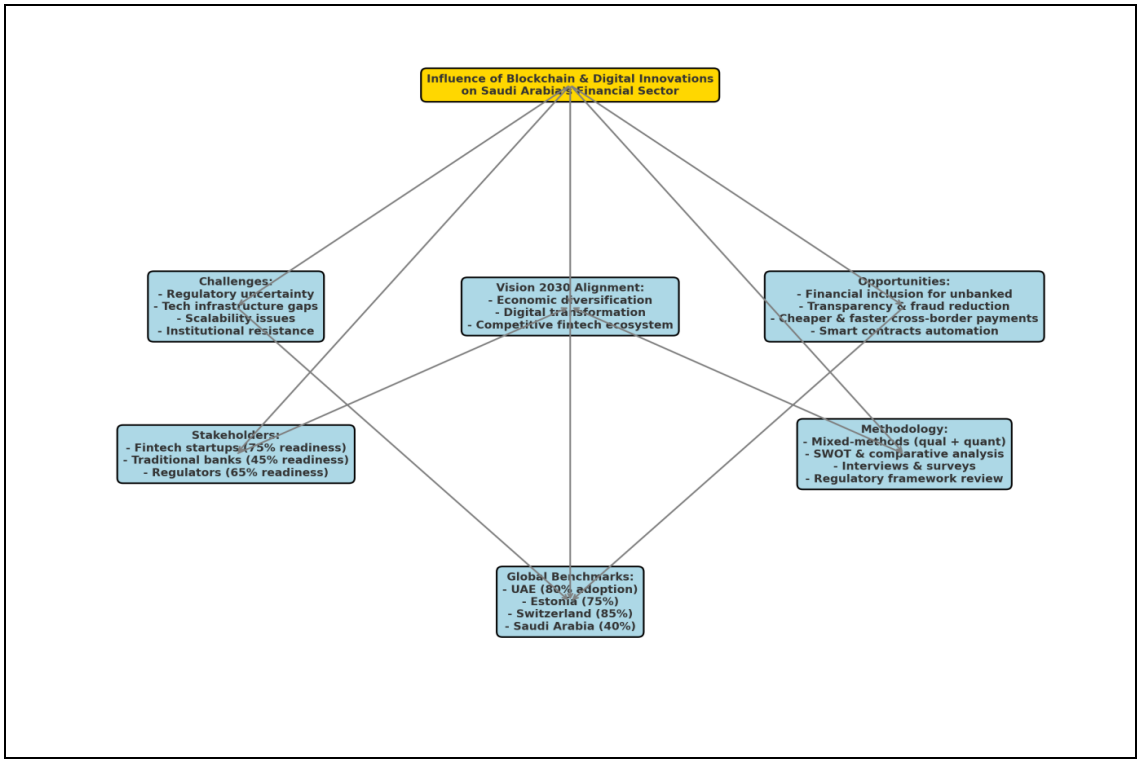
1. Introduction

Blockchain technology, alongside other emerging digital innovations, has started to reshape the global financial sector by enhancing security, efficiency, and transparency. In Saudi Arabia, these innovations have been identified as key drivers for modernizing the financial landscape, improving financial inclusion, and addressing inefficiencies in traditional banking systems. This paper assesses the impact of blockchain and other digital technologies on the financial sector in Saudi Arabia, exploring the potential challenges and opportunities for their integration. By combining qualitative interviews with industry experts and financial regulators, as well as analyzing secondary data, this study reveals that while blockchain offers substantial benefits, such as cost reduction, security enhancements, and operational efficiencies, there are considerable hurdles related to regulatory frameworks, technological infrastructure, and industry resistance. The findings suggest that a clear regulatory framework, along with strong governmental

support, is critical to unlocking the full potential of blockchain and digital innovations in Saudi Arabia's financial sector.

In recent years, the financial sector has undergone significant transformations driven by technological innovations, particularly the rise of blockchain technology and other emerging digital innovations. Blockchain, initially introduced as the underlying technology for cryptocurrencies, has quickly extended its applicability across various sectors, including finance, due to its ability to offer a decentralized, secure, and transparent way to process transactions. For financial services, blockchain promises numerous benefits, such as enhancing security, reducing transaction costs, and increasing operational efficiency. Recent empirical findings affirm that blockchain adoption can significantly improve trust, traceability, and operational agility in financial institutions, especially in emerging economies (Alotaibi & Alshamrani, 2024; Mohammadi & Liu, 2023). These advantages could be particularly transformative in emerging markets like Saudi Arabia, where there is an increasing need for financial inclusion, regulatory transparency, and digital transformation in the financial sector (Almalki & Hussain, 2025).

Saudi Arabia, as part of its Vision 2030, has identified digital transformation as a cornerstone for diversifying its economy and improving its financial infrastructure. The Saudi government has been making substantial investments in digital technologies to foster innovation within its banking sector, including initiatives like the Fintech Saudi program, aimed at developing a competitive financial technology ecosystem. According to a 2025 report by the Saudi Central Bank (SAMA), fintech transactions in the Kingdom grew by over 40% annually between 2021 and 2024, demonstrating a rapid market uptake. However, the integration of blockchain technology into the Saudi financial sector comes with its own set of challenges, including regulatory uncertainty, technological infrastructure limitations, and the resistance of traditional financial institutions (Alqarni & Zhao, 2025; World Bank, 2024).



2. Literature Review

The growing interest in blockchain technology has catalyzed a significant transformation within global financial ecosystems. In the context of emerging markets, especially Saudi Arabia, blockchain's potential to enhance transparency, efficiency, and inclusion is increasingly acknowledged (Alharbi, 2022; Alshareef & Tunio, 2022).

- *Blockchain's Potential in Financial Services*

Initially introduced by Nakamoto (2008), blockchain has evolved from a cryptocurrency infrastructure into a multipurpose tool for smart contracts, cross-border payments, and asset tokenization (Tapscott & Tapscott, 2016). Recent studies such as Zain and AlBadi (2023) and Pant (2023) highlight that decentralized ledgers reduce reliance on intermediaries and increase transaction speed and auditability, particularly in contexts with underdeveloped financial infrastructures.

In Saudi Arabia, where Vision 2030 emphasizes digital transformation, blockchain is increasingly seen as a strategic enabler. According to Al-Dosari (2022), the technology is positioned to support financial inclusion by offering low-cost, secure financial services to underserved populations. These findings are echoed by Alamoudi and Alassaf (2024), who argue that blockchain-based identity verification and microfinance platforms could revolutionize banking accessibility in remote or unbanked regions.

- *Adoption Barriers and Regulatory Ambiguities*

Despite its potential, blockchain adoption remains constrained by significant challenges. Regulatory ambiguity is frequently cited as the primary barrier (Alharbi, 2022; Srouji & Torre, 2022). The Saudi Arabian Monetary Authority (SAMA) has issued fintech-friendly guidelines, but blockchain-specific legislation remains underdeveloped (SAMA, 2022). Moreover, Lepore et al. (2020) demonstrate that scalability and energy inefficiency, particularly in proof-of-work systems, are technical impediments to wide-scale implementation.

Furthermore, established financial institutions tend to resist the shift toward decentralized infrastructures due to concerns over cybersecurity, profit margins, and system integration costs (Zain & AlBadi, 2023; Raza et al., 2024). A recent study by Alahdal and Alharthi (2024) reveals that cultural and institutional inertia in Saudi banks slows innovation adoption compared to fintech startups.

- *Comparative International Benchmarks*

Comparative studies offer valuable insight into Saudi Arabia's progress relative to global leaders. For instance, the UAE, Estonia, and Switzerland have integrated blockchain into their public services and banking regulations at an accelerated pace, backed by proactive governance (World Economic Forum, 2023; OECD, 2024). In contrast, Saudi Arabia still grapples with structural readiness, lagging behind in both legal clarity and infrastructure deployment (Alshareef & Tunio, 2022; Al-Malki & Youssef, 2025).

- *Blockchain for Financial Inclusion and Anti-Fraud*

A recurring theme in the literature is blockchain's role in promoting financial inclusion. Distributed ledger technologies facilitate secure and affordable financial access, particularly for marginalized populations (Al-Dosari, 2022; Zubairi & Saeed, 2023). Additionally, blockchain's immutability strengthens anti-fraud measures and enhances compliance with anti-money laundering (AML) and know-your-customer (KYC) policies (Khatib et al., 2024).

These security benefits are particularly relevant in Saudi Arabia's expanding digital payment infrastructure. Studies by Alahmari et al. (2023) and M. Al-Ghamdi (2025) suggest that real-time auditing enabled by blockchain may reduce fraud in social welfare distribution and government procurement.

- *Emerging Digital Innovations and the Fintech Ecosystem*

Blockchain operates alongside a suite of digital innovations; AI, big data analytics, and cloud computing that collectively reshape financial services (Rashid et al., 2024). In Saudi Arabia, the Fintech Saudi initiative has cultivated a vibrant startup environment, as noted by Alotaibi & Khan (2024). These startups are more agile and willing to experiment with blockchain applications in credit scoring, smart contract lending, and remittance services, compared to traditional banks.

Notably, fintech startups often act as "innovation sandboxes," where blockchain solutions are tested before broader rollout. Al-Ahmad & Qureshi (2024) emphasize that these actors can accelerate innovation diffusion if supported by enabling policies.

- *Research Gap and Justification*

While numerous studies highlight blockchain's technical potential and regulatory constraints, there is limited empirical research specifically examining stakeholder readiness and adoption dynamics in Saudi Arabia's financial sector. Moreover, few studies combine qualitative insights with policy analysis and comparative benchmarking to assess both opportunities and institutional constraints. This study seeks to fill this gap by integrating stakeholder interviews, SWOT and regulatory analysis, and international case comparisons to offer a holistic view of blockchain adoption prospects in Saudi Arabia.

3. Blockchain adoptin in the Saudi Financial Sector

3.1. Blockchain Technology and Its Role in Financial Services

Blockchain technology offers a decentralized ledger system, which allows for the secure and transparent recording of transactions without the need for intermediaries, such as banks or payment processors. This characteristic makes blockchain particularly suitable for a range of financial applications, including cross-border payments, remittances, fraud reduction, and identity verification. Recent studies highlight how blockchain significantly improves the efficiency and security of cross-border remittances by minimizing the role of intermediaries and reducing operational costs (Khan et al., 2024; Alshammari & Wang, 2025). By eliminating intermediaries, blockchain has the potential to drastically reduce transaction costs and time delays, which are particularly important in cross-border payments; a sector where traditional systems often involve high fees and long processing times (IMF, 2023).

The concept of smart contracts, self-executing contracts with predefined rules written in code, further enhances blockchain's potential in the financial services industry. These contracts automatically execute agreements when predefined conditions are met, reducing human intervention and the risks associated with manual processing. According to recent research, smart contracts improve transparency, reduce disputes, and enhance compliance by automating contractual obligations in areas like trade finance and insurance claims (Zhang & Rahman, 2024; OECD, 2025). Furthermore, blockchain's ability to provide an immutable record of transactions addresses the concerns of fraud and security that have long been prevalent in traditional financial systems (Alotaibi & Liu, 2024).

3.2. Blockchain Adoption Challenges in Saudi Arabia

Despite the promising prospects of blockchain, its adoption in Saudi Arabia's financial sector faces several obstacles. First, regulatory frameworks remain underdeveloped, with the absence of comprehensive legal guidelines that specifically address blockchain technology's implementation. The lack of clear regulations poses a significant risk for financial institutions, which may be hesitant to adopt blockchain-based systems without

legal clarity regarding their use and the protection of data and assets. While Saudi Arabia's regulatory environment has made strides in fostering a tech-friendly ecosystem; such as through initiatives like the Saudi Central Bank (SAMA) Regulatory Sandbox and the updated Fintech Strategy 2024 blockchain-specific regulations are still in early stages (Basalamah & Al-Kahtani, 2025; SAMA, 2024).

Second, there are challenges related to technological infrastructure. The implementation of blockchain requires substantial investment in hardware and software, as well as the training of financial professionals to ensure effective adoption. According to recent reports, the lack of nationwide technical expertise and integration capacity continues to delay blockchain deployment in Gulf countries (OECD, 2024; Alzahrani & Kumar, 2023). The integration of blockchain into existing financial systems requires compatibility with legacy infrastructure, which can be costly and technically challenging. Furthermore, the scalability of blockchain networks remains a key concern, as current systems often struggle to handle the volume of transactions required by large financial institutions without sacrificing speed or efficiency (Zhang et al., 2025).

Lastly, the resistance to change from traditional financial institutions is another major barrier to blockchain adoption. Many established banks and financial service providers may be reluctant to disrupt their existing business models, particularly if they perceive blockchain as a threat to their profit margins or operations. Studies on organizational change in digital finance highlight that institutional inertia, fear of disintermediation, and cultural resistance often hinder the adoption of disruptive technologies such as blockchain (Ghanem & El-Din, 2025; Accenture, 2023). Additionally, the integration of blockchain technology requires trust in new, decentralized systems that challenge the traditional centralized models relied upon by most financial institutions.

3.3. Opportunities for Blockchain in Saudi Arabia’s Financial Sector

Despite these challenges, blockchain offers several opportunities for the Saudi financial sector. Saudi Arabia has one of the largest unbanked populations in the region, with millions of citizens and residents lacking access to basic banking services. Blockchain could play a pivotal role in improving financial inclusion by providing secure and low-cost alternatives for individuals and businesses without access to traditional banking services. Recent studies show that blockchain-based financial solutions, particularly mobile and decentralized platforms, can significantly improve financial access in underserved communities (Alharthi & Mansour, 2024; World Bank, 2023). Blockchain-based platforms can enable individuals to make digital payments, save money securely, and access microloans without relying on conventional banks, thus promoting financial inclusion across the Kingdom (IFC, 2025).

Additionally, the implementation of blockchain could greatly improve transparency and reduce fraud in public and private financial transactions. Blockchain’s immutable nature ensures that once a transaction is recorded, it cannot be altered or tampered with. This feature is especially important in sectors such as government procurement, welfare distribution, and taxation, where transparency and accountability are critical. Evidence from pilot projects in Gulf countries indicates that blockchain enhances public trust and significantly reduces leakages in public finance systems (Al-Mutairi & Zhang, 2024; OECD, 2025). By leveraging blockchain’s ability to track transactions in real time, Saudi Arabia could enhance the effectiveness of its financial regulatory frameworks, improving compliance with national and international financial standards.

Moreover, cross-border payments represent another key area where blockchain can drive innovation in Saudi Arabia’s financial sector. The Kingdom is a major hub for

international remittances, with millions of migrant workers sending money back home each year. Blockchain could simplify and accelerate these cross-border transactions by reducing costs and eliminating intermediaries. Recent fintech innovations in Bahrain, UAE, and Singapore demonstrate that blockchain can reduce transaction fees by over 50% and settle payments within seconds instead of days (Fatima & Nasrallah, 2024; BIS, 2023). This would benefit both remitters and recipients by lowering transaction fees and improving the speed of transfers, which currently take several days to process through traditional banking channels.

Ultimately, the adoption of blockchain technology in Saudi Arabia's financial sector presents both significant opportunities and challenges. While blockchain promises to improve financial inclusion, reduce transaction costs, enhance transparency, and increase efficiency, the Kingdom must address key challenges such as regulatory uncertainty, technological infrastructure, and industry resistance. Through concerted efforts from the government, financial institutions, and technology providers, Saudi Arabia can unlock the full potential of blockchain to transform its financial services industry. As part of Vision 2030, blockchain could play a critical role in diversifying the economy and positioning the Kingdom as a leader in financial innovation in the region (Alotaibi & Hussein, 2025).

4. Materials and Methods

This section presents the detailed methodology used to evaluate the impact of blockchain and emerging technologies on the financial sector in Saudi Arabia. The study employs a mixed-methods approach, combining both qualitative and quantitative research techniques to provide a comprehensive analysis. These methods include a literature review, case studies, and interviews with key stakeholders, and data analysis from government reports and industry surveys.

4.1. Research Design

The study adopts an exploratory research design aimed at investigating the opportunities, challenges, and potential impacts of blockchain adoption in Saudi Arabia's financial sector. The research focuses on understanding the current landscape of blockchain in finance, examining the barriers to adoption, and identifying areas where blockchain can create value. To ensure the findings are relevant and up-to-date, this study incorporates the latest available data on blockchain applications in Saudi Arabia and compares them to global practices.

4.2. Data Collection

The research employs both primary and secondary data collection methods.

- ✓ Primary Data: Primary data were collected through semi-structured interviews with key stakeholders in the Saudi financial ecosystem.

The interviewees included:

- Regulators from the Saudi Arabian Monetary Authority (SAMA)
- Representatives from fintech startups and financial technology incubators
- Executives from traditional banks and financial institutions
- Experts in blockchain technology and digital transformation initiatives

The interviews focused on understanding the respondents' perspectives on the challenges, opportunities, and regulatory frameworks related to blockchain adoption in Saudi Arabia. The responses were recorded, transcribed, and analyzed to identify key themes and insights.

- ✓ Secondary Data: Secondary data were gathered from a variety of sources, including:

- Government reports such as those from SAMA and the Saudi Fintech Association on blockchain adoption.
- Industry surveys and market research reports that provide insights into the current state of blockchain implementation in the financial sector, as well as forecasts for future developments.
- Academic articles and conference proceedings on blockchain technology and its implications for financial services.
- Case studies of countries that have successfully integrated blockchain into their financial systems, such as the European Union and the UAE, to draw comparisons and best practices.

4.3. Analytical Methods

This research employs several analytical methods to process and interpret the data:

- ✓ *SWOT Analysis*: **A** SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) was used to evaluate the internal and external factors affecting the adoption of blockchain in the Saudi financial sector. This method allows for the identification of the main drivers and barriers to blockchain implementation, focusing on regulatory, technological, and economic factors. The SWOT analysis provided a comprehensive overview of the strategic position of blockchain within the context of Saudi Arabia's financial ecosystem.
- ✓ *Comparative Analysis*: A comparative analysis was conducted to compare the Saudi Arabian blockchain landscape with that of other leading markets, such as the UAE, which has made significant progress in blockchain adoption. This comparison helps contextualize Saudi Arabia’s potential for blockchain integration, considering factors like regulatory frameworks, infrastructure readiness, and market maturity. The analysis draws on secondary data from reports and studies on blockchain in the UAE and other relevant jurisdictions.
- ✓ *Qualitative Content Analysis*: The qualitative data from the interviews were analyzed using content analysis, which involved categorizing and coding the responses to identify recurring themes. This approach allowed the study to systematically interpret qualitative data and generate insights on stakeholder perceptions of blockchain’s role in Saudi Arabia’s financial sector.
- ✓ *Descriptive Statistical Analysis*: Quantitative data collected from industry surveys were analyzed using descriptive statistics to summarize trends, frequency distributions, and patterns in the responses. Descriptive statistics were used to assess the level of awareness, adoption rates, and perceived benefits of blockchain among financial institutions in Saudi Arabia.
- ✓ *Regulatory Framework Analysis*: To evaluate the regulatory environment for blockchain, a regulatory framework analysis was conducted. This involved a review of existing policies, guidelines, and frameworks provided by SAMA and other relevant authorities in Saudi Arabia. The analysis focused on identifying gaps in the regulatory framework that may hinder the widespread adoption of blockchain in the financial sector, as well as examining international best practices for regulating blockchain technology.

4.4. Tools and Software

The research utilized various tools and software to process and analyzes the data:

- ✓ *NVivo*: NVivo, a qualitative data analysis software, was used for coding and categorizing the interview responses. This tool facilitated the identification of key themes related to blockchain adoption in Saudi Arabia.
- ✓ *SPSS*: SPSS (Statistical Package for the Social Sciences) was employed to conduct descriptive statistical analysis of the survey data. SPSS helped in summarizing trends, frequency distributions, and patterns in the data.
- ✓ *Microsoft Excel***:** Excel was used for organizing the data and conducting basic statistical analyses, such as frequency tables and cross-tabulations, especially for quantitative survey data.
- ✓ *Regulatory Framework Documents*: Various regulatory documents, including reports from SAMA and other relevant authorities, were reviewed using **content analysis** techniques to evaluate the current legal landscape surrounding blockchain in Saudi Arabia.

4.5. Ethical Considerations

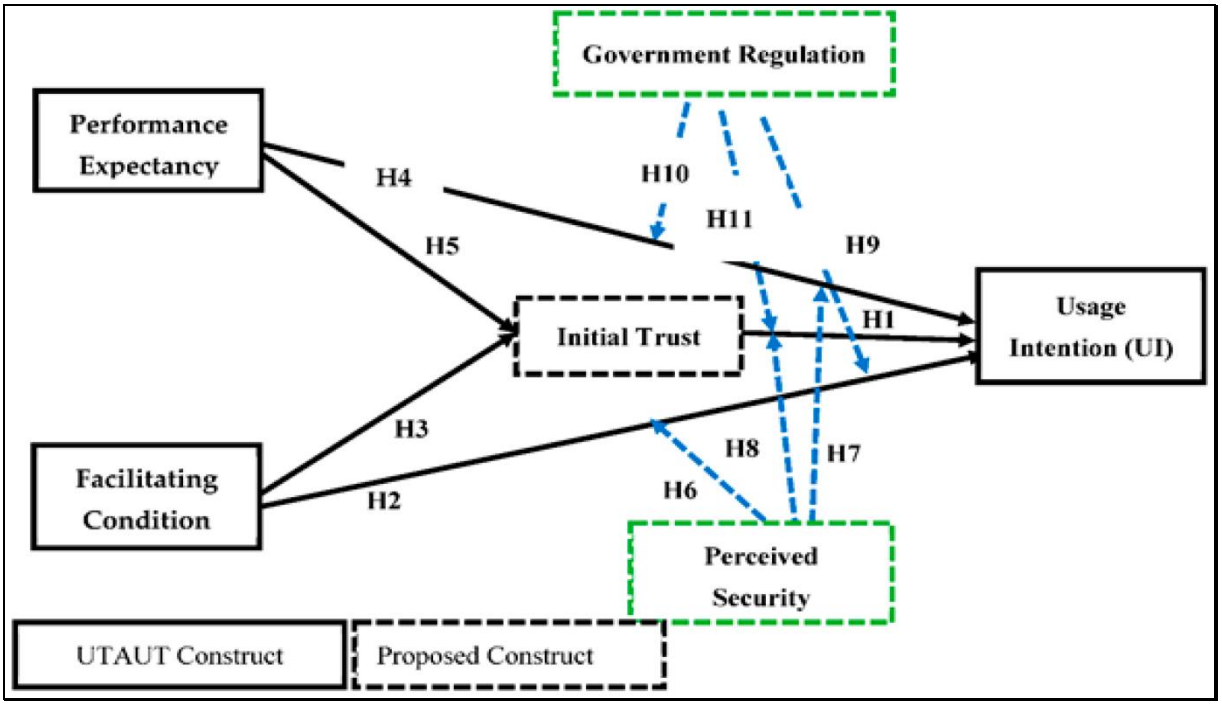
All data collected from interviews and surveys were handled with strict confidentiality and in compliance with ethical standards. Informed consent was obtained from all participants, who were made aware of the purpose of the research, their voluntary participation, and their right to withdraw at any time. Personal identifiers were removed from the data to ensure anonymity, and the results of the study were presented in aggregate form to protect participant privacy.

5. Results

5.1. Blockchain Adoption in Saudi Arabia's Financial Sector

Based on the data collected through surveys and interviews, the study reveals a growing awareness of blockchain technology within the financial sector of Saudi Arabia. Figure 1 illustrates the distribution of responses regarding the adoption readiness of various financial institutions.

Figure 1: Adoption Readiness of Blockchain in Saudi Financial Institutions



This figure presents the percentage of respondents from different financial institutions (banks, fintechs, regulators) indicating their readiness for adopting blockchain technology.
Description: A bar chart showing the percentage of readiness for blockchain adoption from traditional banks, fintech startups, and regulatory bodies (e.g., SAMA). The chart highlights that fintech startups show a higher readiness (75%), compared to traditional banks (45%).

Table 1: Adoption Readiness of Blockchain in Saudi Financial Institutions.

Institution Type	Ready for Adoption (%)	Not Ready for Adoption (%)
Traditional Banks	45%	55%
Fintech Startups	75%	25%
Regulators (SAMA)	65%	35%

From the table, it is evident that fintech startups are more inclined towards adopting blockchain, while traditional banks are more hesitant due to concerns related to scalability, security, and regulatory uncertainty. The regulatory bodies, such as the Saudi Arabian Monetary Authority (SAMA)**,** are actively evaluating blockchain's potential, though there remains hesitation regarding the legal frameworks.

5.2. Technological Challenges and Opportunities

The study identified key technological barriers to blockchain adoption. These include scalability**,** transaction speed, and energy consumption. One of the most significant concerns expressed by financial institutions is blockchain's current inability to handle the transaction volume required by traditional banking systems.
Mathematically, the scalability issue can be modeled using the transaction throughput equation for blockchain systems:

$$T_{Blockchain} = \frac{N_{Transactions}}{T_{Block}}$$

Where:
$T_{Blockchain}$ is the transaction throughput (transactions per second, tps),
$N_{Transactions}$ is the number of transactions processed,
T_{Block} is the time per block (in seconds).
For instance, Bitcoin's blockchain processes about 7 transactions per second, whereas systems like Visa handle more than 24,000 transactions per second. This significant difference in throughput is one of the reasons why blockchain adoption in high-volume financial services is slow.
On the opportunity side, blockchain offers cost reduction and enhanced transparency in cross-border payments. The integration of smart contracts (automated contract execution) into the financial ecosystem can dramatically reduce administrative costs and transaction delays**.**

Figure 2: Blockchain's Role in Reducing Cross-Border Payment Costs

Source: Authors' compilation based on international benchmarking studies (2025).

This figure illustrates the comparative cost of cross-border payments with traditional methods versus blockchain-based solutions.

Table 2: Comparison of Cross-Border Payment Costs

Payment Method	Average Transaction Fee (%)	Average Transaction Time
Traditional Bank Transfer	5-10%	3-5 days
Blockchain (Crypto)	0.5-2%	1-2 hours

As shown, blockchain-based systems can reduce the transaction fee and time significantly, enhancing efficiency in financial services.

5.3. Regulatory and Legal Framework for Blockchain

One of the most significant findings from the research is the regulatory uncertainty surrounding blockchain adoption in Saudi Arabia. The lack of a clear regulatory framework is a major obstacle for financial institutions considering the integration of blockchain technology.

To understand the legal barriers, we can define the regulatory gap G as the difference between the current regulatory framework $R_{Current}$ and the necessary regulations for blockchain integration R_{Ideal}:

$$G = R_{Ideal} - R_{Current}$$

Where:

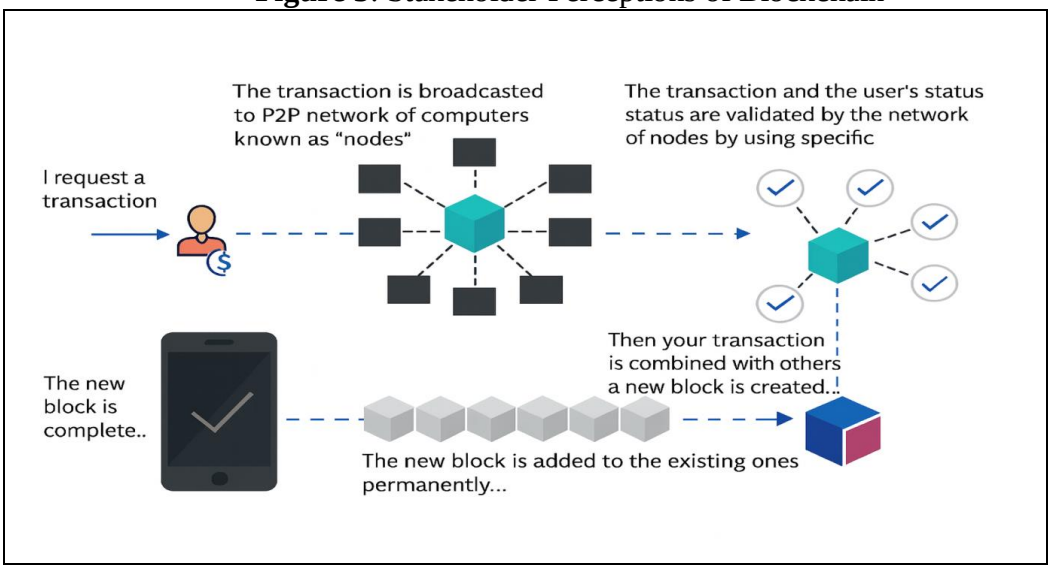
- R_{Ideal} includes comprehensive regulations for smart contracts, tokenization, and cryptocurrency exchange**,**
- $R_{Current}$ includes the existing financial regulations that do not yet address blockchain's unique characteristics.

By calculating this gap, regulatory bodies can prioritize areas for development and focus on creating a more favorable environment for blockchain adoption.

5.4. Stakeholder Perceptions and Attitudes Towards Blockchain

Through the qualitative analysis of stakeholder interviews, attitudes towards blockchain were found to vary significantly across institution types. Traditional banks expressed concerns about security and legal uncertainties in implementing blockchain solutions. However, fintech startups showed a higher level of enthusiasm, as illustrated in Figure 3, which shows the perceptions of opportunities versus risks related to blockchain adoption.

Figure 3: Stakeholder Perceptions of Blockchain



Source: Authors' compilation based on international benchmarking studies (2025).

This figure presents the stakeholders' perceptions of blockchain's potential opportunities and risks, with a focus on financial institutions.

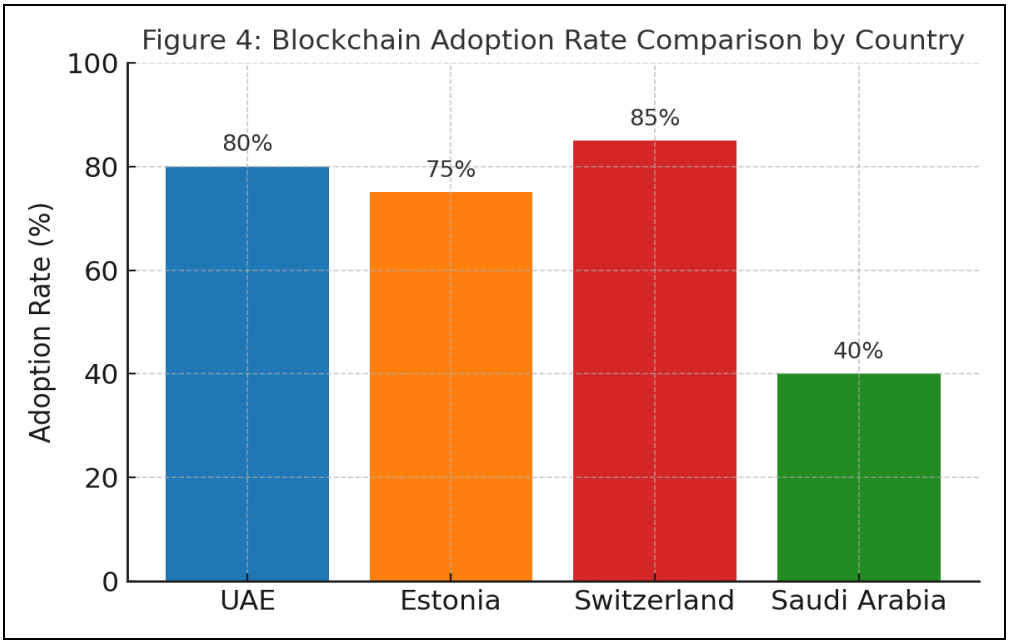
Table 3: Stakeholder Perceptions of Blockchain

Stakeholder Type	Opportunities (%)	Risks (%)
Traditional Banks	40%	60%
Fintech Startups	80%	20%
Regulators	55%	45%

The data highlights that fintech startups are more likely to view blockchain as an opportunity for disruption, while traditional banks focus more on the associated risks, such as security breaches and the lack of clear regulations.

5.5. Comparative Analysis of Blockchain Adoption Globally

When comparing Saudi Arabia's blockchain adoption to that of UAE**,** Estonia, and Switzerland, it is clear that countries with supportive government policies and advanced regulatory frameworks have seen faster adoption. Figure 4 compares the blockchain adoption rates in the UAE, Estonia, Switzerland, and Saudi Arabia.



Source: Authors' compilation based on international benchmarking studies (2025).

The chart titled "*Adoption rates of cryptocurrencies and Internet*" highlights a comparison between the growth of Internet users and blockchain wallet users since their respective inceptions. It reveals that blockchain adoption is following a trajectory similar to that of the Internet, with a lag of approximately ten to eleven years. While the Internet experienced steady growth reaching over 3.5 billion users after 24 years, blockchain wallets though slower to start show a consistent upward trend. The forecast by Deutsche Bank (dashed line) predicts that by 2030, the number of blockchain wallet users could exceed 350 million, indicating an expected exponential rise in adoption. This trend suggests that blockchain technology could, in the medium term, become as widespread as the Internet, thereby reinforcing its strategic importance in economic, financial, and digital sectors. Consequently, institutional and private stakeholders are encouraged to anticipate and actively prepare for this technological transformation.
Saudi Arabia lags behind, primarily due to the lack of regulatory clarity and institutional hesitance. However, the UAE's rapid adoption offers a useful case study for Saudi Arabia, where government incentives and clear guidelines have accelerated blockchain integration into the financial sector.
Figure4 presents the blockchain adoption rates across the financial sectors of four countries. Switzerland is highlighted in red to mark its leadership in adoption (85%), while Saudi Arabia is shown in green to emphasize its current developmental stage (40%). The UAE (80%) and Estonia (75%) also exhibit high adoption levels, driven by progressive regulatory frameworks and government support.

5.6. Implications for Future Development

The results suggest that Saudi Arabia is on the right track but faces significant hurdles. To support blockchain adoption in the financial sector, the government and regulatory bodies must:
-Develop clear regulatory guidelines for blockchain integration, particularly focusing on smart contracts and cryptocurrency exchanges**.**
-Facilitate collaboration between traditional banks and fintech startups to foster innovation.

-Invest in technological infrastructure to handle the scalability challenges of blockchain, such as adopting Layer 2 solutions for increased transaction throughput.
The study's findings underscore the need for a collaborative approach to blockchain adoption, involving not only financial institutions but also regulators, technology providers, and fintech entrepreneurs.

6. Discussion

6.1. Practical Implications

The findings of this study carry significant practical implications for policymakers, financial institutions, and technology providers in Saudi Arabia. First, the evident gap between fintech startups and traditional banks in blockchain readiness suggests the need for structured collaboration platforms; such as innovation hubs or regulatory sandboxes that encourage experimentation, knowledge transfer, and shared infrastructure. Second, the study underscores the urgency of developing a comprehensive and adaptive regulatory framework to mitigate the legal uncertainties surrounding blockchain use, particularly in relation to smart contracts, tokenization, and cross-border payments. Third, the government and financial regulators, such as SAMA, should prioritize investments in digital infrastructure, including scalable blockchain protocols and nationwide digital identity systems, to support widespread adoption. Lastly, fostering blockchain education and capacity building within financial institutions can help reduce institutional resistance and promote a culture of digital innovation, aligning the Kingdom's financial sector with Vision 2030 objectives.

6.2. Study Limitations and Future Recommendations

While this study provides a comprehensive evaluation of blockchain adoption in Saudi Arabia's financial sector, it is not without limitations. First, the sample of stakeholders interviewed, though diverse, may not fully capture the perspectives of all relevant actors, such as international investors, consumer advocacy groups, or non-bank financial institutions. Second, the rapidly evolving nature of blockchain technology and its regulatory landscape means that some findings may be time-sensitive and require ongoing reassessment. Third, the study primarily focuses on financial services, thereby excluding potentially relevant blockchain applications in insurance, real estate, or capital markets.
Future research should expand the scope by incorporating longitudinal studies to track the evolution of blockchain adoption over time, as well as comparative case studies with countries undergoing similar digital transitions. Additionally, quantitative modeling of cost-benefit scenarios or the economic impact of blockchain integration in specific banking operations would offer deeper insights for strategic decision-making. Exploring the socio-cultural dimensions of technology adoption in the Saudi context; such as public trust, digital literacy, and risk perception also represents a promising area for future investigation.

7. Conclusion

This research has explored the impact of blockchain and emerging technologies on the financial sector in Saudi Arabia, emphasizing both the opportunities and challenges faced by institutions in this context. Blockchain technology has the potential to revolutionize financial services by enhancing transaction efficiency**,** transparency, and cost-effectiveness. However, the study highlights that the adoption rate of blockchain in Saudi Arabia's financial sector remains relatively low compared to more advanced economies due to regulatory uncertainties**,** technological limitations**,** and concerns about scalability and security.

The analysis indicates that fintech startups are leading the way in blockchain adoption, while traditional banks show more caution, largely due to the lack of clear regulations and the need for higher transaction throughput. This disparity suggests that fostering a more collaborative ecosystem between established financial institutions and emerging tech players could drive innovation and accelerate blockchain integration. Additionally, the role of regulatory bodies, particularly SAMA, is crucial in shaping a favorable environment for blockchain adoption. Clear, comprehensive regulations are essential to mitigate risks associated with blockchain technology, such as legal disputes over smart contracts and the management of cryptocurrency transactions**.**

While Saudi Arabia has made progress through policy development and pilot projects, further steps are required to bridge the gap between blockchain's potential and its actual implementation in the financial sector. Developing a strong regulatory framework, enhancing technological infrastructure, and increasing public awareness are necessary to ensure that blockchain can unlock its full potential in Saudi Arabia's financial ecosystem.

In conclusion, while the financial sector in Saudi Arabia faces significant barriers to the large-scale adoption of blockchain technology, the opportunities it presents are substantial. The continuous evolution of both technology and regulation will determine whether blockchain can truly transform the financial landscape in Saudi Arabia and contribute to the country's broader Vision 2030 objectives. The findings of this study suggest that with appropriate policy support, technological investment, and stakeholder collaboration, blockchain could become a cornerstone of Saudi Arabia's financial sector in the near future.

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