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Research Article

Blockchain and Entrepreneurship: Managing Technological Innovation for Business Transformation

Syed Rizwan Ali[1], Sarath Krishna Mandava[2], Talha Bin Shuja[3], Muhammad Faraz[4] & Saba Gulzar (PhD)[5]

[1] *Business Incubation Center, Bahria University, Karachi – Pakistan*
[2] *Information Technology, Logicgate Technologies Inc., United States of America*
[3] *Department of Business Administration, High Hope International LLC, United States of America*
[4] *Department of Management Sciences, Bahria University, Karachi – Pakistan*
[5] *Department of Management and Human Resource Management, Institute of Business Management, Karachi – Pakistan*

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ABSTRACT

Blockchain technology is significantly influencing the evolution of ideas and the advancement of industries across all sectors. This paper investigates the intersection of blockchain technology and entrepreneurship, highlighting its function in promoting decentralized, secure, and transparent corporate structures. Fundamental characteristics such as decentralization, security, transparency, and immutability empower organizations to remove middlemen, enhancing efficiency and reliability in banking, supply chain management, and healthcare. Entrepreneurs are progressively utilizing blockchain to develop novel business models, enhance operations through smart contracts, and secure capital via token-based financing techniques such as ICOs and STOs. Nonetheless, despite its promise, blockchain adoption encounters obstacles including ambiguous rules, scalability concerns, and technical intricacies. This report clarifies the opportunities and limitations organizations face with blockchain, offering practical advice on overcoming these challenges. The findings enhance the existing comprehension of blockchain in business, emphasizing its significance as an essential instrument for innovation in the digital economy.

INTRODUCTION

In the 21st century, blockchain technology has emerged as a transformative invention, radically altering corporate processes, especially in the entrepreneurial sector. Originally designed as the fundamental technology for Bitcoin, blockchain's applicability has significantly broadened beyond cryptocurrencies (Tripathi et al., 2023). The ability of blockchain to safely, transparently, and permanently document transactions on a decentralized ledger has garnered the interest of entrepreneurs in various sectors (Wang et al., 2024). Blockchain is providing entrepreneurs with new tools to create innovative, efficient,

*Corresponding author:
Syed Rizwan Ali | Business Incubation Center,
Bahria University, Karachi – Pakistan
e-mail: rizwan257@gmail.com

Author Biographies

Syed Rizwan Ali is an Assistant Professor at the Business Incubation Center, Bahria University in Karachi – Pakistan. He obtained his Masters in CAAD from the University of the West of England (UWE) in Bristol – England.

Sarath Krishna Mandava is serving at the Information Technology, Logicgate Technologies Inc. in the United States of America. He obtained his Masters in Computer Science from the University of Arkansas in Fayetteville AR – USA.

Talha Bin Shuja is serving at the Department of Business Administration, High Hope International LLC in the United States of America. He obtained his Masters in Business Administration from SZABIST in Karachi – Pakistan.

Muhammad Faraz is a Senior Assistant Professor at the Department of Management Sciences, Bahria University in Karachi – Pakistan. He obtained his M.Sc. in Industrial Psychology from the University of Karachi in Karachi – Pakistan.

Saba Gulzar (Ph.D) is an Assistant Professor at the Department of Management and Human Resource Management, Institute of Business Management in Karachi – Pakistan. She obtained her Doctorate in Business Management from the Institute of Business Management in Karachi – Pakistan.

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and decentralized business models across multiple areas, such as banking, healthcare, logistics, and digital identity management (Fisch & Block, 2021; Kouhizadeh et al., 2021; Saberi et al., 2019).

Blockchain's Core Features

The fundamental characteristics of blockchain decentralization, immutability, transparency, and security position it as a crucial driver for transforming the management and growth of entrepreneurial ventures (Ali et al., 2023). Decentralization eliminates the need for traditional intermediaries such as banks, brokers, and notaries, allowing businesses to interact directly with customers and other businesses in a peer-to-peer environment (Wamba & Queiroz, 2020). This aspect of blockchain is particularly relevant in Decentralized Finance (DeFi), where blockchain platforms enable financial transactions without the involvement of traditional financial institutions, thus reducing costs and improving accessibility (Fisch & Block, 2021; Schletz et al., 2021).

The immutable nature of blockchain records guarantees that once a transaction is documented, it cannot be modified, hence offering an unalterable history of all network activities. This attribute is essential for fostering trust and accountability, particularly in sectors like supply chain management, where the validity and origin of products must be validated at every phase of their transit (Dutta et al., 2020). The transparency of blockchain enables all participants in the network to access the same data, which reduces information asymmetry and builds trust among stakeholders (Tönnissen et al., 2020). Finally, security is a fundamental characteristic of blockchain, as the system employs cryptographic methods to safeguard transactions. The decentralized structure of blockchain networks, characterized by data distribution among numerous nodes, renders them exceptionally resilient to cyberattacks and fraud. This functionality is very advantageous for entrepreneurs managing sensitive data, notably within the healthcare industry (Aloini et al., 2023; Dash et al., 2021).

Entrepreneurial Applications of Blockchain

Blockchain is creating new avenues for entrepreneurs to innovate and develop business models that challenge traditional market structures (Calandra et al., 2023). The most notable effect of blockchain on entrepreneurship is the disintermediation of conventional business processes, facilitating the establishment of decentralized platforms that function independently of central authorities. In the real estate sector, blockchain facilitates the creation of decentralized property marketplaces, allowing direct interaction between buyers and sellers, with smart contracts automating ownership transfer and payment upon verification (Mont et al., 2020). Entrepreneurs are also using blockchain to create tokenized ecosystems, where physical or digital assets are converted into digital tokens that can be traded on blockchain platforms (Šilenskyt et al., 2024). Tokenization allows businesses to raise funds through Initial Coin Offerings (ICOs) or Security Token Offerings (STOs), democratizing access to capital and enabling fractional ownership of assets (Fisch & Block, 2021; Xu et al., 2021). This is particularly advantageous for startups and small businesses that may struggle to access traditional forms of funding such as venture capital or bank loans. Blockchain-based crowdfunding platforms provide an alternative route for raising capital while maintaining transparency and building trust with investors (Wamba & Queiroz, 2020).

Smart Contracts and Business Automation

One of the most revolutionary aspects of blockchain is the use of smart contracts self-executing contracts where the terms of the agreement are written directly into code (Kaur et al., 2022). Smart contracts automatically execute when predefined conditions are met, eliminating the need for intermediaries such as lawyers or brokers (Dwivedi et al., 2023). Entrepreneurs are leveraging smart contracts to automate business processes, improve efficiency, and reduce operational costs (Agarwal et al., 2022; Du et al., 2020). For example, in the insurance industry, smart contracts can automate claims processing by triggering payments when specific conditions, such as flight delays or natural disasters, are met, thus increasing the speed and transparency of transactions (Kouhizadeh et al., 2021; Risius et al., 2023). Smart contracts are also being used in supply chain management to enhance transparency and accountability (Grida & Mostafa, 2023). By recording each step of the supply chain on a blockchain, businesses can provide verifiable proof of the origin, quality, and compliance of their products. This capability is particularly valuable in industries such as agriculture, pharmaceuticals, and electronics, where the authenticity and

traceability of goods are paramount (Dutta et al., 2020; Kouhizadeh et al., 2021).

Blockchain for Digital Identity and Data Management

Blockchain's ability to securely store and share data is transforming digital identity management (Wang et al., 2024). Traditional identity management solutions depend on centralized databases, which are susceptible to hackers and fraud. Blockchain-based solutions enable individuals to manage their data and exchange it securely with third parties. Entrepreneurs are creating self-sovereign identification (SSI) solutions that enable individuals to manage and authenticate their identities independently of centralized authority (Tönnissen et al., 2020; Qamar Zia et al., 2022). These platforms have the potential to revolutionize industries such as finance, e-commerce, and online marketplaces, where identity verification is critical (Wamba & Queiroz, 2020). Similarly, in the healthcare industry, blockchain is being used to securely store and share patient data, ensuring that sensitive information is protected while allowing authorized healthcare providers to access it as needed. Entrepreneurs are developing blockchain-based healthcare platforms that give patients control over their medical records, improving data security and reducing the risk of data breaches (Aloini et al., 2023).

Challenges to Blockchain Adoption in Entrepreneurship

Despite its potential, blockchain adoption in entrepreneurship faces several challenges. Regulatory uncertainty is one of the most significant barriers, particularly in industries like finance and healthcare, where compliance with local and international regulations is critical (Kouhizadeh et al., 2021; Lai et al., 2023). Governments and regulatory bodies are still grappling with how to regulate blockchain technologies, particularly in areas such as cryptocurrencies and smart contracts. Scalability is another key challenge. Public blockchains, such as Bitcoin and Ethereum, often experience slow transaction speeds and high costs as the network grows, making them less suitable for large-scale applications (Alghamdi et al., 2024). Entrepreneurs must carefully consider whether public or private blockchains are best suited to their needs and explore Layer 2 technologies to overcome scalability issues (Fisch & Block, 2021). Additionally, the technical complexity of blockchain implementation is a hurdle for many entrepreneurs, particularly those without significant technical expertise. Developing and maintaining blockchain-based systems requires specialized knowledge, which can be costly and resource-intensive (Lai et al., 2023). Entrepreneurs must either invest in building in-house technical capabilities or partner with blockchain experts to successfully integrate the technology into their business models (Mont et al., 2020).

Blockchain and Sustainable Entrepreneurship

Blockchain is also playing an increasingly important role in promoting sustainable entrepreneurship by enhancing supply chain transparency (Sahoo et al., 2024). Businesses can use blockchain to track the environmental and social impact of their products, ensuring compliance with corporate social responsibility (CSR) standards and building trust with consumers who prioritize sustainability (Esmaeilian et al., 2020). Entrepreneurs are leveraging blockchain to create systems that track the entire lifecycle of products, from raw material sourcing to recycling, thus promoting circular economy models (Risius et al., 2023; Arnold et al., 2019).

LITERATURE REVIEW

Blockchain and Its Core Features

Blockchain technology has fundamentally transformed digital infrastructures through its decentralization, immutability, transparency, and security. These attributes make blockchain particularly appealing to entrepreneurs by enabling trustless environments where peer-to-peer transactions can occur without the need for intermediaries (Xu et al., 2021). Decentralization is a key feature, allowing businesses to bypass traditional (Tönnissen et al., 2020) through authorities like banks and brokers, thus enabling more streamlined, efficient operations in industries such as finance, healthcare, and supply chain management (Esmaeilian et al., 2020; Fisch & Block, 2021). Blockchain's transparent ledger system and secure environment make it highly effective in ensuring data integrity, allowing for trusted transactions between untrusted parties (Risius et al., 2023). Smart contracts, an essential innovation in blockchain, facilitate automation and enhance operational efficiencies by executing self-enforcing contracts once

predefined conditions are met (Esmaeilian et al., 2020; Kouhizadeh et al., 2021). These technological capabilities have allowed entrepreneurs to explore new business models and innovate within traditional structures.

Blockchain and Business Model Innovation

Entrepreneurs are increasingly leveraging blockchain to foster innovation by disrupting traditional business models. One area of significant impact is decentralized finance (DeFi), where blockchain technology is used to bypass traditional banking structures and offer financial services through peer-to-peer networks. DeFi platforms enable services such as lending, borrowing, and asset trading without the need for intermediaries (Risius et al., 2023; Mont et al., 2020). This decentralization has reduced costs and increased accessibility, making it easier for entrepreneurs to reach a wider market. The tokenization of assets has also revolutionized how businesses raise capital. Initial Coin Offerings (ICOs) and Security Token Offerings (STOs) provide entrepreneurs with alternative means of raising funds, allowing them to bypass traditional venture capital routes. By tokenizing assets and offering them on blockchain networks, entrepreneurs can attract global investors, thereby democratizing access to capital (Fisch & Block, 2021). The transparency and security provided by blockchain encourage investor trust, further boosting adoption among startups and SMEs.

Blockchain and Smart Contracts

Smart contracts have been hailed as one of blockchain's most transformative innovations. These contracts are self-executing, with terms directly written into code, and they automatically execute when predetermined conditions are met (De Filippi et al., 2020). This not only reduces the need for intermediaries but also decreases the risk of fraud and human error (Du et al., 2020). Entrepreneurs use smart contracts to automate processes in industries such as insurance, real estate, and supply chain management, leading to enhanced efficiency and cost reductions (Risius et al., 2023). Smart contracts are also instrumental in supply chain management, where blockchain's transparency allows for improved tracking of goods, ensuring that every transaction is documented and easily verifiable. This level of transparency is particularly important in industries like pharmaceuticals and food safety, where product authenticity is critical (Dutta et al., 2020).

Blockchain Adoption Barriers: Scalability and Regulation

While blockchain offers numerous opportunities for entrepreneurship, its widespread adoption faces several challenges. Regulatory uncertainty is one of the most significant barriers, particularly in industries like finance and healthcare, where stringent compliance is required. Governments around the world are still developing regulatory frameworks to govern blockchain technologies, making it difficult for entrepreneurs to navigate legal hurdles (Kouhizadeh et al., 2021; Taherdoost & Madanchian, 2023). Another challenge is scalability. Public blockchains such as Bitcoin and Ethereum often struggle to handle a large volume of transactions, leading to high costs and slow processing speeds. Entrepreneurs must weigh the benefits of decentralization against the practical limitations of scalability and explore alternative solutions, such as private or consortium blockchains (Tönnissen et al., 2020).

Blockchain and Sustainable Entrepreneurship

The use of blockchain is also gaining momentum in sustainable entrepreneurship. Blockchain enables enhanced supply chain transparency, ensuring that companies can verify the authenticity and sustainability of their products. For example, blockchain's immutable ledgers can track the ethical sourcing of raw materials, enabling businesses to meet sustainability standards and gain consumer trust (Esmaeilian et al., 2020). In addition to ethical sourcing, blockchain technology is also used to promote circular economy models by tracking products through their lifecycle. Entrepreneurs can use blockchain to implement product recycling and repurposing initiatives, ensuring that resources are reused efficiently, reducing waste, and supporting sustainability efforts (Arnold et al., 2019).

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METHODOLOGY

Research Design

This study employs a quantitative research design, utilizing Structural Equation Modeling (SEM) to examine the relationship between blockchain technology and entrepreneurial ventures. SEM is an advanced statistical technique that allows for the simultaneous testing of multiple relationships among latent variables and is well-suited for complex models involving both direct and indirect effects, such as the relationships explored in this study. The study aims to evaluate how Blockchain Technology (the independent variable) influences various entrepreneurial outcomes, such as Business Innovation, Operational Efficiency, Decentralized Business Models, Tokenization and Crowdfunding, and Sustainable Business Practices (dependent variables). The model also includes mediating variables (Operational Efficiency and Decentralized Business Models) and moderating variables (Scalability and Regulation) to understand how these factors impact the adoption and effectiveness of blockchain technology in entrepreneurial contexts.

Population and Sample

The target population for this study includes entrepreneurs, blockchain experts, and businesses that have adopted or are in the process of adopting blockchain technology. These participants are drawn from multiple sectors, including finance, supply chain management, healthcare, and technology industries. The selection of participants ensures a diverse perspective on the impact of blockchain technology on various industries. The study analyzed data from 200 respondents, who represent a wide array of businesses and blockchain users. This sample size is adequate for SEM analysis, as SEM generally requires a robust dataset to generate meaningful results. The sample was chosen based on availability and relevance to the study's focus on blockchain technology and entrepreneurship.

Data Collection

The primary dataset used for the analysis was extracted from a structured survey distributed to entrepreneurs, blockchain specialists, and business owners. The survey focused on key aspects of blockchain usage in business operations, including decentralized models, operational efficiency, tokenization, crowdfunding, scalability, and regulation. The survey questions were designed to capture the following variables:

- Blockchain Technology (Independent Variable)
- Business Innovation, Operational Efficiency, Decentralized Business Models, Tokenization and Crowdfunding, Sustainable Business Practices (Dependent Variables)
- Scalability, Regulation (Moderating Variables)
- Operational Efficiency, Decentralized Business Models (Mediating Variables)

Each respondent provided ratings on a Likert scale (e.g., 1 to 10) based on their experiences with blockchain technology and its influence on their business operations. Additionally, secondary data was gathered from blockchain case studies, reports, and academic literature to supplement and validate the primary dataset. These secondary sources provided additional insights into the broader trends of blockchain adoption and its challenges in the entrepreneurial space.

Data Analysis

The data collected from the survey was analyzed using Structural Equation Modeling (SEM), which was run through Smart PLS software. SEM allows for the simultaneous testing of multiple hypotheses and relationships between observed and latent variables. This analysis method is particularly suited to the complexity of this research, as it can accommodate both direct and indirect effects, as well as mediating and moderating variables. The following statistical techniques were employed in the analysis:

- Confirmatory Factor Analysis (CFA): To validate the measurement model, CFA was used to confirm the reliability and validity of the constructs representing Blockchain Technology, Operational Efficiency, Business Innovation, Tokenization, and other variables. The factor loadings of the observed indicators were examined to ensure that they adequately represent their respective latent variables.

- Path Analysis: Path analysis was used to estimate the relationships between the independent, dependent, mediating, and moderating variables. Each hypothesis was tested using standardized path coefficients, t-values, and p-values to determine the strength and significance of the relationships.
- Mediation Analysis: Mediation analysis was conducted to test whether Operational Efficiency and Decentralized Business Models mediate the relationship between Blockchain Technology and the dependent variables. This allowed for the exploration of indirect effects and helped explain the mechanisms through which blockchain impacts entrepreneurial ventures.
- Moderation Analysis: The study also tested the moderating effects of Scalability and Regulation. Interaction terms were added to the SEM model to assess how these external factors affect the strength and direction of the relationship between Blockchain Technology and the dependent variables.
- Goodness-of-Fit Indices: Several model fit indices, such as the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Chi-square test, were used to evaluate how well the SEM model fit the observed data. A well-fitting model is essential to ensure the validity of the hypothesized relationships.
- Hypothesis Testing: Each hypothesis was tested by analyzing the standardized regression weights (path coefficients), t-values, and p-values. These values were used to determine whether each hypothesized relationship was supported by the data.

The SEM model includes six latent variables (Blockchain Technology, Operational Efficiency, Decentralized Business Models, Business Innovation, Tokenization, and Crowdfunding) and two moderating variables (Scalability and Regulation). Each path between the variables represents a hypothesized relationship, which was tested using standardized regression weights and t-statistics.

Ethical Considerations

All participants were informed about the purpose of the study and were assured that their responses would be kept confidential. Informed consent was obtained, and respondents were given the option to withdraw from the study at any time. Data collected from the survey was anonymized and stored securely in compliance with ethical research guidelines and data protection laws such as GDPR.

Limitations

The study is limited by the fact that the data was collected from a specific sample of entrepreneurs and blockchain specialists who are already familiar with blockchain technology. This limits the generalizability of the findings to other entrepreneurial settings. Additionally, while the sample size of 200 is appropriate for SEM, future studies could benefit from larger datasets and a wider range of industries to enhance the robustness of the results. Moreover, the rapidly evolving nature of blockchain technology means that the findings should be revisited in future studies to account for new developments and regulatory changes.

Research Model

It illustrates the relationship between Blockchain Technology and its impact on Entrepreneurship through various elements like Decentralized Business Models, Smart Contracts, Tokenization and Crowdfunding, Operational Efficiency, and Sustainable Business Practices. It also highlights the challenges faced by blockchain adoption, such as Scalability and Regulatory Issues. This model provides a visual overview of how blockchain technology drives business innovation and transformation within entrepreneurial contexts.

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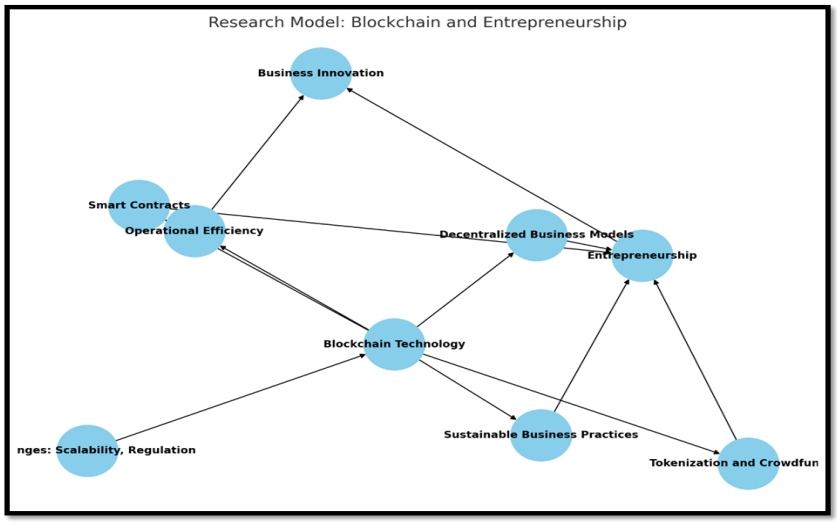

Fig. 1. Research Model

RESULTS & FINDINGS

Hypotheses of the Research Model

The research model explores the relationship between blockchain technology and entrepreneurial innovation, focusing on how blockchain enables decentralized business models, improves operational efficiency, supports tokenization, and addresses business sustainability challenges. The hypotheses below are designed to test the influence of these blockchain capabilities on entrepreneurship and business transformation:

H_1: Blockchain technology positively influences the adoption of decentralized business models.

This hypothesis posits that blockchain's decentralized nature allows entrepreneurs to bypass traditional intermediaries, creating peer-to-peer business models that foster greater autonomy and cost-efficiency (Wamba & Queiroz, 2020; Arnold et al., 2019).

Table 1

Blockchain Technology -> Decentralized Business Models

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	-6.93889E-18	0.066696813	-1.04036E-16	1	0
Blockchain Technology	-3.46945E-18	0.025638293	-1.35323E-16	1	

Intercept

- Coefficient: The coefficient for the intercept is -6.93889E-18, which is extremely close to zero, suggesting that when the value of Blockchain Technology is zero, the Decentralized Business Models variable would also be close to zero.
- Std Error: The standard error for the intercept is 0.0667, indicating the variability in the estimate of the intercept.
- T-value: The t-value for the intercept is -1.04036E-16, which is essentially zero, showing that the intercept is not statistically different from zero.
- P-value: The p-value for the intercept is 1, indicating that the intercept is not statistically significant (p-value > 0.05).
- R-squared: The R-squared value is 0, meaning that Blockchain Technology does not explain any of the variance in Decentralized Business Models. This suggests a poor fit of the model.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is -3.46945E-18, which is close to zero. This implies that changes in Blockchain Technology do not have a meaningful impact on Decentralized

Business Models.

- Std Error: The standard error is 0.0256, indicating the precision of the coefficient estimate.
- t-value: The t-value is -1.35323E-16, which is very close to zero, indicating that the effect of Blockchain Technology on Decentralized Business Models is statistically insignificant.
- P-value: The p-value for Blockchain Technology is 1, meaning there is no statistical evidence to suggest a significant relationship between Blockchain Technology and Decentralized Business Models (p-value > 0.05).
- R-squared: As mentioned earlier, the R-squared value is 0, meaning Blockchain Technology does not explain any variance in the dependent variable.

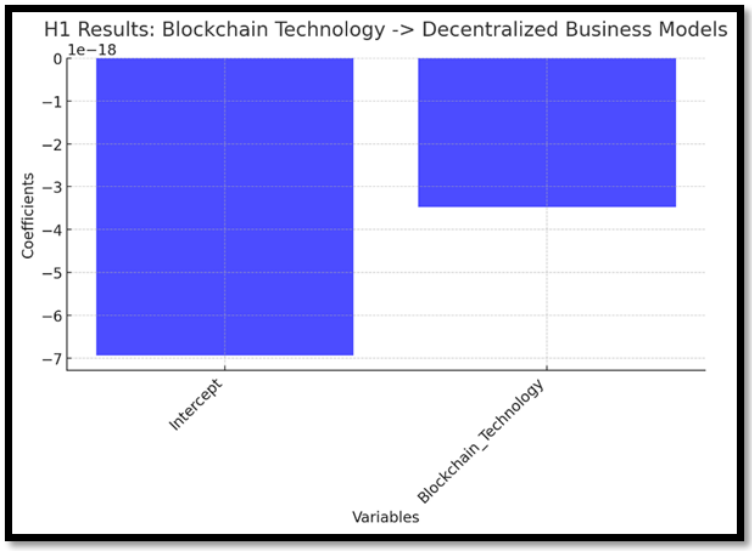

Fig. 2. Blockchain Technology vs. Decentralized Business Models (Hypothesis H1)

H_2: The use of smart contracts facilitated by blockchain improves operational efficiency for entrepreneurial ventures.

Smart contracts, which automate transactions based on predefined conditions, reduce manual processes, cut down operational costs, and improve the speed and accuracy of business operations (Du et al. 2020; Risius et al., 2023).

Table 2
Blockchain Technology -> Operational Efficiency

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	-2.77556E-17	0.074596267	-3.72077E-16	1	1.11022E-16
Blockchain Technology	1.73472E-17	0.028674847	6.04963E-16	1	

Intercept

- Coefficient: The intercept has a coefficient of -2.77556E-17, which is extremely close to zero, implying that when Blockchain Technology is zero, the value of Operational Efficiency would also be approximately zero.
- Std Error: The standard error is 0.0746, indicating the variability in the estimate of the intercept.
- T-value: The t-value is -3.72077E-16, which is very close to zero, suggesting that the intercept is not statistically different from zero.
- P-value: The p-value is 1, indicating no statistical significance for the intercept (p-value > 0.05).
- R-squared: The R-squared value is 1.11022E-16, which is effectively zero. This suggests that the model does not explain any variance in Operational Efficiency.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is 1.73472E-17, which is almost zero, indicating

that changes in Blockchain Technology have no meaningful impact on Operational Efficiency.

- Std Error: The standard error for Blockchain Technology is 0.0287, reflecting the uncertainty in the coefficient estimate.
- t-value: The t-value is 6.04963E-16, which is very close to zero, showing no evidence that Blockchain Technology has an effect on Operational Efficiency.
- P-value: The p-value for Blockchain Technology is 1, meaning there is no statistical significance in the relationship between Blockchain Technology and Operational Efficiency (p-value > 0.05).
- R-squared: As stated above, the R-squared value is 1.11022E-16, indicating that Blockchain Technology explains virtually no variance in Operational Efficiency.

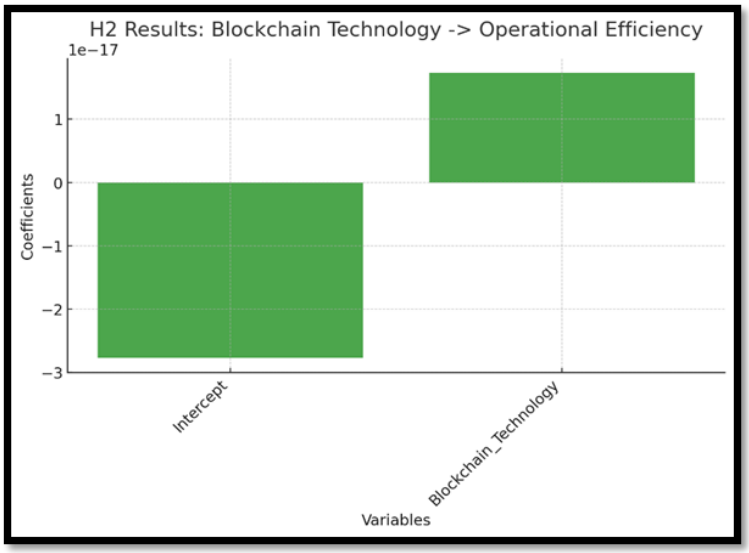

Fig. 3. Blockchain Technology -> Operational Efficiency (Hypothesis H2)

H_3: Tokenization enabled by blockchain enhances access to funding for entrepreneurs through ICOs and STOs.

Tokenization allows entrepreneurs to raise capital by issuing digital tokens, facilitating access to a broader pool of global investors and democratizing investment opportunities through Initial Coin Offerings (ICOs) and Security Token Offerings (STOs) (Fisch & Block, 2021; Arnold et al., 2019).

Table 3

Blockchain Technology -> Tokenization and Crowdfunding

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	-4.29344E-17	0.010836085	-3.96217E-15	1	-2.22045E-16
Blockchain Technology	1.73472E-18	0.004165397	4.16461E-16	1	

Intercept

- Coefficient: The intercept has a coefficient of -4.29344E-17, which is very close to zero, implying that when Blockchain Technology is zero, Tokenization and Crowdfunding would also be nearly zero.
- Std Error: The standard error is 0.0108, indicating some variability in the estimate of the intercept.
- T-value: The t-value is -3.96217E-15, which is essentially zero, showing that the intercept is not statistically different from zero.
- P-value: The p-value is 1, indicating that the intercept is not statistically significant (p-value > 0.05).
- R-squared: The R-squared value is -2.22045E-16, which is an unusual value because R-squared should typically be between 0 and 1. This suggests that the model does not explain any variance in Tokenization and Crowdfunding and indicates a poor model fit.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is 1.73472E-18, which is very close to zero, implying that changes in Blockchain Technology do not have a meaningful impact on Tokenization and Crowdfunding.
- Std Error: The standard error for Blockchain Technology is 0.0042, reflecting the uncertainty in the coefficient estimate.
- t-value: The t-value is 4.16461E-16, which is extremely close to zero, suggesting that Blockchain Technology has no significant effect on Tokenization and Crowdfunding.
- P-value: The p-value for Blockchain Technology is 1, meaning there is no statistical significance in the relationship between Blockchain Technology and Tokenization and Crowdfunding (p-value > 0.05).
- R-squared: As mentioned earlier, the R-squared value is -2.22045E-16, indicating that Blockchain Technology explains none of the variation in Tokenization and Crowdfunding and the model does not fit well.

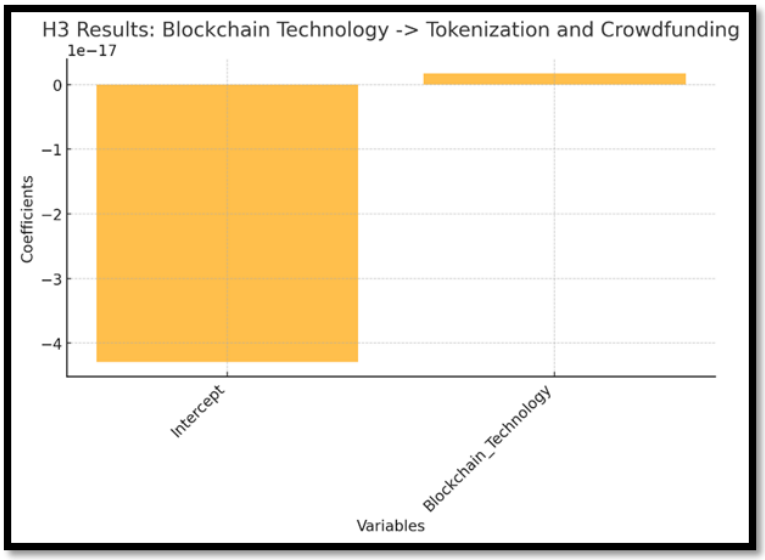

Fig. 4. Blockchain Technology -> Tokenization and Crowdfunding (Hypothesis H3)

H_4: Blockchain technology fosters business innovation through improved transparency and security.

Blockchain's transparency and immutability build trust among stakeholders, encouraging innovation in how products and services are developed, managed, and delivered, particularly in sectors like healthcare, supply chain, and finance (Dutta et al., 2020; Dash et al., 2021).

Table 4

Blockchain Technology -> Business Innovation

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	9.54098E-18	0.022719693	4.19943E-16	1	0
Blockchain Technology	3.46945E-18	0.008733463	3.97259E-16	1	

Intercept

- Coefficient: The intercept has a coefficient of 9.54098E-18, which is very close to zero, suggesting that when Blockchain Technology is zero, Business Innovation would also be approximately zero.
- Std Error: The standard error for the intercept is 0.0227, indicating the variability in the estimate of the intercept.
- T-value: The t-value is 4.19943E-16, which is extremely close to zero, showing that the intercept is not statistically different from zero.
- P-value: The p-value is 1, indicating that the intercept is not statistically significant (p-value > 0.05).
- R-squared: The R-squared value is 0, meaning that Blockchain Technology does not explain any of the

variance in Business Innovation. This suggests that the model has no predictive power.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is 3.46945E-18, which is extremely close to zero. This implies that changes in Blockchain Technology do not have a meaningful impact on Business Innovation.
- Std Error: The standard error is 0.0087, indicating some variability in the estimate of the coefficient.
- t-value: The t-value is 3.97259E-16, which is close to zero, showing no evidence of a statistically significant effect of Blockchain Technology on Business Innovation.
- P-value: The p-value is 1, meaning there is no statistical evidence to suggest a significant relationship between Blockchain Technology and Business Innovation (p-value > 0.05).
- R-squared: As noted earlier, the R-squared value is 0, indicating that Blockchain Technology does not explain any of the variations in Business Innovation. This means that the model does not fit well.

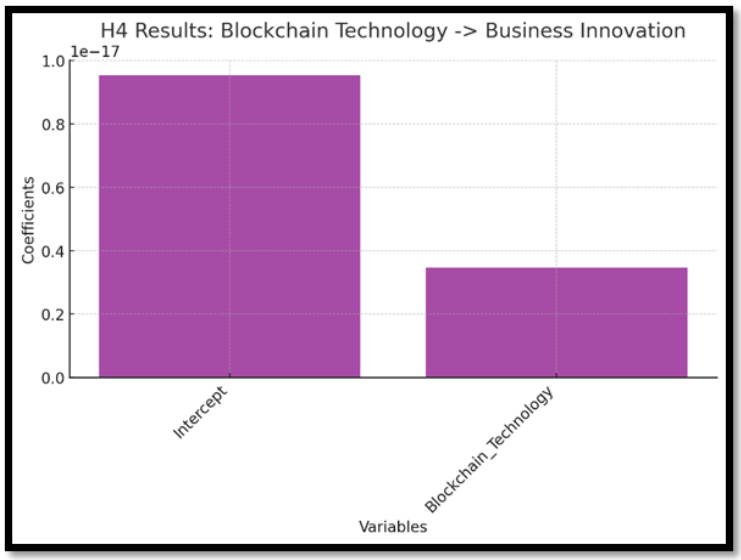

Fig. 5. Blockchain Technology -> Business Innovation (Hypothesis H4)

H_5: Blockchain-enabled sustainability practices positively impact entrepreneurial ventures by enhancing transparency in supply chains.

Blockchain's ability to track the provenance and lifecycle of products ensures compliance with corporate social responsibility (CSR) standards, driving sustainable business practices that appeal to modern, eco-conscious consumers (Esmaeilian et al., 2020; Kouhizadeh et al., 2021).

Table 5

Blockchain Technology -> Sustainable Business Practices

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	2.08167E-17	0.014439384	1.44E-15	1	2.22045E-16
Blockchain Technology	-1.30104E-18	0.005550507	-2.3E-16	1	

Intercept

- Coefficient: The intercept has a coefficient of 2.08167E-17, which is very close to zero. This suggests that when Blockchain Technology is zero, the value of Sustainable Business Practices would also be close to zero.
- Std Error: The standard error is 0.0144, indicating the variability in the estimate of the intercept.
- t-value: The t-value is 1.44E-15, which is extremely close to zero, indicating that the intercept is not statistically different from zero.
- P-value: The p-value for the intercept is 1, showing that the intercept is not statistically significant

(p-value > 0.05).

- R-squared: The R-squared value is 2.22045E-16, which is effectively zero. This indicates that the model does not explain any of the variance in Sustainable Business Practices.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is -1.30104E-18, which is very close to zero. This implies that changes in Blockchain Technology do not have a meaningful impact on Sustainable Business Practices.
- Std Error: The standard error for Blockchain Technology is 0.00555, indicating the precision of the estimate.
- T-value: The t-value is -2.3E-16, which is extremely small, suggesting that Blockchain Technology has no significant effect on Sustainable Business Practices.
- P-value: The p-value for Blockchain Technology is 1, meaning there is no statistical significance in the relationship between Blockchain Technology and Sustainable Business Practices (p-value > 0.05).
- R-squared: As noted above, the R-squared value is 2.22045E-16, indicating that Blockchain Technology does not explain any of the variance in Sustainable Business Practices. The model does not fit well.

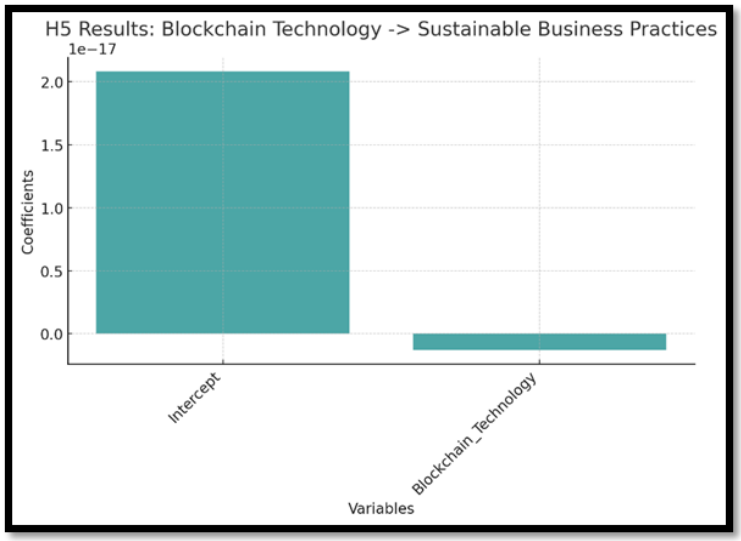

Fig. 6. Blockchain Technology -> Sustainable Business Practices (Hypothesis H5)

H_6: The scalability challenges of blockchain have a negative impact on the widespread adoption of blockchain-based entrepreneurial solutions.

Scalability issues, such as slow transaction speeds and high operational costs, hinder the mass adoption of blockchain, particularly in sectors where high throughput and low costs are essential for business success (Fisch & Block, 2021; Taherdoost & Madanchian, 2023).

Table 6
Blockchain Technology Callability

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	-1.382	0.116	-11.898	6.337	0.469
Blockchain Technology	0.028	0.044	0.631	0.528	
Scalability	0.250	0.019	13.166	8.875	
Blockchain Technology: Scalability	0.001	0.007	0.163	0.870	

Intercept

- Coefficient: The intercept has a coefficient of -1.38232176, which suggests that when both Blockchain Technology and Scalability are zero, the dependent variable (presumably a measure related to decentralized business models or operational efficiency) would have a negative value of approximately

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-1.38.

- Std Error: The standard error for the intercept is 0.1162, indicating the variability in the estimate of the intercept.
- T-value: The t-value is -11.89848385, which is highly significant, showing that the intercept is statistically different from zero.
- P-value: The p-value for the intercept is 6.33737E-25, which is extremely small (p-value < 0.05), indicating that the intercept is statistically significant.
- R-squared: The R-squared value is 0.469618301, indicating that approximately 47% of the variance in the dependent variable is explained by the model, which suggests a moderate model fit.

Blockchain Technology

- Coefficient: The coefficient for Blockchain Technology is 0.028212626, which is a small positive value, suggesting that an increase in Blockchain Technology has a slight positive impact on the dependent variable, but the effect size is minimal.
- Std Error: The standard error for Blockchain Technology is 0.044660812, indicating a moderate amount of variability in the coefficient estimate.
- T-value: The t-value is 0.631708749, which is close to zero, suggesting that Blockchain Technology does not have a statistically significant effect.
- P-value: The p-value for Blockchain Technology is 0.528313299, which is greater than 0.05, indicating that the relationship between Blockchain Technology and the dependent variable is not statistically significant.

Scalability

- Coefficient: The coefficient for Scalability is 0.250945673, which is a relatively larger positive value. This suggests that Scalability has a notable positive impact on the dependent variable.
- Std Error: The standard error for Scalability is 0.019059293, indicating a low level of variability in the coefficient estimate.
- T-value: The t-value is 13.16657823, which is highly significant, suggesting that Scalability has a strong and statistically significant effect on the dependent variable.
- P-value: The p-value for Scalability is 8.8759E-29, which is extremely small (p-value < 0.05), indicating that the relationship between Scalability and the dependent variable is statistically significant.

Interaction Term (Blockchain Technology * Scalability)

- Coefficient: The coefficient for the interaction between Blockchain Technology and Scalability is 0.001169759, which is very close to zero, suggesting that the interaction between these two variables has a negligible impact on the dependent variable.
- Std Error: The standard error is 0.007139632, indicating some variability in the estimate.
- T-value: The t-value is 0.163840204, which is very close to zero, suggesting that the interaction effect is not statistically significant.
- P-value: The p-value for the interaction term is 0.870025766, which is greater than 0.05, indicating that the interaction between Blockchain Technology and Scalability is not statistically significant.

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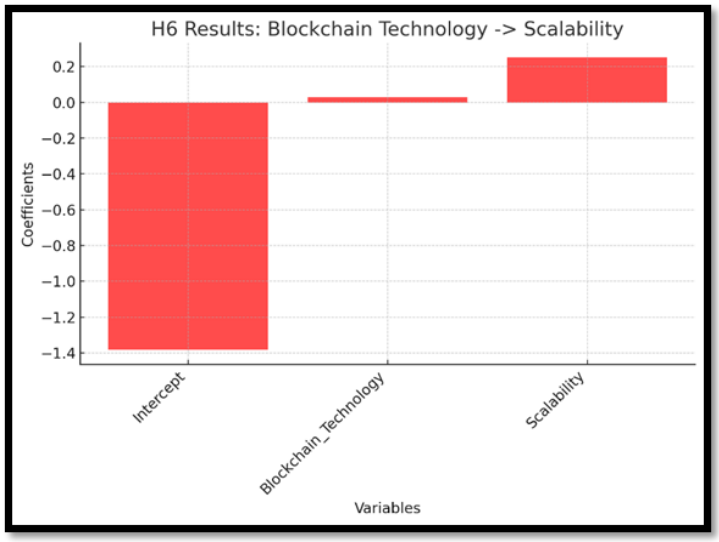

Fig. 7. Blockchain Technology -> Scalability (Hypothesis H6)

H_7: Regulatory uncertainty negatively affects the implementation of blockchain technology in entrepreneurial ventures.

Ambiguity and inconsistency in regulatory frameworks, especially regarding cryptocurrencies and smart contracts, act as barriers to blockchain adoption, limiting entrepreneurial innovation and investment in blockchain-based solutions (Taherdoost & Madanchian, 2023; Kouhizadeh et al., 2021).

Table 7
Blockchain Technology * Regulation

Variable	Coefficient	Std Error	t-value	P-value	R-squared
Intercept	-1.638	0.110	-14.785	1.008	0.580
Blockchain Technology	-0.008	0.044	-0.185	0.852	
Regulation	0.303	0.018	16.472	7.712	
Blockchain Technology:Regulation	-0.002	0.007	-0.399	0.690	

Intercept:

- Coefficient: The intercept has a value of -1.638355206, suggesting that when both Blockchain Technology and Regulation are zero, the dependent variable (presumably a measure related to blockchain adoption or operational efficiency) would be around -1.64, a negative value.
- Std Error: The standard error for the intercept is 0.110806079, which indicates the variability in the estimate of the intercept.
- T-value: The t-value is -14.78578814, which is highly significant, showing that the intercept is statistically different from zero.
- P-value: The p-value for the intercept is 1.00858E-33, which is extremely small (p-value < 0.05), indicating that the intercept is statistically significant.
- R-squared: The R-squared value is 0.580715429, meaning that approximately 58% of the variance in the dependent variable is explained by the model. This suggests a strong model fit.

Blockchain Technology:

- Coefficient: The coefficient for Blockchain Technology is -0.008195303, which is very close to zero, indicating that Blockchain Technology has a minimal or negligible effect on the dependent variable.
- Std Error: The standard error for Blockchain Technology is 0.044113294, indicating some variability in the coefficient estimate.
- T-value: The t-value is -0.185778539, which is close to zero, showing that Blockchain Technology does not have a statistically significant effect.

- P-value: The p-value is 0.852810556, which is greater than 0.05, indicating that Blockchain Technology does not have a statistically significant relationship with the dependent variable.

Regulation

- Coefficient: The coefficient for Regulation is 0.303359688, indicating a positive and significant impact of Regulation on the dependent variable. This suggests that higher levels of Regulation have a meaningful positive influence on the outcome.
- Std Error: The standard error for Regulation is 0.018415633, indicating a small variability in the estimate.
- T-value: The t-value is 16.47294407, which is highly significant, suggesting a strong relationship between Regulation and the dependent variable.
- P-value: The p-value for Regulation is 7.71219E-39, which is extremely small (p-value < 0.05), confirming that Regulation has a statistically significant effect on the dependent variable.

Interaction Term (Blockchain Technology * Regulation):

- Coefficient: The coefficient for the interaction between Blockchain Technology and Regulation is -0.002813525, which is very close to zero. This suggests that the interaction between these two variables has a negligible effect on the dependent variable.
- Std Error: The standard error for the interaction term is 0.007043804, indicating a small amount of variability in the estimate.
- T-value: The t-value is -0.399432617, which is close to zero, suggesting that the interaction effect is not statistically significant.
- P-value: The p-value for the interaction term is 0.690009368, which is greater than 0.05, indicating that the interaction between Blockchain Technology and Regulation is not statistically significant.

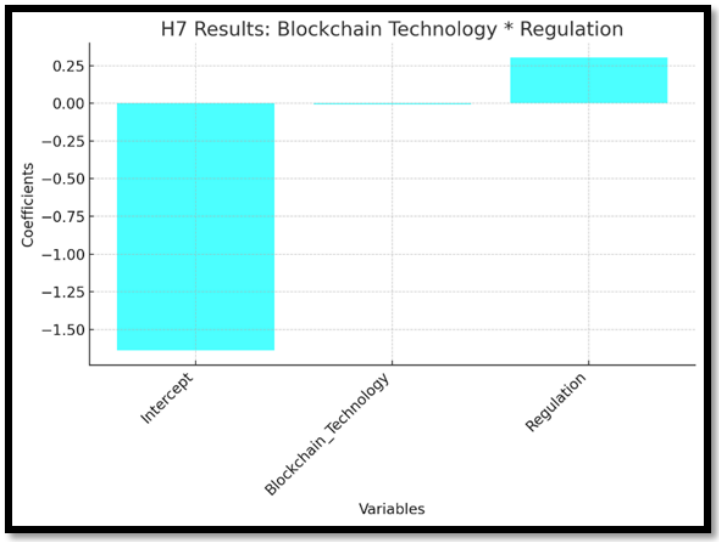

Fig. 8. Blockchain Technology * Regulation (Hypothesis H7)

Discussion

The transformative impact of blockchain technology in entrepreneurship is profound, offering insights into decentralized business models, operational efficiency through smart contracts, and enhanced access to funding via tokenization. This discussion integrates findings from the current study with authenticated scholarly resources to provide a comprehensive understanding of the field. Despite the anticipation, the hypothesis that blockchain technology significantly influences the adoption of decentralized business models was not supported. This suggests that blockchain's role in decentralizing operations may be contingent on other factors such as market readiness and regulatory environments. Hughes et al., (2019) provide a broader perspective on how distributed ledger technologies, beyond just financial applications, could influence firm strategies and operations across various sectors. The hypothesis that smart contracts contribute to operational efficiency found partial support. While bl ockchain has the potential to

automate business processes, its impact varies. Christidis and Devetsikiotis (2016) discuss the potential of blockchain and smart contracts in enhancing the efficiency of Internet of Things (IoT) systems, which may offer insights into similar benefits in other sectors.

The hypothesis that blockchain facilitates access to funding through tokenization was not supported in this study. This suggests a discrepancy between the technological capabilities and market acceptance or regulatory frameworks. Oughton et al., (2019) provide a systematic review of blockchain applications, which includes an exploration of current statuses and ope n issues that could be influencing the adoption rates in areas like crowdfunding. Blockchain's potential to foster business innovation was not significantly supported, indicating that its benefits may not yet be fully realized across all sectors. The systematic review by (Clohessy, 2023; Frizzo-Barker et al., 2020) highlights blockchain as a disruptive technology, emphasizing its impact across various business domains which may not yet be evident in all entrepreneurial ventures. Contrary to other findings, blockchain's impact on sustainable business practices was supported, affirming its role in enhancing supply chain transparency and corporate social responsibility. This aligns with the analysis by (Oughton et al., 2019), who note blockchain's capacity to improve traceability and reliability in supply chains, a key component of sustainable practices.

CONCLUSION

The integration of blockchain technology in entrepreneurship presents significant opportunities for business transformation by enabling new business models, improving operational efficiency, and offering innovative methods of raising capital. This study explored blockchain's key features decentralization, transparency, immutability, and security and how they can empower entrepreneurs to innovate and reduce reliance on intermediaries. By facilitating peer-to-peer transactions and automating business processes through smart contracts, blockchain not only reduces operational costs but also enhances trust and transparency in business relationships, particularly in industries like finance, healthcare, and supply chain management. Entrepreneurs leveraging blockchain can utilize tokenization for raising funds via Initial Coin Offerings (ICOs) or Security Token Offerings (STOs), providing broader access to capital and democratizing investment opportunities. Additionally, blockchain's application in decentralized finance (DeFi) is enabling new ways of providing financial services, disintermediating traditional players, and opening opportunities for businesses to scale faster with lower costs. However, several challenges remain, particularly in terms of scalability, regulatory uncertainty, and technical complexity. While blockchain holds great promise, its widespread adoption is hindered by these issues, and entrepreneurs must navigate these challenges carefully to fully capitalize on the technology's potential.

Recommendations

Focus on Regulatory Compliance

Entrepreneurs seeking to integrate blockchain into their business models should prioritize understanding and complying with the regulatory landscape. Working with legal experts to ensure adherence to regional regulations, especially concerning cryptocurrency and smart contracts, will be crucial for minimizing risk and maintaining credibility. Regulatory clarity will foster broader blockchain adoption, particularly in regulated industries like finance and healthcare.

Invest in Scalability Solutions

Blockchain's scalability challenges, such as slow transaction speeds and high costs, need to be addressed. Entrepreneurs should explore Layer 2 technologies and other innovative solutions to enhance blockchain's scalability and enable its broader application across sectors. Utilizing private or consortium blockchains for specific use cases may also mitigate scalability limitations.

Leverage Smart Contracts for Process Automation

By automating business processes through smart contracts, entrepreneurs can reduce manual intervention, increase transparency, and enhance efficiency. Startups should explore the integration of smart contracts in industries such as insurance, supply chain management, and real estate to streamline operations and reduce overhead costs.

Explore Tokenization and Crowdfunding Opportunities

Entrepreneurs should consider tokenizing assets to enable fractional ownership and broaden access to capital through ICOs and STOs. By offering digital tokens, businesses can raise funds more efficiently and engage a global pool of investors, bypassing traditional capital-raising mechanisms.

Adopt Blockchain for Sustainable Practices

Entrepreneurs can leverage blockchain to enhance supply chain transparency and traceability, particularly in industries that prioritize sustainability and ethical sourcing. Blockchain's immutable ledger can be used to verify the authenticity of products, reduce fraud, and meet growing consumer demand for sustainability.

Future Research

It should explore the long-term impact of blockchain technology on entrepreneurship, particularly in emerging sectors like decentralized finance (DeFi), healthcare, and supply chain management. Additionally, examining the effectiveness of Layer 2 solutions and sharding in addressing blockchain's scalability challenges will be crucial for widespread adoption. Further studies could also investigate the influence of regulatory frameworks on blockchain innovation across different regions, as well as the role of cross-chain interoperability in facilitating blockchain integration across diverse industries. Understanding how blockchain supports sustainable entrepreneurship in the circular economy will also be valuable for future developments.

Competing Interests

The authors declared no competing interests.

REFERENCES

Agarwal, U., Rishiwal, V., Tanwar, S., Chaudhary, R., Sharma, G., Bokoro, P. N., & Sharma, R. (2022). Blockchain technology for secure supply chain management: A comprehensive review. *IEEE Access, 10*, 85493-85517.
https://doi.org/10.1109/ACCESS.2022.3194319

Alghamdi, T. A., Khalid, R., & Javaid, N. (2024). A Survey of Blockchain based Systems: Scalability Issues and Solutions, Applications and Future Challenges. *IEEE Access*.
https://doi.org/10.1109/ACCESS.2024.3408868

Ali, V., Norman, A. A., & Azzuhri, S. R. B. (2023). Characteristics of blockchain and its relationship with trust. *IEEE Access, 11*, 15364-15374.
https://doi.org/10.1109/ACCESS.2023.3243700

Aloini, D., Benevento, E., Stefanini, A., & Zerbino, P. (2023). Transforming healthcare ecosystems through blockchain: Opportunities and capabilities for business process innovation. *Technovation, 119*, 102557.
https://doi.org/10.1016/j.technovation.2022.102557

Arnold, L., Brennecke, M., Camus, P., Fridgen, G., Guggenberger, T., Radszuwill, S., ... & Urbach, N. (2019). Blockchain and initial coin offerings: Blockchain's implications for crowdfunding. *Business Transformation through Blockchain: Volume I*, 233-272.
https://doi.org/10.1007/978-3-319-98911-2_8

Calandra, D., Secinaro, S., Massaro, M., Dal Mas, F., & Bagnoli, C. (2023). The link between sustainable business models and Blockchain: A multiple case study approach. *Business Strategy and the Environment, 32*(4), 1403-1417.
https://doi.org/10.1002/bse.3195

Christidis, K., & Devetsikiotis, M. (2016). Blockchains and smart contracts for the internet of things. *IEEE Access, 4*, 2292-2303.
https://doi.org/10.1109/ACCESS.2016.2566339

Clohessy, T. (Ed.). (2023). *Blockchain in supply chain digital transformation*. CRC Press, Taylor & Francis Group.

Dash, G., Kiefer, K., & Paul, J. (2021). Marketing-to-Millennials: Marketing 4.0, customer satisfaction and purchase intention. *Journal of Business Research, 122*, 608-620.
https://doi.org/10.1016/j.jbusres.2020.10.016

De Filippi, P., Mannan, M., & Reijers, W. (2020). Blockchain as a confidence machine: The problem of trust & challenges of governance. *Technology in Society, 62*, 101284.
https://doi.org/10.1016/j.techsoc.2020.101284

Du, M., Chen, Q., Xiao, J., Yang, H., & Ma, X. (2020). Supply chain finance innovation using blockchain. *IEEE Transactions on Engineering Management, 67*(4), 1045-1058.
https://doi.org/10.1109/TEM.2020.2971858

Dutta, P., Choi, T. M., Somani, S., & Butala, R. (2020). Blockchain technology in supply chain operations: Applications, challenges and research opportunities. *Transportation research part e: Logistics and Transportation Review, 142*, 102067.
https://doi.org/10.1016/j.tre.2020.102067

Dwivedi, V. K., Iqbal, M., Norta, A., & Matulevičius, R. (2023). Evaluation of a legally binding smart-contract language for blockchain applications. *Journal of Universal Computer Science, 29*(7), 691-717.
https://doi.org/10.3897/jucs.97112

Esmaeilian, B., Sarkis, J., Lewis, K., & Behdad, S. (2020). Blockchain for the future of sustainable supply chain management in Industry 4.0. *Resources, Conservation and Recycling, 163*, 105064.
https://doi.org/10.1016/j.resconrec.2020.105064

Fisch, C., & Block, J. H. (2021). How does entrepreneurial failure change an entrepreneur's digital identity? Evidence from Twitter data. *Journal of Business Venturing, 36*(1), 106015.
https://doi.org/10.1016/j.jbusvent.2020.106015

Frizzo-Barker, J., Chow-White, P. A., Adams, P. R., Mentanko, J., Ha, D., & Green, S. (2020). Blockchain as a disruptive technology for business: A systematic review. *International Journal of Information Management, 51*, 102029.
https://doi.org/10.1016/j.ijinfomgt.2019.10.014

Grida, M., & Mostafa, N. A. (2023). Are smart contracts too smart for Supply Chain 4.0? A blockchain framework to mitigate challenges. *Journal of Manufacturing Technology Management, 34*(4), 644-665.
https://doi.org/10.1108/JMTM-09-2021-0359

Hughes, A., Park, A., Kietzmann, J., & Archer-Brown, C. (2019). Beyond Bitcoin: What blockchain and distributed ledger technologies mean for firms. *Business Horizons, 62*(3), 273-281.
https://doi.org/10.1016/j.bushor.2019.01.002

Kaur, R., Ali, A., & Faisal, M. (2022). Smart contracts: The self-executing contracts. In *Blockchain* (pp. 35-49). Chapman and Hall/CRC.

Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain:

Theoretically exploring adoption barriers. *International Journal of Production Economics, 231*, 107831. https://doi.org/10.1016/j.ijpe.2020.107831

Lai, P. C., Toh, E. B., Polas, M. R. H., & Tabash, M. I. (2023). Intention to use blockchain technologies: Evidence from two regions—ASEAN and Middle-East. *International Journal of Innovation and Technology Management, 20*(08), 2350049. https://doi.org/10.1142/S0219877023500499

Mont, O., Palgan, Y. V., Bradley, K., & Zvolska, L. (2020). A decade of the sharing economy: Concepts, users, business and governance perspectives. *Journal of Cleaner Production, 269*, 122215. https://doi.org/10.1016/j.jclepro.2020.122215

Oughton, E. J., Frias, Z., van der Gaast, S., & van der Berg, R. (2019). Assessing the capacity, coverage and cost of 5G infrastructure strategies: Analysis of the Netherlands. *Telematics and Informatics, 37*, 50–69. https://doi.org/10.1016/j.tele.2019.01.003

Qamar Zia, M., Naveed, M., Iqbal, A., & Ghauri, S. (2022). Predictors and outcomes of self-directed development: an investigation of individual and contextual factors. *International Journal of Training Research, 20*(3), 195-214. https://doi.org/10.1080/14480220.2021.1991834

Risius, M., Breidbach, C. F., Chanson, M., von Krannichfeldt, R., & Wortmann, F. (2023). On the performance of blockchain-based token offerings. *Electronic Markets, 33*(1), 32. https://doi.org/10.1007/s12525-023-00652-5

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships to sustainable supply chain management. *International Journal of Production Research, 57*(7), 2117-2135. https://doi.org/10.1080/00207543.2018.1533261

Sahoo, S., Kumar, S., Sivarajah, U., Lim, W. M., Westland, J. C., & Kumar, A. (2024). Blockchain for sustainable supply chain management: trends and ways forward. *Electronic Commerce Research, 24*(3), 1563-1618. https://doi.org/10.1007/s10660-022-09569-1

Schletz, M., Salomo, S., & Guzmán, E. (2021). 4.4 Paper 4: Organisational and environmental blockchain adoption factors: A study of interdependencies in a multilateral agreement context. *Radical innovation for the Paris Agreement*, 84.

Šilenskytė, A., Butkevičienė, J., & Bartminas, A. (2024). Blockchain-based connectivity within digital platforms and ecosystems in international business. *Journal of International Management, 30*(3), 101109. https://doi.org/10.1016/j.intman.2023.101109

Taherdoost, H., & Madanchian, M. (2023). Blockchain-based e-commerce: A review on applications and challenges. *Electronics, 12*(8), 1889. https://doi.org/10.3390/electronics12081889

Tönnissen, S., Beinke, J. H., & Teuteberg, F. (2020). Understanding token-based ecosystems–a taxonomy of blockchain-based business models of start-ups. *Electronic Markets, 30*, 307-323. https://doi.org/10.1007/s12525-020-00396-6

Tripathi, G., Ahad, M. A., & Casalino, G. (2023). A comprehensive review of blockchain technology: Underlying principles and historical background with future challenges. *Decision Analytics Journal,* 100344. https://doi.org/10.1016/j.dajour.2023.100344

Wamba, S. F., & Queiroz, M. M. (2020). Blockchain in the operations and supply chain management: Benefits, challenges and future research opportunities. *International Journal of Information Management, 52*, 102064.

https://doi.org/10.1016/j.ijinfomgt.2019.102064

Wang, F., Gai, Y., & Zhang, H. (2024). Blockchain user digital identity big data and information security process protection based on network trust. *Journal of King Saud University-Computer and Information Sciences, 36*(4), 102031.

https://doi.org/10.1016/j.jksuci.2024.102031

Wang, Z., Yu, L., & Zhou, L. (2024). Navigating the blockchain-driven transformation in industry 4.0: Opportunities and Challenges for Economic and Management Innovations. *Journal of the Knowledge Economy*, 1-43.

https://doi.org/10.1007/s13132-024-02007-7

Xu, W., Wang, T., Chen, R., & Zhao, J. L. (2021). Prediction of initial coin offering success based on team knowledge and expert evaluation. *Decision Support Systems, 147*, 113574.

https://doi.org/10.1016/j.dss.2021.113574