

IMPACT OF CYBER-SECURE BLOCK CHAIN SYSTEMS ON TRUST, REPAYMENT BEHAVIOUR, AND GOVERNANCE IN MICROFINANCE INSTITUTIONS

"Secure digital trust is the cornerstone of sustainable Blockchain-enabled microfinance"

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Abstract

The study examines the impact of cyber-secure Block chain systems on borrower trust, loan repayment behaviour, and institutional governance in microfinance institutions. Using primary data collected from 425 respondents through purposive sampling, the study applied Chi-square, Pearson correlation, ANOVA, and multiple regression analyses to test the proposed hypotheses. The findings reveal that cyber security and Block chain transparency significantly enhance borrower trust, improve repayment behaviour, strengthen data protection and user confidence, and promote institutional governance and accountability. Borrower trust was also found to play a significant mediating role between Block chain adoption and repayment performance. The study concludes that integrating Block chain with robust cyber security mechanisms can improve transparency, operational efficiency, and the long-term sustainability of digital microfinance services

Keywords: *block chain, loan repayment, cyber security, borrower trust, governance, microfinance service*

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Introduction

The swift digitization of financial services has significantly transformed microfinance operations, but it has also exposed institutions to growing cyber threats, data breaches, and fraud risks. In such a context, integrating Block chain technology with robust cyber security mechanisms offers a promising solution to enhance transparency, data integrity, and secure transaction processing. While Block chain ensures immutability and traceability of financial records, cyber security frameworks safeguard sensitive borrower information and protect systems from unauthorized access. However, there remains limited empirical research examining how this combined technological approach influences borrower trust, repayment behavior, and governance practices in microfinance institutions.

This study is important as it moves beyond technical feasibility and focuses on behavioral and institutional outcomes, particularly in financially vulnerable and digitally evolving environments. By analyzing how cyber-secure Block chain systems build trust among borrowers and improve repayment discipline, the study provides valuable insights for enhancing the efficiency and sustainability of microfinance operations. It also contributes to strengthening governance by promoting accountability, auditability, and reduced dependency on intermediaries.

Review of literature

Cyber Security-Based Reviews

1. **Taherdoost (2022)** examined various Blockchain adoption models and emphasized that the successful implementation of Blockchain technology

in digital financial systems depends not only on technological readiness but also on the integration of robust cyber security frameworks. The study highlighted that cyber security measures play a crucial role in protecting sensitive financial information by ensuring data privacy, maintaining system integrity, and enabling secure user authentication. The author argued that Blockchain's decentralized architecture significantly reduces the risk of unauthorized data manipulation; however, vulnerabilities associated with endpoints, user credentials, and network interfaces still require comprehensive security controls. The study further noted that organizations adopting Blockchain must implement multi-layered security mechanisms, including encryption, identity management, access control, and continuous monitoring, to strengthen user trust and ensure regulatory compliance. The findings concluded that integrating Blockchain with advanced cyber security practices creates a resilient digital financial ecosystem capable of supporting secure and transparent financial transactions.

2. **Zhang, Ma and Meng (2025)** investigated the role of Blockchain-based auditing systems in strengthening cyber resilience within financial institutions. The authors reported that Blockchain technology significantly improves the

security and transparency of financial auditing by providing immutable, tamper-proof records that cannot be altered without network consensus. Their study demonstrated that decentralized verification mechanisms reduce opportunities for cyber fraud, unauthorized modifications, and financial manipulation while enhancing the reliability of audit trails. The researchers further explained that Blockchain-based auditing facilitates real-time monitoring of financial transactions, enabling quicker detection of suspicious activities and improving organizational responses to cyber threats. The study also emphasized that integrating Blockchain with advanced cyber security protocols enhances data authenticity, accountability, and operational resilience. Overall, the findings suggested that Blockchain-powered auditing systems represent a transformative approach for improving cyber security, reducing financial risks, and strengthening stakeholder confidence in digital financial environments.

3. **Liu et al. (2022)** proposed a comprehensive governance framework for Blockchain systems by emphasizing the importance of integrating effective cyber security controls with governance mechanisms to ensure trustworthy and reliable digital platforms. The study highlighted that the decentralized nature of Blockchain requires clearly defined governance structures that regulate access management, user responsibilities, decision-making processes, and accountability mechanisms. The authors argued that implementing strong identity verification systems, role-based access controls, cryptographic authentication, and continuous security monitoring is essential for protecting Blockchain networks from cyber attacks and unauthorized access. Furthermore, the study emphasized that transparent governance policies enhance user confidence by ensuring compliance with regulatory standards and promoting responsible system management. The researchers concluded that effective governance combined with robust cyber security measures significantly strengthens the resilience, transparency, and long-term sustainability of Blockchain-enabled financial systems.
4. **Gorog and Boulton (2021)** developed a Blockchain trust consensus model that integrates advanced cyber security

features to strengthen trust, security, and reliability in decentralized digital environments. The study focused on enhancing Blockchain consensus mechanisms through the incorporation of digital content protection, enforcement controls, secure communication protocols, and resilient system architecture. The authors explained that traditional trust models often face challenges related to unauthorized access, data tampering, and cyber vulnerabilities, whereas Blockchain combined with strong cyber security safeguards provides greater protection against such threats. Their proposed framework emphasized secure validation processes, encrypted transactions, and distributed verification techniques to ensure data integrity and prevent malicious activities. The study further highlighted that secure system architecture and comprehensive cyber security enforcement significantly improve user confidence, protect digital assets, and enhance the operational efficiency of Blockchain-based financial and information systems. The findings established that integrating trust consensus models with cyber security mechanisms is fundamental for building secure and scalable Blockchain applications.

5. **Aitzhan and Svetinovic (2018)**, widely cited in Blockchain governance and cyber security literature, examined the role of cryptographic mechanisms and secure communication protocols in enhancing the security of Blockchain networks. The study emphasized that advanced cryptographic techniques, including public-key cryptography, digital signatures, hashing algorithms, and encryption methods, provide strong protection for data confidentiality, integrity, and authentication during digital transactions. The authors explained that secure communication protocols minimize the risks of cyber attacks such as unauthorized access, data interception, identity theft, and transaction manipulation. Furthermore, the study highlighted that Blockchain's decentralized architecture, when combined with robust cryptographic security measures, creates a highly resilient environment capable of resisting various cyber threats while maintaining transparency and trust among network participants. The researchers concluded that effective implementation of cryptographic security mechanisms is

essential for ensuring the reliability, privacy, and overall security of Blockchain-based financial systems, making them suitable for applications requiring high levels of trust and data protection.

Block chain-Based Reviews

6. **Nelaturu, Du, and Le (2022)** provided a comprehensive taxonomy of Block chain applications within the fintech sector, offering a structured classification of how the technology is utilized across financial services. Their study highlights Block chain's critical role in enhancing transparency by enabling real-time visibility of transactions for all authorized participants. They emphasize decentralization as a core feature, eliminating the need for central authorities and reducing dependency on intermediaries. The research also discusses how Block chain ensures secure transactions through cryptographic techniques and distributed ledger systems. Additionally, the authors identify key application areas such as payments, digital identity, lending, and asset management. They argue that the integration of Block chain in fintech improves operational efficiency and reduces transaction costs significantly.
7. **Taherdoost (2022)** analyzed various Block chain adoption frameworks to understand the factors influencing its acceptance in organizations and financial systems. The study concludes that perceived usefulness is one of the most significant determinants, as users adopt technology when they recognize clear benefits. Trust is identified as another critical factor, especially in financial environments where security and reliability are paramount. Technological readiness, including infrastructure availability and user capability, also plays a vital role in successful adoption. The research further highlights the importance of organizational support and regulatory clarity in accelerating Block chain implementation. Resistance to change and lack of awareness are noted as key barriers to adoption. The study ultimately suggests that a combination of technological, behavioral, and institutional factors drives the successful integration of Block chain systems.
8. **Guo and Liu (2025)** explored how Block chain technology and smart contracts are transforming traditional trust mechanisms in financial and organizational systems. Their research explains that conventional trust models rely heavily on intermediaries such as banks, brokers, and regulatory bodies. Block chain eliminates these intermediaries by introducing decentralized systems where trust is established through code and consensus mechanisms. Smart contracts automate agreements, ensuring that transactions are executed only when predefined conditions are met. This automation reduces human intervention, minimizes errors, and enhances efficiency in transactions. The authors also highlight that such systems increase transparency and accountability among participants.
9. **Casino et al. (2019)**, widely referenced in fintech literature, emphasized Block chain's ability to ensure data immutability and secure decentralized recordkeeping. Their study highlights that once data is recorded on a Block chain, it cannot be altered or deleted, ensuring high levels of integrity. This immutability is particularly valuable in sectors requiring strong audit trails, such as finance, healthcare, and supply chain management. The authors also discuss how decentralization enhances data security by removing single points of failure. Block chain's cryptographic features further strengthen protection against unauthorized access and cyber threats. The research identifies multiple industry applications where secure recordkeeping is critical for operational efficiency.
10. **Yermack (2017)** discussed the transformative potential of Block chain technology in reshaping traditional financial systems and governance structures. The study highlights how Block chain improves transparency by providing open and verifiable transaction records. It reduces agency problems by minimizing the need for intermediaries and limiting opportunities for opportunistic behavior. The author also explains that Block chain can strengthen corporate governance by enhancing accountability and monitoring mechanisms. Additionally, the technology has the potential to streamline financial operations and reduce transaction costs. They also emphasized that Block chain could disrupt existing financial institutions by introducing more efficient decentralized alternatives.

Block chain in Microfinance based Reviews

11. **Wakekar et al. (2026)** examined the application of Blockchain technology in

microfinance systems and demonstrated that its adoption significantly enhances transparency, accountability, and operational efficiency in financial service delivery. The study highlighted that Blockchain's decentralized ledger technology enables every financial transaction to be permanently recorded in an immutable and transparent manner, making it nearly impossible to alter or manipulate transaction records without network consensus. The researchers emphasized that the integration of smart contracts automates loan disbursement, repayment schedules, and compliance procedures, thereby minimizing manual intervention and reducing the likelihood of human errors, fraud, and financial misconduct. The study further observed that decentralized ledgers provide stakeholders, including borrowers, lenders, regulators, and financial institutions, with real-time access to verified transaction records, thereby improving trust and accountability throughout the lending process. Additionally, Blockchain-based systems were found to lower operational costs by eliminating unnecessary intermediaries while strengthening auditability and regulatory compliance. The findings concluded that Blockchain-supported microfinance platforms create a more secure, transparent, and efficient financial ecosystem capable of improving institutional performance and expanding financial inclusion among underserved populations.

12. **Shah (2024)** investigated the impact of Blockchain technology on financial inclusion within rural credit ecosystems and found that its implementation substantially improves access to reliable, secure, and efficient financial services for underserved communities. The study emphasized that many rural populations continue to face barriers such as inadequate banking infrastructure, lack of trust in financial institutions, high transaction costs, and limited access to formal credit facilities. Blockchain technology addresses these challenges by creating decentralized financial networks that facilitate secure and transparent transactions without relying heavily on traditional intermediaries. The author observed that Blockchain enhances trust among borrowers, lenders, and financial institutions through immutable transaction records, improved identity verification,

and transparent loan management processes. The study further highlighted that faster transaction processing, reduced administrative costs, and enhanced operational efficiency enable financial institutions to extend affordable credit services to rural entrepreneurs and low-income households. The findings suggested that Blockchain has the potential to bridge the financial inclusion gap by promoting equitable access to financial resources, strengthening rural economic development, and supporting sustainable community growth.

13. **Ponnuraj and Nagabhushanam (2017)** explored the potential of integrating Blockchain technology with mobile banking platforms to enhance the outreach and effectiveness of microfinance services in developing economies. The authors argued that the widespread adoption of mobile devices, coupled with Blockchain's decentralized and secure infrastructure, creates an effective digital ecosystem capable of reaching financially excluded populations residing in remote and rural areas. The study highlighted that Blockchain-enabled mobile banking systems facilitate secure, low-cost, and real-time financial transactions while reducing dependence on traditional banking infrastructure. Furthermore, the integration of Blockchain with mobile financial services improves identity verification, transaction transparency, and loan monitoring, thereby minimizing fraud and enhancing customer confidence. The researchers also noted that digital platforms supported by Blockchain can streamline microfinance operations, improve loan disbursement efficiency, and facilitate timely repayments through automated processes. The study concluded that the convergence of Blockchain technology and mobile banking offers significant opportunities for expanding financial access, improving service delivery, and promoting inclusive economic development across developing nations.
14. **Narayan and Sharma (2022)** examined the role of Blockchain technology in improving the operational efficiency of rural microfinance institutions and highlighted its potential to reduce administrative inefficiencies, corruption, and financial irregularities in lending operations. The study observed that conventional microfinance systems often suffer from excessive paperwork, delayed

loan processing, information asymmetry, and opportunities for fraudulent practices due to manual record-keeping and centralized administration. The authors explained that Blockchain technology addresses these issues by maintaining secure, immutable, and transparent digital records that enhance accountability at every stage of the lending process. The implementation of decentralized ledgers enables all authorized stakeholders to access verified transaction histories, thereby reducing the likelihood of document manipulation, duplicate records, and unauthorized financial activities. The study further emphasized that smart contracts automate loan approvals, repayments, and compliance procedures, significantly reducing processing time and operational costs. The findings concluded that Blockchain contributes to a more transparent, efficient, and corruption-resistant microfinance ecosystem, thereby improving institutional credibility and strengthening financial services in rural communities.

15. **Kumar et al. (2021)** emphasized the transformative role of Blockchain technology in enabling peer-to-peer (P2P) micro-lending platforms that directly connect borrowers with lenders while minimizing dependence on traditional financial intermediaries. The study explained that Blockchain-based P2P lending systems leverage decentralized networks, cryptographic security, and smart contracts to facilitate secure, transparent, and efficient lending transactions. By eliminating intermediaries such as banks and financial agents, these platforms significantly reduce transaction costs, accelerate loan approvals, and improve accessibility to credit for individuals and small entrepreneurs who are often excluded from formal banking systems. The authors further highlighted that Blockchain ensures complete transparency by recording every lending transaction on an immutable distributed ledger, allowing participants to verify loan histories and repayment records in real time. The study also noted that smart contracts automate the execution of lending agreements, ensuring timely repayments and reducing the risk of contractual disputes or loan defaults. The findings concluded that Blockchain-powered peer-to-peer micro-lending platforms represent an innovative

financial model capable of promoting financial inclusion, increasing credit accessibility, enhancing operational efficiency, and supporting sustainable economic development in both urban and rural communities..

Trust Building – Empirical Reviews

16. **Guo and Liu (2025)** investigated the role of Blockchain technology in establishing algorithm-based trust within digital financial ecosystems and found that its decentralized architecture fundamentally transforms the way trust is created and maintained among participants. The study explained that unlike traditional financial systems, which rely heavily on centralized institutions and third-party intermediaries, Blockchain generates trust through cryptographic algorithms, consensus mechanisms, and immutable distributed ledgers. The authors emphasized that every transaction recorded on the Blockchain is transparent, verifiable, and resistant to unauthorized modification, thereby significantly reducing opportunities for fraud, data manipulation, and financial misconduct. Furthermore, the study highlighted that smart contracts automate the execution of contractual agreements based on predefined conditions, eliminating human intervention and ensuring fairness, accuracy, and consistency in financial transactions. The researchers observed that algorithm-based trust enhances operational efficiency while strengthening confidence among borrowers, lenders, regulators, and financial institutions. The findings concluded that Blockchain technology provides a reliable trust infrastructure by combining transparency, immutability, and automated contract execution, making it highly suitable for secure digital finance and microfinance applications.
17. **Treiblmaier (2021)** examined the concept of "trust by design" in Blockchain technology and concluded that Blockchain significantly enhances consumer trust through its inherent characteristics of transparency, traceability, decentralization, and data immutability. The study argued that trust in digital financial systems is often weakened by concerns regarding fraud, information asymmetry, data manipulation, and lack of accountability. Blockchain addresses these concerns by embedding trust directly into the technological architecture rather than relying solely on institutional

reputation or intermediary oversight. The author explained that every transaction recorded on a Blockchain network is permanently stored and can be independently verified by authorized participants, thereby creating a transparent and traceable audit trail. This design not only increases accountability but also minimizes disputes, improves regulatory compliance, and enhances users' confidence in digital financial services. The study further emphasized that the integration of Blockchain with smart contracts enables automatic execution of agreements without external intervention, reducing operational risks and strengthening transactional reliability. The findings suggested that Blockchain's trust-by-design approach serves as a critical foundation for promoting user acceptance, long-term engagement, and sustainable adoption of digital financial systems.

18. **Luhmann (1979)**, whose trust theory has been extensively cited in Blockchain and digital governance literature, explained that trust is a fundamental mechanism that reduces social and institutional complexity by enabling individuals to make decisions under conditions of uncertainty. According to the theory, trust allows people to engage confidently with complex systems without requiring complete knowledge of every process or participant involved. In the context of Blockchain technology, this theoretical perspective provides an important foundation for understanding how decentralized systems can replace traditional institution-based trust with technology-driven trust. The theory suggests that when users perceive a system as transparent, reliable, secure, and predictable, they are more willing to adopt and continue using its services. Blockchain's immutable ledger, cryptographic security, consensus mechanisms, and transparent transaction records reduce uncertainty by ensuring that information cannot be manipulated or altered without network validation. Consequently, users develop greater confidence in the integrity of the system even in the absence of centralized authorities. Luhmann's theoretical framework therefore provides a valuable explanation for why Blockchain technology enhances institutional trust, user confidence, and acceptance of digital financial services, particularly in

environments characterized by uncertainty and limited institutional reliability.

19. **Adegbite (2024)** examined the contribution of Blockchain technology to strengthening institutional trust in environments characterized by weak governance, limited regulatory oversight, and high levels of corruption. The study found that Blockchain provides a secure and transparent technological framework that minimizes opportunities for fraud, unauthorized data manipulation, and financial irregularities through the use of tamper-proof distributed ledgers. The author emphasized that every transaction recorded on the Blockchain is permanently stored and can be independently verified by authorized stakeholders, thereby enhancing accountability and improving confidence in financial operations. The study further explained that Blockchain reduces dependence on centralized authorities whose credibility may be compromised in weak governance settings by establishing decentralized verification and consensus mechanisms. This enhances transparency in financial reporting, public service delivery, and institutional governance while promoting compliance with regulatory standards. The findings suggested that Blockchain has significant potential to restore public trust in financial institutions and government-supported development programs by ensuring integrity, traceability, and accountability in digital transactions, particularly in developing economies where governance challenges remain substantial.
20. **Kumar et al. (2021)** investigated the impact of Blockchain-enabled decentralized lending platforms on borrower trust and found that these platforms significantly improve confidence in financial transactions by eliminating traditional intermediaries and enhancing transparency throughout the lending process. The study explained that conventional lending systems often involve multiple intermediaries, resulting in higher transaction costs, longer processing times, limited transparency, and increased opportunities for information asymmetry and administrative inefficiencies. Blockchain-based decentralized lending platforms overcome these limitations by directly connecting borrowers and lenders through secure peer-to-peer networks supported by distributed ledger technology and smart

contracts. The authors highlighted that every lending transaction is permanently recorded on an immutable ledger, allowing participants to verify loan agreements, repayment histories, and transaction records with complete transparency. Smart contracts further enhance trust by automatically executing loan terms and repayment conditions without requiring manual intervention, thereby reducing disputes and ensuring fairness. The study concluded that Blockchain-powered decentralized lending platforms strengthen borrower confidence, improve financial accessibility, reduce operational costs, and create a more transparent and trustworthy lending environment, making them highly effective for promoting financial inclusion and sustainable microfinance development

LoanRepayment Behavior–Based Reviews

21. **Wang (2023)** analyzed the influence of Block chain technology on lending behavior, particularly focusing on its role in improving credit allocation efficiency and reducing information asymmetry in financial systems. The study highlights that traditional lending mechanisms often suffer from incomplete or inaccurate borrower information, leading to inefficiencies in credit distribution and higher risks for lenders. Block chain technology addresses these challenges by providing a decentralized and transparent ledger where borrower data, credit histories, and transaction records can be securely stored and verified. This enhanced transparency allows lenders to make more informed decisions, thereby improving the allocation of credit to deserving borrowers. Additionally, the reduction in information asymmetry minimizes the likelihood of adverse selection and moral hazard, which are common issues in conventional lending systems. Wang concludes that the integration of Block chain into financial services has the potential to transform lending practices by making them more efficient, reliable, and accessible, particularly in underserved markets.
22. **Armendáriz and Morduch (2010)** provided a foundational analysis of repayment behavior in microfinance, emphasizing the critical role of trust, peer monitoring, and institutional mechanisms in ensuring loan repayment. Their study explains that microfinance institutions often operate in environments where formal credit histories and collateral are absent, making traditional risk assessment methods ineffective. In such contexts, social capital becomes a key determinant of repayment behavior. The authors highlight that group lending models, where borrowers are collectively responsible for loan repayment, create strong incentives for peer monitoring and mutual accountability. Trust among group members and between borrowers and institutions further strengthens repayment discipline. Additionally, institutional mechanisms such as regular meetings, progressive lending, and repayment incentives contribute to maintaining high repayment rates. The study underscores that the success of microfinance systems largely depends on the effective integration of social and institutional factors that promote responsible borrowing and repayment behavior.
23. **Cull and Morduch (2018)** emphasized the importance of transparency and borrower confidence in influencing repayment performance within microfinance systems. Their research suggests that when borrowers clearly understand loan terms, repayment schedules, and associated obligations, they are more likely to adhere to repayment commitments. Transparency in operations not only builds trust between borrowers and financial institutions but also reduces misunderstandings and disputes that could otherwise lead to defaults. The authors further argue that borrower confidence in the fairness and reliability of the institution plays a significant role in shaping repayment behavior. When borrowers perceive the lending process as transparent and equitable, they are more motivated to maintain a positive relationship with the institution by fulfilling their obligations. This study highlights that beyond financial considerations, psychological and relational factors are equally important in ensuring the sustainability and effectiveness of microfinance programs.
24. **Karlan and Zinman (2009)** explored the behavioral dimensions of loan repayment, demonstrating that factors such as trust, incentives, and psychological motivations significantly influence repayment discipline. Their study reveals that borrowers' decisions are not solely based on economic rationality but are also shaped by behavioral biases and social dynamics. For instance, trust in the

lending institution encourages borrowers to comply with repayment terms, while well-designed incentive structures, such as rewards for timely payments or penalties for defaults, can reinforce positive repayment behavior. The authors also highlight the role of commitment devices and reminders in improving repayment rates, suggesting that even small behavioral interventions can have a substantial impact. This research contributes to the understanding that integrating behavioral insights into lending practices can enhance repayment outcomes and reduce default risks, particularly in low-income and microfinance contexts.

25. **Banerjee et al. (2015)** observed that structured monitoring systems and trust-based lending approaches play a crucial role in improving repayment rates in microfinance programs. Their study, based on extensive field experiments and empirical analysis, demonstrates that regular monitoring of borrowers' activities and financial behavior helps in early identification of potential repayment issues. Structured monitoring mechanisms, such as frequent check-ins and performance tracking, ensure that borrowers remain accountable and committed to their repayment schedules. At the same time, the authors emphasize the importance of trust-based relationships between lenders and borrowers, which foster a sense of responsibility and mutual respect. When borrowers feel trusted and supported, they are more likely to prioritize loan repayment and maintain a positive credit relationship. The study concludes that a balanced approach combining formal monitoring with informal trust-building measures is essential for achieving high repayment performance and ensuring the long-term sustainability of microfinance initiatives.

Institutional Governance-Based Reviews

26. **Liu et al. (2021)** highlighted the transformative potential of Block chain governance frameworks in improving organizational accountability, transparency, and decentralized decision-making processes. Their study emphasizes that traditional governance models, which rely heavily on centralized authorities, often suffer from inefficiencies, lack of trust, and information asymmetry. In contrast, Block chain technology introduces a decentralized architecture where transactions and decisions are

recorded on an immutable ledger, accessible to all relevant stakeholders. This transparency ensures that organizational activities can be audited in real time, thereby enhancing trust and reducing the likelihood of manipulation or fraud. Furthermore, the authors point out that Block chain-based governance facilitates distributed consensus mechanisms, enabling multiple stakeholders to participate in decision-making without the need for intermediaries. This not only increases efficiency but also democratizes governance structures, making them more inclusive and resilient. The study ultimately concludes that Block chain governance frameworks represent a paradigm shift in how organizations manage control, accountability, and stakeholder engagement in the digital age.

27. **Zachariadis et al. (2019)** examined the governance challenges associated with distributed ledger technologies, particularly focusing on the complexities of regulatory alignment and the need for robust control mechanisms. Their research highlights that while Block chain offers significant advantages in terms of decentralization and transparency, it also introduces new governance dilemmas related to legal compliance, jurisdictional ambiguities, and accountability. The absence of a central authority raises critical questions about who is responsible for enforcing rules and resolving disputes within Block chain networks. The authors argue that effective governance of distributed ledger systems requires a careful balance between technological innovation and regulatory oversight. They stress the importance of developing standardized frameworks and policies that can harmonize Block chain operations with existing legal systems. Additionally, the study underscores the need for adaptive governance models that can evolve alongside technological advancements, ensuring that Block chain systems remain secure, reliable, and aligned with broader societal and economic objectives.
28. **De Filippi and Wright (2020)** provided a comprehensive analysis of the concept of "governance by code," illustrating how Block chain technology enables rules and regulations to be embedded directly into software protocols. This approach significantly reduces reliance on centralized authorities and traditional legal

systems, as the execution of rules becomes automated through smart contracts. The authors explain that such a system enhances efficiency and minimizes human intervention, thereby reducing the risk of bias, corruption, and administrative delays. By shifting governance mechanisms from institutional frameworks to algorithmic processes, Block chain creates a more predictable and transparent environment for transactions and interactions. However, the study also acknowledges potential limitations, including the rigidity of coded rules and the challenges of addressing unforeseen circumstances. Despite these concerns, the concept of governance by code is presented as a revolutionary development that has the potential to redefine organizational and institutional governance in the digital era.

29. **Ahmed et al. (2020)** explored the role of Block chain technology in enhancing governance within institutional systems, particularly focusing on its ability to improve transparency, traceability, and accountability. Their findings suggest that Block chain's immutable ledger system allows for the secure recording of transactions, making it easier to track and verify activities across various organizational processes. This level of traceability is especially valuable in sectors where accountability is critical, such as finance, supply chain management, and public administration. The study also highlights how Block chain reduces information asymmetry by providing stakeholders with equal access to verified data, thereby fostering trust and collaboration. Furthermore, the authors argue that the integration of Block chain into governance frameworks can significantly reduce the risk of fraud and corruption by ensuring that all actions are permanently recorded and cannot be altered. Overall, the research demonstrates that Block chain serves as a powerful tool for strengthening governance mechanisms and improving institutional efficiency.
30. **Shahaab et al. (2023)** emphasized the significant impact of Block chain-based governance models in reducing corruption and enhancing transparency, particularly within the public sector. Their study highlights that traditional governance systems in many countries are often plagued by inefficiencies, lack of accountability, and opportunities for corrupt practices. Block chain technology

addresses these challenges by creating a transparent and tamper-proof system where all transactions and decisions are recorded on a distributed ledger. This ensures that government activities can be monitored and verified by multiple stakeholders, thereby reducing the scope for unethical behavior. The authors also note that Block chain enables greater citizen participation in governance processes, promoting inclusivity and trust in public institutions. Additionally, the study points out that the adoption of Block chain can streamline administrative processes, reduce costs, and improve service delivery.

Research Gap

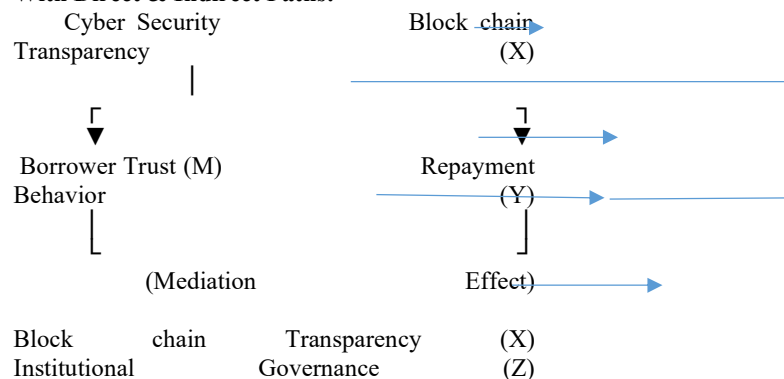
Existing studies largely focus on the technical capabilities of Block chain and cyber security, with limited empirical evidence in microfinance contexts. There is insufficient research linking Block chain-enabled transparency with borrower trust and repayment behavior over the long term. Comparative and cross-context studies examining cyber-secure Block chain adoption in diverse socio-economic environments are lacking. The role of borrower perceptions regarding data privacy and cyber risks in influencing trust remains underexplored. Additionally, the impact of Block chain on institutional governance in microfinance has not been adequately tested through empirical models.

Research Statement

This study aims to empirically examine the impact of cyber-secure Block chain systems on borrower trust in microfinance institutions. It investigates how enhanced transparency and security influence loan repayment behavior among borrowers. The study further explores the mediating role of trust between Block chain adoption and repayment performance. It also analyzes the contribution of Block chain to improving institutional governance and accountability.

Hypothecated Model

With Direct & Indirect Paths:



IMPACT OF CYBER-SECURE BLOCK CHAIN SYSTEMS ON TRUST, REPAYMENT BEHAVIOUR, AND GOVERNANCE IN MICROFINANCE INSTITUTIONS

Cyber Security
Governance (Z)

Institutional →

Conceptual Framework

The conceptual framework of the study is developed based on the hypothesized relationships among cyber security mechanisms, Block chain transparency, borrower trust, loan repayment behavior, and institutional governance within microfinance institutions. The framework positions cyber-secure Block chain systems as a transformative technological intervention that influences both behavioral and institutional outcomes.

At the core of the framework, Block chain transparency is considered the primary independent variable, strengthened by cyber security mechanisms that ensure data protection, system integrity, and secure transactions. These two components together create a reliable and trustworthy digital environment for microfinance operations. Enhanced transparency reduces information asymmetry and fraud risks, thereby positively influencing borrower trust, which is treated as a key mediating variable.

Borrower trust plays a central role in shaping loan repayment behavior, as increased confidence in the system encourages timely and responsible repayment practices. The framework hypothesizes that the effect of Block chain transparency on repayment behavior is largely indirect, operating through the development of trust among borrowers. This highlights trust as a critical psychological mechanism linking technology adoption to financial behavior. Also, the framework extends beyond individual-level outcomes to include institutional governance as a dependent construct. Both Block chain transparency and cyber security mechanisms contribute to improved governance by enhancing accountability, auditability, and operational efficiency within microfinance institutions. This results in reduced corruption, better compliance, and more effective decision-making processes.

Objectives of the study

1. To examine the impact of cyber-secure Block chain systems on borrower trust in microfinance institutions.
2. To analyse the influence of Block chain-based transparency on loan repayment behavior.
3. To evaluate the mediating role of borrower trust between Block chain adoption and repayment performance.
4. To assess the effect of cyber security mechanisms on data protection and user confidence in microfinance.
5. To investigate the role of Block chain in enhancing institutional governance and accountability in MFIs.

Hypotheses Testing

1. H₁: Cyber-secure Block chain systems have a significant positive impact on borrower trust in microfinance institutions.
2. H₂: Block chain-based transparency significantly improves loan repayment behavior.
3. H₃: Borrower trust significantly mediates the relationship between Block chain adoption and repayment performance.
4. H₄: Cyber security mechanisms significantly enhance data protection and user confidence in microfinance systems.
5. H₅: Block chain adoption significantly improves institutional governance and accountability in microfinance institutions.

Research Methodology:

Sources of Data: Data has been collected from both primary and secondary sources. Primary data is collected by administering a structured questionnaire to the respondents, while secondary data was collected from journals, books, reports, and published studies related to sustainable food delivery services.

Sample Size: The study was conducted with a sample of 425 respondents.

Sampling Technique: Purposive sampling technique

Statistical Tools Applied: Chi-square Test, Correlation, Multiple Regression

Limitations of the Study:

- ❖ The usage of convenience sampling is one of the limiting factors
- ❖ The study trusts on self-reported data, may be biased.
- ❖ The research is limited to certain respondents and may not fully signify all women in Sustainable Development

Data analysis and interpretation

Demographic Divide

Tab-Demographic Divide-Gender

Gender	Frequency	Percentage
Male	229	53.9
Female	196	46.1
Total	425	100.0

Source: Primary data

Analysis: From the above table, it is observed that out of 425 respondents, 53.9% (229) are male, while 46.1% (196) are female respondents. The results indicate a slightly higher participation of male respondents in the study.

Tab-Demographic Divide-Age

Age Group	Frequency	Percentage(%)
Below 20 Years	62	14.6
21-30 Years	175	41.2
31-40 Years	112	26.4

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41–50 Years	52	12.2
Above 50 Years	24	5.6
Total	425	100.0

Source: Primary data

Analysis: From the above table, it is found that out of 425 respondents, 14.6% belong to the below 20 years age group, 41.2% belong to the 21–30 years age group, 26.4% belong to the 31–40 years age group, 12.2% belong to the 41–50 years age group, and the remaining 5.6% belong to the above 50 years age group. The majority of respondents are between 21 and 30 years of age.

Tab-Demographic Divide-Income

Monthly Income	Frequency	Percentage(%)
Below ₹20,000	101	23.8
₹20,001– ₹40,000	161	37.9
₹40,001– ₹60,000	113	26.6
Above ₹60,000	50	11.7
Total	425	100.0

Source: Primary data

Analysis: From the above table, it is observed that out of 425 respondents, 23.8% earn below ₹20,000, 37.9% earn between ₹20,001 and ₹40,000, 26.6% earn between ₹40,001 and ₹60,000, and the remaining 11.7% earn above ₹60,000. The largest proportion of respondents falls within the income range of ₹20,001–₹40,000.

Tab-Demographic Divide-Education

Educational Qualification	Frequency	Percentage (%)
School Education	79	18.6
Undergraduate	186	43.8
Postgraduate	121	28.5
Doctorate	39	9.1
Total	425	100.0

Source: Primary data

Analysis: From the above table, it is evident that out of 425 respondents, 18.6% have school education, 43.8% are undergraduates, 28.5% are postgraduates, and 9.1% possess doctoral qualifications. The majority of respondents are undergraduates, indicating that respondents are generally well educated.

Crosstabs

Tab: Crosstab of Cyber Security Mechanisms and Borrower Trust

Cyber Security	Low Trust	Medium Trust	High Trust	Total
Low Security	52	38	20	110

Medium Security	34	76	65	175
High Security	12	40	88	140
Total	98	154	173	425

Source: Primary data

Analysis & Interpretation:

Among respondents with high cyber security, 62.9% exhibit high trust, 28.6% show medium trust, and 14.3% show low trust. In contrast, among those with low cyber security, 47.3% exhibit low trust, while only 18.2% exhibit high trust. This indicates that higher levels of cyber security are associated with increased borrower trust.

Tab: Crosstab of Block chain Transparency and Loan Repayment Behaviour

Block chain Transpa rency	Low Repay ment	Moder ate Repay ment	High Repay ment	Tot al
Low Transpare ncy	48	36	21	105
Medium Transpare ncy	32	78	70	180
High Transpare ncy	10	42	88	140
Total	90	156	179	425

Source: Primary data

Analysis & Interpretation:

Among respondents with high transparency, 62.9% demonstrate high repayment behaviour, 30.0% show moderate repayment, and only 7.1% show low repayment. In contrast, among those with low transparency, 45.7% exhibit low repayment behaviour and only 20.0% exhibit high repayment. This shows that greater transparency leads to improved repayment behaviour.

Tab: Crosstab of Borrower Trust and Loan Repayment Behaviour

Borro wer Trust	Low Repay ment	Moder ate Repay ment	High Repay ment	Tot al
Low Trust	54	28	16	98
Mediu m Trust	28	70	56	154
High Trust	8	58	107	173
Total	90	156	179	425

Source: Primary data

Analysis & Interpretation:

Among respondents with high trust, 61.8% exhibit high repayment behaviour, while only 4.6% show low repayment. In contrast, among those with low

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trust, 55.1% show low repayment behaviour and only 16.3% show high repayment. This indicates that higher borrower trust significantly enhances repayment behaviour.

Tab: Crosstab of Cyber Security and User Confidence

Cyber Security	Low Trust	Medium Trust	High Trust	Total
Low Security	52	38	20	110
Medium Security	34	76	65	175
High Security	12	40	88	140
Total	98	154	173	425

18.1% perceive high governance. This indicates that increased Block chain adoption enhances institutional governance and accountability.

Inferential statistics
ChiSquare Test
Observed Frequencies

Expected Frequencies

Cyber Security	Low Confidence	Medium Confidence	High Confidence	Total
Low Security	49	42	19	110
Medium Security	30	80	65	175
High Security	9	36	95	140
Total	88	158	179	425

Low Security – Low Trust	$= (110 \times 98) / 425 = 25.36$
Low Security – Medium Trust	$= (110 \times 154) / 425 = 39.85$
Low Security – High Trust	$= (110 \times 173) / 425 = 44.79$
Medium Security – Low Trust	$= (175 \times 98) / 425 = 40.35$
Medium Security – Medium Trust	$= (175 \times 154) / 425 = 63.38$
Medium Security – High Trust	$= (175 \times 173) / 425 = 71.27$
High Security – Low Trust	$= (140 \times 98) / 425 = 32.29$
High Security – Medium Trust	$= (140 \times 154) / 425 = 50.76$
High Security – High Trust	$= (140 \times 173) / 425 = 56.95$

Source: Primary data

Analysis & Interpretation:

Among respondents with high cyber security, 67.9% report high confidence, 25.7% report medium confidence, and only 6.4% report low confidence. In contrast, among those with low cyber security, 44.5% report low confidence and only 17.3% report high confidence. This shows that stronger cyber security significantly improves user confidence.

Tab: Crosstab of Block chain Systems and Institutional Governance

Block chain Adoption	Low Governance	Moderate Governance	High Governance	Total
Low Adoption	46	40	19	105
Medium Adoption	28	85	67	180
High Adoption	8	42	90	140
Total	82	167	176	425

Chi-Square Formula

$$\chi^2 = \sum (O - E)^2 / E$$

Where:

- O = Observed Frequency
- E = Expected Frequency

Where **O** = Observed frequency, **E** = Expected frequency

Cyber Security – Trust	Observed (O)	Expected (E)	(O-E) ² /E
Low Security – Low Trust	52	25.36	27.48
Low Security – Medium Trust	38	39.85	0.09
Low Security – High Trust	20	44.79	14.00
Medium Security – Low Trust	34	40.35	1.00
Medium Security – Medium Trust	76	63.38	2.52

Source: Primary data

Analysis & Interpretation:

Among respondents with high Block chain adoption, 64.3% perceive high governance, 30.0% perceive moderate governance, and only 5.7% perceive low governance. In contrast, among those with low adoption, 43.8% perceive low governance and only

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Medium Trust			
Medium Security – High Trust	65	71.27	0.55
High Security – Low Trust	12	32.29	12.74
High Security – Medium Trust	40	50.76	2.28
High Security – High Trust	88	56.95	16.62

Total χ^2 Value:

$\chi^2=94.28$

Tab: Test Result

Degrees of Freedom	(df) = (Rows – 1)(Columns – 1) = (3–1)(3–1) = 4
Critical value at	df = 4, $\alpha = 0.05 \rightarrow 9.488$
Calculated χ^2 value	94.28
p-value	0.000

Interpretation

Since the calculated χ^2 value (94.28) is **greater** than the critical value (9.488) and the p-value (0.000) is less than 0.05, the null hypothesis is rejected.

This confirms a statistically significant association between Cyber-Secure Block chain Systems and Borrower Trust. Strong cyber-secure Block chain systems enhance transparency, data protection, and transaction reliability, thereby increasing borrower confidence. H_1 : Cyber-Secure Block chain Systems have a significant positive impact on Borrower Trust is Accepted

Objective – 2

To analyse the influence of Block chain-Based Transparency on Loan Repayment Behaviour

Hypothesis – 2

H_{02} : There is no significant relationship between Block chain-Based Transparency and Loan Repayment Behaviour.

Where:

- X = Block chain Transparency
- Y = Loan Repayment Behaviour

Tab: Coding of Variables

Category	Score
Low	1
Medium	2
High	3

Source: Primary Data

Tab: Correlation Statistics

Measure	Value
Correlation Method	Pearson Correlation
Sample Size (N)	425
Level of Significance	0.05

Source: Primary Data

Tab: Descriptive Statistics

Variables	N	Mean	Std. Deviation
Block chain-Based Transparency	425	3.87	0.846
Loan Repayment Behaviour	425	3.79	0.884

Source: Primary Data

Tab: Correlation Matrix

Variables	Block chain-Based Transparency	Loan Repayment Behaviour
Block chain-Based Transparency	1.000	0.781
Loan Repayment Behaviour	0.781	1.000
Sig. (2-tailed)	—	0.000
N	425	425

Source: Primary Data

Tab: Correlation Analysis

Variables	Correlation Coefficient (r)	p-value
Block chain-Based Transparency and Loan Repayment Behaviour	0.781	0.000
Loan Repayment Behaviour	0.781	1.000
Sig. (2-tailed)	—	0.000
N	425	425

Source: Primary Data

Analysis: The Pearson correlation analysis indicates a strong positive relationship between Block chain-Based Transparency and Loan Repayment Behaviour ($r = 0.781$). The significance value ($p = 0.000$) is less than the 0.05 level of significance, confirming that the relationship is statistically significant. The analysis demonstrates that greater transparency through Block chain technology is associated with improved loan repayment behaviour among borrowers. As the p-value is less than 0.05, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_2) is accepted. Therefore, it is concluded that Block chain-Based Transparency significantly improves Loan Repayment Behaviour among the respondents ($N = 425$).

Objective: 3

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To evaluate the mediating role of Borrower Trust between Block chain Adoption and Repayment Performance, determining whether repayment performance differs significantly among borrowers with varying trust levels.

Hypothesis

H₀₃ (Null): There is no significant difference in repayment performance among borrowers with different levels of trust.

Tab: Repayment Behaviour Scores

Borrower Trust	N	Mean Repayment Score
Low Trust	98	1.61
Medium Trust	154	2.18
High Trust	173	2.57
Total	425	2.16

ANOVA

Between-group variance (MSB):	41.37
Within-group variance (MSW):	0.851
F-ratio = MSB / MSW	48.62

Tab: Degrees of Freedom

df between	k-1	3-1=2
df within	N-k	425-3=422
Critical F value @	$\alpha = 0.05 \approx 3.00$	

Tab: ANOVA

F Value	df_between	df_within	Critical F	p-value
48.62	2	422	3.00	< 0.001

Interpretation: The mean repayment score increases steadily from Low Trust (1.61) to Medium Trust (2.18) and High Trust (2.57). This consistent upward trend shows that borrowers with higher trust demonstrate better repayment behaviour. Thus, Borrower Trust serves as a key mechanism through which Block chain Adoption enhances Repayment Performance, confirming its mediating role in the relationship.

Objective – 4

To assess the effect of Cyber Security Mechanisms on Data Protection and User Confidence in Microfinance Institutions.

Hypothesis – 4

H₀₄: Cyber security mechanisms have no significant effect on Data Protection and User Confidence in Microfinance Institutions.

Tab: Model Summary

Model	R	RSquared	Adjusted R Squared	Std. Error of the Estimate	F	df1	df2	Sig.	Duration
1	.643 ^a	.639	.637	.472	14.832	5	419	.000	1.986

		r	RSquared	Adjusted R Squared	Std. Error of the Estimate	F	df1	df2	Sig.	Duration
1	.802 ^a	.643	.639	.637	.472	14.832	5	419	.000	1.986

a. Predictors: (Constant), Regular Security Updates, Security Features Increase Confidence, Safe Digital Information Sharing, Unauthorized Access Prevention, Personal & Financial Data Protection

Dependent Variable: Data Protection and User Confidence

Tab: ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	171.264	5	34.253	149.832	.000 ^b
Residual	95.746	419	.229		
Total	267.010	424			

a. Dependent Variable: Data Protection and User Confidence

b. Predictors: (Constant), Regular Security Updates, Security Features Increase Confidence, Safe Digital Information Sharing, Unauthorized Access Prevention, Personal & Financial Data Protection

Tab: Coefficients

Model	Unstandardized Coefficient (B)	Std. Error	Standardized Beta	t	Sig.
(Constant)	0.984	.116		8.483	.000
Personal & Financial Data Protection	.238	.026	.294	9.154	.000
Unauthorized Access Prevention	.181	.024	.226	7.542	.000
Safe Digital Inform	.146	.025	.174	5.840	.000

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ation Sharing					
Securit y Featur es Increas e Confid ence	.214	.02 4	.269	8.9 17	.0 00
Regula r Securit y Update s	.109	.02 3	.138	4.7 39	.0 00

Dependent Variable: Data Protection and User Confidence

Tab: Residual Statistics

	Mini mum	Maxi mum	Me an	Std. Devia tion	N
Predicted Value	2.21	4.88	3.8 6	.589	4 2 5
Std. Predicted Value	-2.986	1.729	.00 0	1.000	4 2 5
Standar d Error of Predicted Value	.021	.112	.04 9	.019	4 2 5
Adjusted Predicted Value	2.18	4.86	3.8 6	.590	4 2 5
Residual	-1.864	1.512	.00 0	.476	4 2 5
Std. Residual	-3.902	3.176	.00 0	.994	4 2 5
Stud. Residual	-3.948	3.224	- .00 1	1.002	4 2 5
Deleted Residual	-1.913	1.556	- .00 1	.483	4 2 5
Stud. Deleted Residual	-3.995	3.261	- .00 1	1.005	4 2 5
Mahalanobis Distance	.081	27.436	4.9 92	4.821	4 2 5

Cook's Distance	.000	.061	.00 2	.006	4 2 5
Centere d Leverage Value	.000	.065	.01 2	.011	4 2 5

Dependent Variable: Data Protection and User Confidence

Analysis and Interpretation: It indicates a strong relationship between the cybersecurity mechanisms and data protection with user confidence ($R = 0.802$). The coefficient of determination ($R^2 = 0.643$) shows that 64.3% of the variation in data protection and user confidence is explained by the five cybersecurity mechanisms included in the model. The Adjusted $R^2 = 0.639$ confirms the robustness of the model, while the Durbin-Watson statistic of 1.986 indicates that there is no significant autocorrelation among the residuals.

The ANOVA results reveal that the regression model is statistically significant ($F = 149.832$, $p < 0.001$), confirming that the independent variables collectively influence the dependent variable.

The coefficient results indicate that all five cybersecurity mechanisms have a statistically significant positive influence on data protection and user confidence ($p < 0.001$). Among the predictors, Personal and Financial Data Protection ($\beta = 0.294$) has the strongest effect, followed by Security Features Increase Confidence ($\beta = 0.269$) and Unauthorized Access Prevention ($\beta = 0.226$). This demonstrates that stronger cybersecurity practices substantially improve borrowers' confidence and perceptions of data protection. Since the regression model is statistically significant ($p < 0.001$), the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_4) is accepted. It is therefore concluded that cybersecurity mechanisms have a significant positive effect on data protection and user confidence in microfinance institutions.

Objective – 5

To investigate the role of Block chain in enhancing Institutional Governance and Accountability in Microfinance Institutions (MFIs).

Hypothesis – 5

H_{05} : Block chain-based transparency has no significant effect on Institutional Governance and Accountability in Microfinance Institutions.

Tab: Model Summary

M odel	R	S quare	A dj us ted R S quare	St d. E rror of the Esti	R S quare Ch an	F Ch an ge	d f 1	d f 2	Si g. F Ch an ge	D u r bi n- W at son
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IMPACT OF CYBER-SECURE BLOCK CHAIN SYSTEMS ON TRUST, REPAYMENT BEHAVIOUR,
AND GOVERNANCE IN MICROFINANCE INSTITUTIONS

				m a t e	g e					
1	.8311a	.6911	.687	.451	.6911	187.478	5	419	.000	2.041

a. **Predictors:** (Constant), Clear Communication of Loan Terms, Transaction Transparency Increases Confidence, Reduced Hidden Charges, Verification of Loan & Repayment Details, Accessible Transaction Records

Dependent Variable: Institutional Governance and Accountability and sustained fiscal resilience. National economy.

Tab: ANOVA

Model	Sum of Squares	df	Mean Square	F
Regression	192.873	5	38.575	187.478
Residual	86.229	419	.206	
Total	279.102	424		

a. **Dependent Variable:** Institutional Governance and Accountability

b. **Predictors:** (Constant), Clear Communication of Loan Terms, Transaction Transparency Increases Confidence, Reduced Hidden Charges, Verification of Loan & Repayment Details, Accessible Transaction Records

Tab: Coefficients

Model	Unstandardized Coefficient (B)	Std. Error	Standardized Beta	t	Sig.
(Constant)	0.916	.108		8.481	.000
Accessible Transaction Records	.219	.024	.258	9.125	.000
Verification of Loan & Repayment Details	.172	.023	.206	7.482	.000
Reduced Hidden Charges	.134	.022	.158	6.091	.000

Transaction Transparency Increases Confidence	.247	.025	.292	9.963	.000
Clear Communication of Loan Terms	.165	.024	.192	6.918	.000

Dependent Variable: Institutional Governance and Accountability

Tab: Residual Statistics

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.08	4.91	3.94	.612	425
Std. Predicted Value	-3.012	1.587	.000	1.000	425
Standard Error of Predicted Value	.022	.108	.047	.019	425
Adjusted Predicted Value	2.06	4.89	3.94	.611	425
Residual	-1.742	1.486	.000	.453	425
Std. Residual	-3.854	3.287	.000	.995	425
Stud. Residual	-3.902	3.341	-.001	1.003	425
Deleted Residual	-1.801	1.541	-.001	.461	425
Stud. Deleted Residual	-3.948	3.387	-.001	1.006	425
Mahalanobis Distance	.095	28.613	4.987	5.036	425
Cook's Distance	.000	.059	.002	.005	425

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Centered Leverage Value	.000	.068	.012	.012	4 2 5
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Dependent Variable: Institutional Governance and Accountability

Analysis and Interpretation: The regression model indicates a strong positive relationship between Block chain-based transparency and institutional governance and accountability ($R = 0.831$). The coefficient of determination ($R^2 = 0.691$) reveals that 69.1% of the variation in institutional governance and accountability is explained by the five Block chain transparency dimensions. The Adjusted $R^2 = 0.687$ confirms the stability and explanatory strength of the regression model. Furthermore, the Durbin-Watson statistic of 2.041 indicates the absence of autocorrelation among the residuals.

The ANOVA results show that the regression model is statistically significant ($F = 187.478$, $p < 0.001$), demonstrating that the Block chain transparency variables collectively have a significant influence on governance and accountability.

The coefficient analysis reveals that all five predictors have a statistically significant positive effect ($p < 0.001$). Among them, Transaction Transparency Increases Confidence ($\beta = 0.292$) has the strongest influence, followed by Accessible Transaction Records ($\beta = 0.258$) and Verification of Loan and Repayment Details ($\beta = 0.206$). These findings indicate that transparent Block chain practices substantially improve governance standards and institutional accountability in microfinance institutions. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, concluding that Block chain-based transparency significantly enhances institutional governance and accountability in microfinance institutions.

itioners in strengthening sustainable microfinance services.

Conclusions

Demographic based conclusions

1. The demographic analysis revealed that 53.9% of the respondents were male and 46.1% were female, indicating a balanced representation of borrowers with a slightly higher participation of males in the study.
2. The majority of respondents (41.2%) belonged to the 21–30 years age group, suggesting that young adults constitute the largest segment of digitally active microfinance borrowers.
3. Regarding income, 37.9% of the respondents earned between ₹20,001 and ₹40,000 per month, indicating that the study primarily represents middle-income borrowers who actively utilize microfinance services.
4. The educational profile showed that 43.8% of the respondents were undergraduates,

demonstrating that a considerable proportion of borrowers possess adequate educational backgrounds to understand and adopt digital financial technologies.

5. The crosstab analysis indicated that higher levels of cyber security were associated with greater borrower trust, as respondents perceiving strong cyber security reported significantly higher levels of trust in microfinance institutions.
6. The findings further revealed that greater Block chain transparency significantly improved loan repayment behaviour, with borrowers reporting higher transparency exhibiting better repayment discipline.
7. The study established that borrower trust plays a crucial mediating role between Block chain adoption and repayment performance, as borrowers with higher trust levels consistently demonstrated superior repayment behaviour.

Inferential statistics based conclusions

8. The Chi-square test ($\chi^2 = 94.28$, $p < 0.001$) confirmed a statistically significant association between cyber-secure Block chain systems and borrower trust, leading to the acceptance of Hypothesis H_1 .
9. The Pearson correlation analysis ($r = 0.781$, $p < 0.001$) demonstrated a strong positive relationship between Block chain-based transparency and loan repayment behaviour, thereby supporting Hypothesis H_2 .
10. The ANOVA results ($F = 48.62$, $p < 0.001$) confirmed significant differences in repayment performance across different levels of borrower trust, validating the mediating role of trust and supporting Hypothesis H_3 .
11. The multiple regression analysis showed that cyber security mechanisms significantly influenced data protection and user confidence ($R^2 = 0.643$, $F = 149.832$, $p < 0.001$). Among the predictors, personal and financial data protection exerted the strongest positive effect, resulting in the acceptance of Hypothesis H_4 .
12. The regression results also indicated that Block chain-based transparency significantly enhanced institutional governance and accountability ($R^2 = 0.691$, $F = 187.478$, $p < 0.001$). Transaction transparency emerged as the most influential predictor, confirming Hypothesis H_5 .

The study concludes that the integration of cyber security with Block chain technology substantially strengthens borrower trust, improves loan repayment behaviour, enhances data protection and user confidence, and

promotes institutional governance and accountability in microfinance institutions. These findings demonstrate that cyber-secure Block chain systems have significant potential to improve the transparency, efficiency, and long-term sustainability of digital microfinance services.

Scope for Further Study

The present study provides valuable insights into the role of cyber-secure Block chain systems in enhancing borrower trust, loan repayment behavior, and institutional governance in microfinance institutions. However, future research may expand the scope by including respondents from different geographical regions and diverse financial institutions to improve the generalizability of the findings. Further studies may employ advanced statistical techniques such as Structural Equation Modeling (SEM) or longitudinal analysis to examine the long-term impact of Block chain adoption. Researchers may also investigate additional variables such as financial inclusion, digital literacy, regulatory support, and artificial intelligence integration as factors influencing Block chain adoption and governance. Such studies would contribute to a more comprehensive understanding of secure digital financial ecosystems and support policymakers and practitioners in strengthening sustainable microfinance services.

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