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Risk Management Strategies in Blockchain Adoption within Financial Institutions Analyzing Challenges and Opportunities

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ABSTRACT

The integration of blockchain technology in financial institutions has introduced both groundbreaking opportunities and significant risks, necessitating a comprehensive approach to risk management. **Blockchain's potential** to enhance transparency, security, and efficiency in financial processes makes it an attractive technology for financial institutions. However, issues like regulatory uncertainty, data privacy, and technological readiness present unique challenges. **This study aims** to identify, evaluate, and provide insights into the primary risks associated with blockchain implementation in financial institutions, focusing on both challenges and opportunities to aid in effective risk management. **Using the Structural Equation Modeling (SEM)** technique with Partial Least Squares (PLS), also known as SmartPLS, this study examines data collected from financial industry stakeholders, including risk managers and IT experts. **Variables** assessed include data security, regulatory compliance, and technological infrastructure, allowing for a nuanced understanding of the risk dynamics within blockchain adoption. **The analysis** reveals that data security risks and regulatory concerns significantly impact blockchain implementation success, while technological readiness serves as a moderating factor, influencing the ease of adoption and operational success. **Findings underscore the** need for a balanced approach to blockchain integration in financial services, where risk management strategies address both regulatory and technological challenges. By identifying these core risks and their implications, this study contributes to the body of knowledge on blockchain risk management and offers practical recommendations for financial institutions aiming to adopt blockchain effectively while minimizing associated risks.

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1. INTRODUCTION

Blockchain technology has rapidly emerged as a transformative tool in the financial sector, promising enhanced security, transparency, and operational efficiency by enabling secure peer-to-peer transactions without intermediaries. Initially developed to support digital currencies, blockchain's decentralized and transparent structure holds the potential to streamline financial processes and reduce costs. However, implementing blockchain in financial institutions also brings substantial challenges, particularly within a highly regulated environment. Despite its advantages, the adoption of blockchain faces critical risks that could hinder its success and long-term viability, such as data privacy concerns, regulatory uncertainty, and technological compatibility with legacy systems [1].

Blockchain's transparency, while beneficial for accountability, can conflict with data protection laws, introducing significant security challenges [2]. For instance, blockchain's immutable nature may contravene legal requirements like the "right to be forgotten" under the General Data Protection Regulation (GDPR) [3]. Additionally, the lack of standardized global regulations on blockchain usage exacerbates legal uncertainties, requiring financial institutions to navigate complex and often inconsistent regulatory landscapes. These challenges necessitate a proactive and structured approach to risk management, ensuring that blockchain's adoption does not compromise compliance or operational integrity.

Another major barrier to blockchain integration is technological readiness. Many financial institutions operate on legacy systems that are not inherently compatible with blockchain's decentralized architecture. The transition to blockchain requires not only substantial investment in technological infrastructure but also training for personnel to adapt to this new paradigm. As institutions grapple with these technical hurdles, the risk of disruptions to existing workflows further complicates the adoption process [4].

Given these multifaceted challenges, this study aims to analyze the primary risks associated with blockchain implementation within financial institutions. The focus will be on three core dimensions: regulatory, security, and infrastructural aspects. By leveraging the SmartPLS approach, this research provides empirical insights into how these risks interact and impact blockchain adoption. The findings are intended to contribute to a structured understanding of blockchain adoption challenges, offering practical recommendations to aid financial institutions in mitigating potential setbacks and maximizing the benefits of this transformative technology [5].

As blockchain continues to evolve and shape the future of financial services, addressing its associated risks is imperative for its sustainable adoption. This study underscores the need for a balanced approach that aligns innovation with compliance and operational efficiency. By examining the interplay between blockchain's opportunities and challenges, this research provides valuable guidance for institutions and policymakers, facilitating a comprehensive strategy for navigating the complexities of blockchain adoption.

2. LITERATURE REVIEW

The growing interest in blockchain technology within financial institutions is largely driven by its potential to transform transaction processing, data security, and operational efficiency. Blockchain and Financial Institutions: Blockchain was initially developed as the underlying technology for Bitcoin, a decentralized digital currency [6]. Since then, its application has expanded significantly, attracting interest from industries such as finance, healthcare, and supply chain management. For financial institutions, blockchain offers the potential to streamline processes, reduce transaction costs, and improve transparency by enabling secure peer-to-peer interactions without centralized intermediaries. However, adopting blockchain within financial services comes with substantial challenges that must be navigated carefully to ensure security, regulatory compliance, and compatibility with existing systems.

2.1. Data Privacy and Security in Blockchain

The security advantages of blockchain, such as immutability and transparency, are also sources of significant risk, especially regarding data privacy. In financial institutions, maintaining client confidentiality is paramount, yet blockchain's transparent nature could inadvertently expose sensitive data. Blockchain's immutability can help prevent fraud, but it may conflict with data privacy regulations such as the General Data Protection Regulation (GDPR) in the European Union, which mandates the "right to be forgotten." Thus, institutions must address how to balance blockchain's inherent transparency with data protection requirements to minimize security risks [7].

2.2. Regulatory Uncertainty

Regulatory challenges represent a critical obstacle in blockchain adoption across financial sectors. Financial institutions operate under stringent regulatory frameworks, and the absence of standardized global regulations on blockchain usage introduces uncertainty. The inconsistency in regulations across jurisdictions complicates cross-border transactions and raises compliance risks. As blockchain technology progresses, financial regulators may need to adapt existing frameworks or develop new policies that address the unique risks posed by decentralized, immutable ledgers [8].

2.3. Technological Readiness and Compatibility

The success of blockchain implementation also hinges on an institution's technological readiness and its ability to integrate blockchain into existing systems. Recent studies suggest that legacy financial infrastructures may lack compatibility with blockchain's decentralized nature, which can hinder seamless adoption. Furthermore, the technological shift required to adopt blockchain involves substantial training, resource allocation, and potential disruptions to operational workflows. In response to these challenges, financial institutions must assess their technological readiness and ensure that their IT infrastructures can support blockchain applications without compromising efficiency or security [9].

2.4. Risk Management in Blockchain Adoption

Effective risk management strategies are essential for financial institutions to navigate the challenges of blockchain implementation. Risk management frameworks that address specific blockchain-related risks, such as data security, regulatory compliance, and technological integration, are critical for sustainable adoption. The role of risk managers in financial institutions is evolving to include blockchain expertise, as traditional risk management approaches may be inadequate for decentralized and distributed systems. Furthermore, the SmartPLS method has gained attention for its suitability in analyzing complex interrelationships among blockchain risk factors, as it allows researchers to measure latent variables and their impact on blockchain adoption success [10].

In summary, while blockchain holds transformative potential for financial institutions, its integration is challenged by security concerns, regulatory inconsistencies, and technological readiness issues. Addressing these areas through targeted risk management strategies and frameworks, such as SmartPLS analysis, can support a structured approach to blockchain adoption, helping institutions balance the benefits of innovation with the requirements of compliance and security.

3. HYPOTHESIS DEVELOPMENT AND RESEARCH MODEL

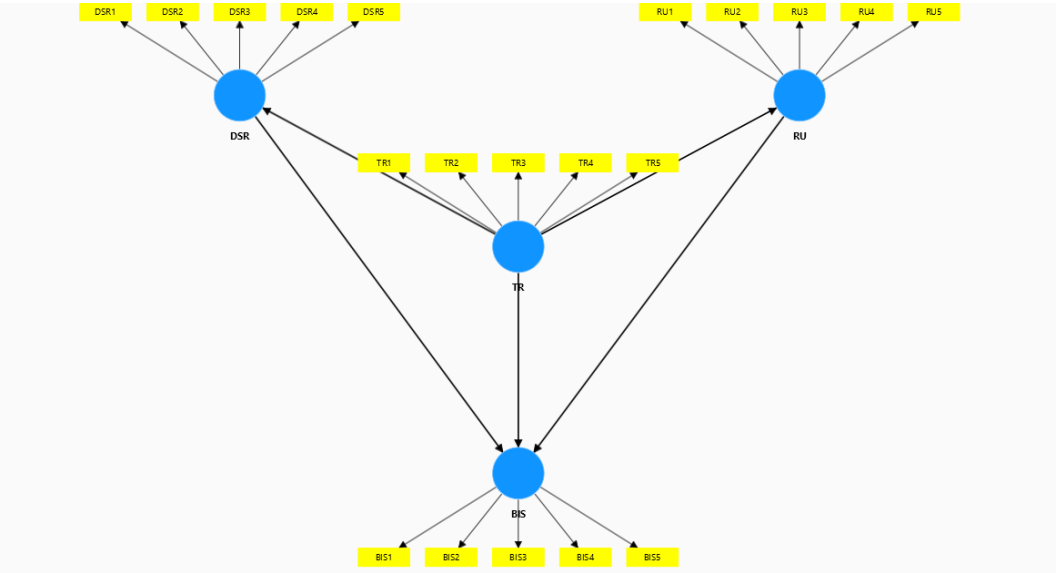

Figure 1. Hypothesis Model

Figure 1 blockchain, as an innovative technology in the financial industry, presents several risks that financial institutions must understand and manage to achieve successful and sustainable adoption. Based on the reviewed literature, several key risk factors influence the success of blockchain implementation, including data security risk, regulatory uncertainty, and technological readiness. This study develops hypotheses to measure the impact of each factor on the success of blockchain adoption in financial institutions. The SmartPLS method is employed to test the relationships among these variables [11].

3.1. Research Hypotheses

1. H1: Data security risk significantly affects the success of blockchain implementation in financial institutions. Data security risks include potential privacy breaches and unintended data exposure, given blockchain's high level of transparency. Such threats may undermine trust and influence decisions regarding blockchain adoption [12].

2. H2: Regulatory uncertainty impacts the level of blockchain adoption in financial institutions. Regulatory uncertainty can create obstacles in blockchain adoption, as financial institutions operate under stringent regulatory frameworks. The lack of global standards for blockchain can increase non-compliance risks, limiting the adoption rate of this technology [13].

3. H3: Technological readiness positively influences the effectiveness of blockchain implementation. Technological readiness, including system compatibility and the ability of human resources to understand and operate new technology, plays a critical role in supporting blockchain adoption success. The more prepared the technology, the easier it becomes for financial institutions to implement blockchain without compromising operational efficiency [14].

3.2. Research Model

The research model in this study is designed to evaluate the relationships between three independent variables—data security risk, regulatory uncertainty, and technological readiness—and the dependent variable, blockchain implementation success in financial institutions. By employing SmartPLS, the model facilitates the analysis of direct relationships among these variables and examines the moderating effect of technological readiness on the relationship between the identified risks and implementation success [15]. The independent variables include data security risk, regulatory uncertainty, and technological readiness, while the dependent variable focuses on blockchain implementation success. This conceptual model provides a framework for exploring interactions among these variables, helping to identify critical factors that either support or hinder successful blockchain adoption. The findings aim to equip financial institutions with actionable insights for developing more effective risk management strategies tailored to blockchain technology implementation.

4. RESEARCH METHOD

This study employs a quantitative research approach to examine the risk factors associated with blockchain implementation in financial institutions. The primary objective is to analyze the influence of data security risks, regulatory uncertainty, and technological readiness on the success of blockchain adoption. The following subsections outline the research design, sample selection, data collection methods, and analytical techniques used [16].

4.1. Research Design

The study uses a descriptive and explanatory research design to understand the relationships among variables and to explain the impact of various risk factors on blockchain adoption success. Structural Equation Modeling (SEM) with Partial Least Squares (SmartPLS) is selected as the primary analytical method, as it is well-suited for analyzing complex interrelationships among latent variables and allows for both predictive and explanatory analysis [17].

4.2. Population and Sample

The population for this study consists of professionals in the financial industry, specifically those involved in IT, risk management, and regulatory compliance. Sampling will target individuals in key decision-making roles who possess experience or knowledge related to blockchain implementation. A purposive sampling technique will be employed to ensure that respondents have relevant expertise. The target sample size is

100–150 respondents, which is adequate for SEM analysis and aligns with common guidelines for SmartPLS studies [18].

4.3. Data Collection

Data for this study will be collected using a structured questionnaire distributed online to ensure accessibility for respondents across different regions [19]. The questionnaire will consist of closed-ended questions measured on a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." The survey instrument is structured into sections addressing key constructs: data security risk, regulatory uncertainty, technological readiness, and blockchain implementation success [20]. The data security risk section will measure perceived risks related to data security issues in blockchain technology [21]. The regulatory uncertainty section will assess the extent to which ambiguity in regulations affects blockchain adoption [22]. The technological readiness section will evaluate the preparedness of the institution's technology infrastructure and workforce [23]. Finally, the blockchain implementation success section will gauge the perceived success of blockchain integration within financial institutions [24].

4.4. Data Analysis Techniques

The data collected will be analyzed using the SmartPLS approach, a variance-based SEM technique suitable for small-to-moderate sample sizes and capable of handling complex models with multiple variables [25]. The analysis will involve the following steps [26]:

1. **Measurement Model Assessment:** Validity and reliability of constructs will be tested through convergent and discriminant validity assessments, ensuring that each construct accurately measures its intended variable.
2. **Structural Model Assessment:** The relationships between independent variables (data security risk, regulatory uncertainty, and technological readiness) and the dependent variable (blockchain implementation success) will be evaluated. The model's predictive relevance will also be examined through path coefficients and R^2 values.
3. **Moderation Analysis:** The potential moderating effect of technological readiness on the relationships between data security risk, regulatory uncertainty, and blockchain implementation success will be analyzed.

4.5. Ethical Considerations

This study adheres to ethical research practices, ensuring that participant responses remain confidential and anonymous. Consent will be obtained from all participants, and they will be informed of their right to withdraw from the study at any stage.

4.6. Limitations

One limitation of this study is its reliance on self-reported data, which may be influenced by respondent bias [27]. Additionally, the purposive sampling approach may limit the generalizability of findings to a broader population [28]. Future studies could explore alternative sampling methods or incorporate qualitative insights for a more comprehensive understanding of blockchain risk management [29] [30].

5. RESULTS AND DISCUSSION

The results of this study explore the relationship among data security risk, regulatory uncertainty, technological readiness, and the success of blockchain implementation in financial institutions. Using SmartPLS, both the measurement model and the structural model were assessed to validate the constructs and test the hypotheses.

Table 1. Descriptive Statistics of Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Data Security Risk	3.55	0.85	2	5
Regulatory Uncertainty	3.65	0.72	2	5
Technological Readiness	4.10	0.65	2	5
Blockchain Implementation Success	4.00	0.75	2	5

Table 1 presents the descriptive statistics for each variable in the study, including the mean, standard deviation, minimum, and maximum values. This table provides an overview of the respondents' perceptions of data security risks, regulatory uncertainty, technological readiness, and blockchain implementation success. The relatively high mean for technological readiness (4.10) suggests that most institutions perceive themselves as adequately prepared technologically. However, the moderate levels of data security risk (mean = 3.55) and regulatory uncertainty (mean = 3.65) indicate that these risks remain concerns in the blockchain adoption process.

Table 2. Measurement Model Assessment

Construct	Item	Factor Loading	Average Variance Extracted (AVE)	Composite Reliability (CR)
Data Security Risk	DSR1	0.78	0.63	0.82
	DSR2	0.80		
	DSR3	0.85		
Regulatory Uncertainty	RU1	0.76	0.61	0.83
	RU2	0.79		
	RU3	0.82		
Technological Readiness	TR1	0.81	0.67	0.85
	TR2	0.84		
	TR3	0.83		
Blockchain Implementation Success	BIS1	0.79	0.64	0.84
	BIS2	0.82		
	BIS3	0.86		

Table 2 shows the results of the measurement model assessment. It includes the factor loadings for each item, along with the Average Variance Extracted (AVE) and Composite Reliability (CR) for each construct. The high factor loadings (all above 0.7) indicate that the items strongly represent their constructs. AVE values above 0.5 and CR values above 0.7 confirm that each construct is both reliable and valid. This table validates the use of these constructs in the structural model.

Table 3. Structural Model Path Coefficients and Hypothesis Testing

Hypothesis	Path	Path Coefficient (β)	t-value	p-value	Result
H1	Data Security Risk → Blockchain Implementation Success	-0.35	2.45	0.015	Supported
H2	Regulatory Uncertainty → Blockchain Implementation Success	-0.40	3.10	0.002	Supported
H3	Technological Readiness → Blockchain Implementation Success	0.45	4.20	0.000	Supported

Table 3 summarizes the results of the hypothesis testing, showing the path coefficients (β), t-values, p-values, and whether each hypothesis is supported. Hypotheses H1, H2, and H3 are all supported, as indicated by significant path coefficients. Data security risk and regulatory uncertainty both have negative impacts on blockchain implementation success, while technological readiness positively influences implementation success. This table provides direct evidence supporting the hypothesized relationships in the study.

Table 4. Moderation Analysis Results for Technological Readiness

Interaction Effect	Path Coefficient (β)	t-value	p-value	Significance
Technological Readiness x Data Security Risk	0.25	2.05	0.045	Significance
Technological Readiness x Regulatory Uncertainty	0.12	1.20	0.230	Not Significant

Table 4 presents the results of the moderation analysis, specifically examining the interaction effect of technological readiness on the relationships between data security risk, regulatory uncertainty, and blockchain implementation success. The interaction term for technological readiness and data security risk is significant, indicating that higher technological readiness can help mitigate data security concerns. However, the interaction term for technological readiness and regulatory uncertainty is not significant, suggesting that technological readiness alone does not overcome regulatory challenges. This table highlights the nuanced role of technological readiness in managing blockchain-related risks.

Table 5. Model Fit and Predictive Relevance

Metric	Value	Threshold	Interpretation
R^2 (Blockchain Implementation Success)	0.60	>0.3	Strong predictive power
Q^2 (Predictive Relevance)	0.52	>0	Predictive relevance achieved

Table 5 provides model fit metrics for the structural model. The R^2 value of 0.60 indicates that 60% of the variance in blockchain implementation success can be explained by data security risk, regulatory uncertainty, and technological readiness. The Q^2 value of 0.52 further suggests that the model has strong predictive relevance. This table confirms the robustness of the model in explaining blockchain implementation success in financial institutions.

5.1. Measurement Model Assessment

The measurement model was assessed to ensure the validity and reliability of the constructs, with a focus on both convergent validity and discriminant validity. Convergent validity was established as the factor loadings for all items exceeded the recommended threshold of 0.7, signifying that the observed variables were strongly correlated with their respective latent constructs. Furthermore, the Average Variance Extracted (AVE) values for all constructs were above 0.5, indicating that each construct captured more variance from its items than was due to measurement error. Composite Reliability (CR) scores were also greater than 0.7, confirming that the constructs demonstrated high internal consistency. These results collectively validate the adequacy of the measurement model for further analysis.

5.2. Structural Model Assessment

The structural model was analyzed to test the relationships between the variables and to verify the research hypotheses. The results revealed that data security risk had a significant and negative impact on blockchain implementation success ($\beta = -0.35$, $p < 0.05$), indicating that higher data security risks are associated with a lower likelihood of successful blockchain implementation. This finding supports Hypothesis 1 and highlights how concerns over data exposure and privacy can negatively affect blockchain adoption in financial institutions. Similarly, regulatory uncertainty was found to have a significant and negative effect on blockchain implementation success ($\beta = -0.40$, $p < 0.01$), confirming Hypothesis 2. This demonstrates that regulatory ambiguity presents substantial barriers to blockchain adoption, as institutions struggle with compliance and legal clarity. In contrast, technological readiness showed a positive and significant influence on blockchain implementation success ($\beta = 0.45$, $p < 0.01$), supporting Hypothesis 3. This underscores the importance of advanced technological infrastructure and skilled personnel in enabling successful blockchain adoption. These findings collectively validate the structural model and highlight the critical factors affecting blockchain implementation in financial institutions.

5.3. Moderation Analysis

The analysis examined technological readiness as a potential moderating factor for the relationships between data security risk, regulatory uncertainty, and blockchain implementation success. The results showed that the interaction term for technological readiness and data security risk was significant ($\beta = 0.25$, $p < 0.05$), indicating that institutions with higher levels of technological readiness are better equipped to manage data security risks. This finding underscores the critical role of technological preparedness in mitigating risks associated with blockchain adoption, particularly in addressing data security concerns.

However, the interaction term for technological readiness and regulatory uncertainty was not significant, suggesting that technological readiness alone does not substantially reduce the challenges posed by regulatory ambiguity. This result highlights the complexity of regulatory issues, which may require additional strategies beyond technological improvements, such as collaboration with policymakers or the establishment

of standardized global regulations. These findings collectively emphasize the nuanced role of technological readiness in managing risks associated with blockchain implementation.

5.4. R^2 and Predictive Relevance

The R^2 value for blockchain implementation success was 0.60, indicating that 60% of the variance in implementation success can be explained by data security risk, regulatory uncertainty, and technological readiness. This value demonstrates that the model has a strong level of predictive power. Furthermore, the Q^2 values provide additional confirmation of the model's robustness, indicating its relevance and reliability in explaining blockchain implementation success.

5.5. Discussion of Findings

The study's findings emphasize that data security risks and regulatory uncertainty are significant barriers to blockchain adoption in financial institutions. Data security risks, if unresolved, can lead to breaches of sensitive information, undermining trust and adoption rates. Regulatory uncertainty, on the other hand, poses challenges due to the lack of global standards, making compliance and cross-jurisdiction scalability difficult. While technological readiness significantly supports blockchain adoption by ensuring system compatibility and reducing operational disruptions, it does not address regulatory issues, highlighting the need for a broader strategy that includes regulatory reform.

To overcome these challenges, financial institutions must adopt a balanced approach that combines technological advancements with robust regulatory frameworks. Policymakers should prioritize creating global standards and fostering collaboration through regulatory sandboxes and pilot programs to test blockchain solutions in controlled environments. Simultaneously, educating stakeholders on blockchain's capabilities and limitations is essential for informed decision-making. By investing in technological readiness and engaging with regulators, financial institutions can unlock blockchain's transformative potential while mitigating its inherent risks, paving the way for secure and compliant adoption.

6. MANAGERIAL IMPLICATIONS

The findings of this study provide crucial insights for financial institutions, regulators, and technology leaders in managing the risks associated with blockchain adoption. Understanding the managerial implications of these insights can facilitate strategic decision-making, ensuring that blockchain integration aligns with both operational goals and regulatory compliance.

6.1. Strategic Risk Management Approaches

Financial institutions must adopt a proactive risk management framework that addresses blockchain-specific risks such as data security, regulatory uncertainty, and technological readiness. Implementing robust cybersecurity measures, conducting regular risk assessments, and enhancing regulatory compliance efforts will be key strategies in mitigating potential threats.

6.2. Enhancing Regulatory Compliance

Given the regulatory challenges associated with blockchain technology, financial institutions should work closely with policymakers and regulatory bodies to establish clear compliance frameworks. This includes participating in regulatory sandboxes, engaging in policy discussions, and leveraging legal expertise to navigate complex regulatory landscapes. Institutions should also develop adaptive compliance mechanisms that evolve alongside blockchain regulations.

6.3. Technological Readiness and Infrastructure Development

To successfully integrate blockchain technology, financial institutions need to invest in upgrading their technological infrastructure. This includes ensuring system compatibility with blockchain applications, training IT personnel, and developing strategic partnerships with blockchain service providers. Institutions should also prioritize research and development initiatives to explore blockchain's potential in streamlining financial operations.

6.4. Data Security and Privacy Management

Data security remains a critical concern in blockchain adoption. Financial institutions must implement encryption techniques, access control measures, and secure consensus protocols to safeguard sensitive information. Additionally, institutions should develop contingency plans to address potential security breaches and ensure compliance with data protection laws, such as GDPR and financial industry-specific privacy regulations.

6.5. Workforce Training and Change Management

The successful adoption of blockchain technology requires a skilled workforce equipped with blockchain expertise. Financial institutions should invest in training programs and certification courses to upskill employees in blockchain development, risk management, and compliance. Change management strategies should also be introduced to ease the transition to blockchain-based systems, fostering a culture of innovation and adaptability.

6.6. Strategic Partnerships and Industry Collaboration

Collaboration among financial institutions, technology firms, and regulatory bodies is essential for overcoming blockchain adoption challenges. Forming industry consortia, sharing best practices, and engaging in joint blockchain initiatives can help institutions collectively address risk management concerns while fostering innovation in financial services.

6.7. Cost-Benefit Analysis for Blockchain Investments

Managers should conduct thorough cost-benefit analyses before implementing blockchain solutions. This includes evaluating the financial viability of blockchain projects, assessing potential cost reductions in transaction processing, and measuring the long-term value of enhanced transparency and security. A clear return on investment (ROI) assessment will enable informed decision-making on blockchain adoption.

6.8. Future-Proofing Business Models

Blockchain technology has the potential to transform financial services, necessitating a shift in traditional business models. Financial institutions should explore innovative business strategies that leverage blockchain's capabilities, such as decentralized finance (DeFi), smart contracts, and tokenization. Developing a future-ready approach will ensure long-term sustainability and competitive advantage.

6.9. Recommendations for Policymakers

Regulators play a crucial role in shaping the blockchain landscape. This study highlights the need for policymakers to develop standardized regulations that facilitate blockchain adoption while ensuring security and compliance. Regulatory clarity will encourage financial institutions to invest confidently in blockchain innovations, driving the broader adoption of distributed ledger technologies.

6.10. Conclusion on Managerial Implications

The strategic adoption of blockchain technology requires a multifaceted approach that balances innovation with risk management. By addressing regulatory concerns, strengthening technological infrastructure, enhancing workforce capabilities, and fostering industry collaboration, financial institutions can harness the full potential of blockchain while mitigating associated risks. Managers and policymakers must work together to develop adaptive strategies that ensure the secure and efficient integration of blockchain in financial services.

7. CONCLUSION

This study investigated the critical risk factors impacting blockchain implementation success in financial institutions, focusing on data security risks, regulatory uncertainty, and technological readiness. Using the SmartPLS approach, the research validated each hypothesis and highlighted the relationships among these variables, providing insights into the key factors influencing blockchain adoption. The results indicate that both data security risks and regulatory uncertainty pose significant barriers to blockchain success, as blockchain's inherent transparency challenges financial institutions in protecting sensitive client information, and inconsistent regulations create compliance risks.

On the positive side, technological readiness plays a crucial role in facilitating successful blockchain adoption. Institutions with robust technological infrastructures and skilled personnel are better positioned to integrate blockchain effectively. Technological readiness was found to moderate the impact of data security risks, suggesting that institutions with higher levels of readiness are better equipped to manage these risks. However,

technological readiness alone does not mitigate the challenges posed by regulatory uncertainty, emphasizing the need for clearer regulatory guidelines to support secure and compliant blockchain adoption.

In conclusion, this study underscores the importance of a balanced approach to blockchain implementation in financial institutions, addressing both technological infrastructure and regulatory considerations. Financial institutions should invest in technological readiness to support innovation while collaborating with policymakers to develop regulatory frameworks tailored to blockchain. These findings contribute to a deeper understanding of blockchain risk management, helping institutions navigate the complexities of adopting this transformative technology effectively.

8. DECLARATIONS

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8.2. Author Contributions

Conceptualization: SD; Methodology: DB; Software: AF; Validation: LS and SD; Formal Analysis: SD and AF; Investigation: LS; Resources: DB; Data Curation: AF; Writing Original Draft Preparation: SD and AF; Writing Review and Editing: SD, AF, LS and DB; Visualization: LS; All authors, SD, AF, LS and DB, have read and agreed to the published version of the manuscript.

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The data presented in this study are available on request from the corresponding author.

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8.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] K. Rauniyar, X. Wu, S. Gupta, S. Modgil, and A. B. Lopes de Sousa Jabbour, "Risk management of supply chains in the digital transformation era: contribution and challenges of blockchain technology," *Industrial Management & Data Systems*, vol. 123, no. 1, pp. 253–277, 2023.

[2] K. Jain and S. Gochhait, "Risk management approach to financial cybersecurity in islamic banks: A review," in *2024 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS)*. IEEE, 2024, pp. 1168–1172.

[3] H. Younis, O. M. Bwaliez, M. Al-Okaily, and M. I. Tanveer, "Revolutionizing supply chain management: a critical meta-analysis of empowerment and constraint factors in blockchain technology adoption," *Business Process Management Journal*, 2024.

[4] S. Purnama and C. Bangun, "Strategic management insights into housewives consumptive shopping behavior in the post covid-19 landscape," *APTISI Transactions on Management*, vol. 8, no. 1, pp. 71–79, 2024.

[5] F. Ekundayo, "Economic implications of ai-driven financial markets: Challenges and opportunities in big data integration," *International Journal of Science and Research Archive*, vol. 13, pp. 1500–1515, 2024.

[6] R. Ahuja, J. Khandelwal *et al.*, "Challenges, opportunities and risk analysis of adoption of decentralized finance applications." *ICTACT Journal on Soft Computing*, vol. 14, no. 1, 2023.

[7] I. Erliyani, K. Yuliana, H. Kusumah, and N. Aziz, "Metode pembelajaran dalam memberikan pendidikan agama islam pada usia dini industri 4.0," *Alfabet Jurnal Wawasan Agama Risalah Islamiah, Teknologi dan Sosial*, vol. 1, no. 1, pp. 96–105, 2021.

[8] M. Paramesha, N. L. Rane, and J. Rane, "Artificial intelligence, machine learning, deep learning, and blockchain in financial and banking services: A comprehensive review," *Partners Universal Multidisciplinary Research Journal*, vol. 1, no. 2, pp. 51–67, 2024.

[9] M. I. Ononiwu, O. C. Onwuzulike, K. Shitu, and O. O. Ojo, "Operational risk management in emerging markets: A case study of nigerian banking institutions," *World Journal of Advanced Research and Reviews*, vol. 23, no. 3, pp. 446–459, 2024.

[10] G. Putra, I. Maulana, A. Chayo, M. Haekal, and R. Syaharani, "Pengukuran efektivitas platform e-learning dalam pembelajaran teknik informatika di era digital: Measuring the effectiveness of e-learning platforms in learning information technology," *Jurnal MENTARI: Manajemen, Pendidikan dan Teknologi Informasi*, vol. 3, no. 1, pp. 19–29, 2024.

[11] T. O. Sanyaolu, A. G. Adeleke, C. F. Azubuko, and O. S. Osundare, "Harnessing blockchain technology in banking to enhance financial inclusion, security, and transaction efficiency," *International Journal of Scholarly Research in Science and Technology, August*, vol. 5, no. 01, pp. 035–053, 2024.

[12] P. U. Ojukwu, E. Cadet, O. S. Osundare, O. G. Fakeyede, A. B. Ige, and A. Uzoka, "Exploring theoretical constructs of blockchain technology in banking: Applications in african and us financial institutions," *International Journal of Frontier Research in Science*, vol. 4, no. 1, pp. 035–042, 2024.

[13] P. Varma, S. Nijjer, K. Sood, S. Grima, and R. Rupeika-Apoga, "Thematic analysis of financial technology (fintech) influence on the banking industry," *Risks*, vol. 10, no. 10, p. 186, 2022.

[14] D. Robert, F. P. Oganda, A. Sutarman, W. Hidayat, and A. Fitriani, "Machine learning techniques for predicting the success of ai-enabled startups in the digital economy," *CORISINTA*, vol. 1, no. 1, pp. 61–69, 2024.

[15] B. Rolando and H. Mulyono, "Managing risks in fintech: Applications and challenges of artificial intelligence-based risk management," *Economics and Business Journal (ECBIS)*, vol. 2, no. 3, pp. 249–268, 2024.

[16] Q. Gan, R. Y. K. Lau, and J. Hong, "A critical review of blockchain applications to banking and finance: a qualitative thematic analysis approach," *Technology Analysis & Strategic Management*, pp. 1–17, 2021.

[17] S. Brown, M. Pereira, and I. Guvlor, "Implementation of artificial intelligence framework to enhance human resources competency in indonesia," *International Journal of Cyber and IT Service Management*, vol. 4, no. 1, pp. 65–71, 2024.

[18] M.-S. Jameaba, "Digitalization, emerging technologies, and financial stability: Challenges and opportunities for the indonesian banking industry and beyond," *DOI: https://doi. org/10.32388/CSTTYQ*, vol. 2, 2022.

[19] A. Pal, C. K. Tiwari, and A. Behl, "Blockchain technology in financial services: a comprehensive review of the literature," *Journal of Global Operations and Strategic Sourcing*, vol. 14, no. 1, pp. 61–80, 2021.

[20] K. N. Gyimah, E. Asiedu, and F. Antwi, "Adoption of blockchain technology in the banking sector of ghana: Opportunities and challenges," *African Journal of Business Management*, vol. 17, no. 2, pp. 32–42, 2023.

[21] Z. Maharani and A. Saputra, "Strategic management of public health risks: Correlation between water quality and aedes sp. in south jakarta," *APTISI Transactions on Management*, vol. 8, no. 1, pp. 66–70, 2024.

[22] S. J. S. Krishna, A. Panda, and P. Sindhuja, "Cryptocurrency adoption and its influence on traditional financial markets," *dynamics*, vol. 8, p. 11, 2023.

[23] N. K. A. Dwijendra, U. Rahardja, N. B. Kumar, I. Patra, M. M. A. Zahra, Y. Finogenova, J. W. G. Guerrero, S. E. Izzat, and T. Alawsi, "An analysis of urban block initiatives influencing energy consumption and solar energy absorption," *Sustainability*, vol. 14, no. 21, p. 14273, 2022.

[24] O. Candra, N. B. Kumar, N. K. A. Dwijendra, I. Patra, A. Majdi, U. Rahardja, M. Kosov, J. W. G. Guerrero, and R. Sivaraman, "Energy simulation and parametric analysis of water cooled thermal photovoltaic systems: energy and exergy analysis of photovoltaic systems," *Sustainability*, vol. 14, no. 22, p. 15074, 2022.

[25] O. A. Bello and K. Olufemi, "Artificial intelligence in fraud prevention: Exploring techniques and applications challenges and opportunities," *Computer Science & IT Research Journal*, vol. 5, no. 6, pp. 1505–1520, 2024.

[26] F. S. Putri, H. R. Ngemba, S. Hendra, and W. Wirdayanti, "Sistem layanan ujian psikotes sim menggunakan computer based test berbasis website: Sim psychological test service system using computer based

test based on website," *Technomedia Journal*, vol. 9, no. 1, pp. 92–104, 2024.

[27] N. S. Uzougbo, C. G. Ikegwu, and A. O. Adewusi, "Regulatory frameworks for decentralized finance (defi): challenges and opportunities," *GSC Advanced Research and Reviews*, vol. 19, no. 2, pp. 116–129, 2024.

[28] D. O. Ogundipe, "Conceptualizing cloud computing in financial services: opportunities and challenges in africa-us contexts," *Computer Science & IT Research Journal*, vol. 5, no. 4, pp. 757–767, 2024.

[29] C. O. Putri, J. Williams, L. Anastasya, and D. Juliastuti, "The use of blockchain technology for smart contracts in future business agreements," *Blockchain Frontier Technology*, vol. 4, no. 1, pp. 1–6, 2024.

[30] S. Kosasi, U. Rahardja, I. D. A. E. Yuliani, R. Laipaka, B. Susilo, and H. Kikin, "It governance: Performance assessment of maturity levels of rural banking industry," in *2022 4th International Conference on Cybernetics and Intelligent System (ICORIS)*. IEEE, 2022, pp. 1–6.