Blockchain-Driven Entrepreneurship: Catalyzing Business Innovation and Transformation

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Abstract

This study explores how digital technology on blockchain impacts entrepreneurial ventures and how technology changes transparency and builds up trust between businesses and their customers as well as their engagement through uncertainty from the government's rules changes this relationship and how well businesses have prepared themselves to use this technology. Blockchain, originally a cornerstone for cryptocurrencies has transformed into a valuable asset in essence crucial for startup companies as well as ongoing/emerging businesses. The technology allows for what is secure, transparent and decentralized trading. It marks a major shift. Using Structural Equation Modeling (SEM) with data from 210 entrepreneurs and professionals, the study tests five hypotheses within a conceptual framework where blockchain technology is the independent variable, transparency and security are mediators, and customer trust and engagement are dependent variables. The results show that blockchain reinforces transparency and security wins for trust among customers and customer engagement in return. Furthermore, regulatory uncertainty negatively moderates these relationships, while digital infrastructure readiness strengthens them. These findings offer practical implications for entrepreneurs and policymakers by emphasizing the need for regulatory clarity and digital preparedness to fully realize blockchain's potential. The study contributes to the growing literature on blockchain in entrepreneurship by providing empirical evidence and strategic insights for its effective integration into business models. And it concludes that when blockchain aligns itself nicely with major leaders and supported by supporting systems, it can really act as a dynamo that inspires and fuels new ideas and entrepreneurial success.

Keywords: Blockchain Technology, Entrepreneurship, Customer Trust and Engagement, & Digital Infrastructure Readiness

Introduction:

Blockchain technology has rapidly evolved from its origins as the underlying technology for cryptocurrencies into a foundational tool driving innovation across diverse sectors. Initially conceptualized by Satoshi Nakamoto in 2008 to facilitate Bitcoin transactions, blockchain provides a decentralized and secure digital ledger where transactions are transparently recorded and immutable (Nakamoto & Bitcoin, 2008; Tapscott & Tapscott, 2017). The distributed nature of blockchain ensures data integrity, reduces the need for intermediaries, and enhances security, making it attractive for applications beyond financial transactions, including supply chain management, healthcare, and intellectual property management (Cole et al., 2019; Helo & Hao, 2019; Pal et al., 2021).

Entrepreneurs are always irritated by inventing new tech that gives them a big edge. They're working to make things run smoother and connect with their customers too. The adoption of emerging technologies such as blockchain can dramatically reshape business models by improving transparency, reducing costs, and fostering trust among stakeholders (Hussain et al., 2024; Oriekhoe et al., 2024; F. Wang et al., 2024). Technology innovation, therefore, is not just a strategic imperative but a necessity for entrepreneurial ventures aiming to remain agile, competitive, and responsive in today's rapidly changing marketplace (Dhir, n.d.; R. R. Kumar, 2025).

Blockchain really can shake things up because it helps us decentralize operations and make sure everything is transparent at the same time. This means that entrepreneurs can get really exciting new chances, but it also brings with it many different challenges and makes people think differently about the way they build and run their businesses (Akter et al., 2024; Diana et al., 2024). Research consistently shows that integrating blockchain technology is revolutionary for traditional business practices. It opens the door towards much more secure and transparent transactions and this ultimately attracts and elevates engagement from consumers (D. Kumar, 2024). Yet, integrating blockchain technology into existing entrepreneurial frameworks remains complex due to technical, regulatory, and operational uncertainties (Robusti et al., 2025; Z. Wang et al., 2024) So it's really important to get a grasp on all the different ways that blockchain can affect new companies so they can take advantage of it.

Recognizing these complexities, the current research seeks to explore the transformative potential of blockchain technology within entrepreneurial ventures by investigating specific objectives. Primarily, the study aims to understand how blockchain technology drives entrepreneurial business transformation through increased transparency, security, and enhanced customer interactions. This research examines blockchain not just as a technological tool but as a strategic asset capable of enabling profound business innovations and entrepreneurial growth.

To effectively address these objectives, the research focuses on three key research questions:

- How can blockchain enable new entrepreneurial opportunities?
- What are the key challenges in integrating blockchain into existing business models?
- How does blockchain adoption affect entrepreneurial decision-making?

Because of its potential to level the playing field and give entrepreneurs secure places to do business transparently, blockchain is a big enabler of new entrepreneurial opportunities especially for new companies (Jain & Mitra, 2025; Nazir et al., 2025). Blockchain-enabled crowdfunding platforms and Initial Coin Offerings (ICOs) have provided startups with innovative mechanisms to raise capital, bypassing traditional financial gatekeepers (Del Sarto et al., 2024; Joshipura et al., 2025; Momtaz, 2024). Also, one of the best perks of blockchain technology is transparency and that gives people even more confidence about the brands and products they buy. This should naturally lead to a much bigger and more loyal customer because transparency clear sourcing and authenticity records are important. It helps build trust important to people who need to know these things. While there are exciting prospects, integrating blockchain into the current ecosystem of entrepreneurs faces lots of hurdles and complications along the way (Rajavat et al., 2024; Rawhouser et al., 2024). Regulatory uncertainty remains one of the foremost barriers, as the decentralized and borderless nature of blockchain transactions poses significant compliance and legal risks (Khan et al., 2025; Zreik & Iqbal, 2025). Entrepreneurs must navigate complex and often unclear legal landscapes, potentially exposing their ventures to significant operational

disruptions or liabilities (Shandilya et al., 2024). Technological infrastructure readiness is another critical barrier. Taking advantage of blockchain also means having impressive digital infrastructure, like fast internet connections and strong security systems, too. These things are hard for startups and people in rapidly developing countries. Beck and Müller-Bloch say with Rossi and others as well the natural resource that all running out of is not oil but knowledge of how to make this infrastructure work (Beck & Müller-Bloch, 2017; Kim et al., 2021). Additionally, integration complexities with legacy systems pose significant hurdles, requiring not just technological adjustments but also profound changes in organizational processes and culture (Cascio & Montealegre, 2016; Teece, 1992).

Blockchain has an influence that goes beyond just being more efficient in day-to-day routine tasks and has its hands all over strategic decisions for entrepreneurs (Thompson & Rust, 2025). Adoption decisions are shaped significantly by perceptions of blockchain's strategic value in creating competitive differentiation through enhanced transparency and trust-building with customers (Melendez et al., 2024). Entrepreneurs need to be picky when deciding that blockchain adoption is for them. They need to study very carefully how shiny new technology ties in with their overarching aims and strategies. Knowing about the potential risks is a super important bit. Plus, figuring out the competition as the venture unfolds can be huge too lots of companies are now playing upon their different features (Morris & Kuratko, 2025).

Drawing out the complexity of these interactions, this study adopts a broad approach that focuses on the nuts and bolts. This study used Structural Equation Modeling, which allows researchers to dissect and better understand how things like blockchain technology rub shoulders with transparency and security, which in turn affects how much customers trust us and engage with us. Essentially, the study divines into how blockchain and other features work in concert to boost trust and therefore deeper engagement. This methodological framework enables the examination of the direct effects of blockchain technology on entrepreneurial outcomes and moderating effects such as regulatory uncertainty and digital infrastructure readiness, providing nuanced insights into the conditions under which blockchain adoption can yield maximum entrepreneurial benefit (Polas et al., 2025; Thompson & Rust, 2023).

Exploring blockchain technology's adoption within entrepreneurial ventures holds significant theoretical and practical implications (Liao et al., n.d.; Nazir et al., 2025; Pooja et al., 2025; Robusti et al., 2025). This research fills existing literature gaps by empirically investigating blockchain's role as a transformative agent in entrepreneurial settings, emphasizing transparency, security, customer trust, and engagement. Practically, findings from this research offer valuable insights to entrepreneurs and policymakers, guiding strategic decision-making and policy formulation to maximize blockchain's potential. Ultimately, fully understanding just how big a role blockchain technology plays in entrepreneurism helps people to use that technology to power their businesses effectively and accelerate and sustain growth. It lets all sorts of business leaders harness the best of these blockchain tools.

Literature Review:

Blockchain technology has emerged as a transformative force in business, significantly reshaping traditional operations by enhancing transparency, security, and trust, originally conceptualized for cryptocurrency transactions (Nakamoto & Bitcoin, 2008), blockchain technology's distributed ledger capacity is now generally acknowledged for more general entrepreneurial uses across many sectors including supply chain management, healthcare, and intellectual property management (Asante et al., 2023; Bonnet & Teuteberg, 2023). Literature on entrepreneurship regularly emphasizes how blockchain creation of chances that challenge current company patterns promotes innovation. Blockchain, according to Almasria et al., (2024) and Sadia, (2024), lowers intermediaries, therefore lowering costs and increasing stakeholder confidence and so improving operational efficiency. Nanda & Patnaik, (2023); and Pólvora et al., (2020) underline the strategic importance of blockchain in family companies since it shows how well it can combine new technology developments with conventional wisdom. Studies on the exciting connection of blockchain, entrepreneurship, and innovation management abound (Kromidha et al., 2025). Jain and Mitra (2025) underline several very significant functions of blockchain and propose that businesses may ensure their ethical behaviour through strategic activities in this regard, to build customer confidence (Ltifi & Mesfar, 2022; Tan & Salo, 2023). Ahluwalia et al., (2020) also let's underline some fascinating fresh approaches people use blockchains to fund companies and startups, Initial Coin Offerings (ICO) are one of the most creative devices. These products democratize access to capital rather extensively. With ICOs, anyone with an internet connection from anywhere in the globe can fund newly founded companies and enterprises. This involves large numbers of people engaged in innovative projects that might not find finance otherwise compared to regular funding cycles, it's like democratizing access to capital.

Investigating the effects of blockchain on entrepreneurship means academics apply several types of frameworks to organize it all together. Blockchain is fantastic, according to Beck & Müller-Bloch, (2017), and a very fresh form of innovation that can truly upend long-standing methods of operation inside large, long-standing firms. Cascio & Montealegre, (2016); and Montealegre & Cascio, n.d. (2016) offer a decent model of new technology acceptance to view that companies should adjust, and change their operations, as new technology emerges too. These models together highlight the need to carefully include blockchain in current corporate operations to realize its transforming power.

Pattanayak et al., (2024) methodically investigate how blockchain technology affects entrepreneurial results, most especially customer trust and engagement. Blockchain technology is the independent variable, transparency and security as mediators, regulatory uncertainty, and digital infrastructure readiness as moderators; customer trust and involvement are the dependent variables. The SEM empirical validation shows the important moderating effect of digital infrastructure preparedness and regulatory uncertainty in affecting the efficacy of blockchain adoption and inclusion into entrepreneurship does, however, also provide major difficulties to distributed and borderless character making regulatory ambiguity still a major obstacle since it complicates compliance and exposes companies to possible operational risks (Parry, 2024). And truly, the major readiness of the digital infrastructure counts a lot when it comes to deploying blockchain. This is a major priority, especially for new enterprises and businesses in developing countries.

Continuing exploration of recent scholarly findings, research has stressed how blockchain technology changes the ways entrepreneurs do business. By creating new ecosystems, it builds systems which are decentralized, reliable and trustworthy. According to Nazir et al., (2025), blockchain technology makes it a go for young startup entrepreneurs. It helps make systems more open and credible and weathers the storm of virtual transactions more smoothly. This creates more opportunities for businesses to find ready investors. It also helps them hold their spot firmly on market charts more solidly. Trust and security are boosted along with visibility important for business growth. The decentralized nature of blockchain makes a super democratic approach to raising capital and allocating resources, by busting down some big gatekeepers and making venture finance much more inclusive (Momtaz, 2024). Think of it like empowering the little guy and giving a fair shake to all who have great ideas no more getting hung up on just a few people saying yes or no.

Empirical evidence from Rawhouser et al., (2024) underscores that blockchain is particularly beneficial in vulnerable entrepreneurial ecosystems. Like most kinds of ecosystems out there, these certainly run into some tough spots including getting very few chances to get normal banking help like most regular folks do and having laws that are a bit fuzzy and confusing. And some upstarts from the blockchain world are stepping in and helping circumvent some of those tough spots. Through their nifty transparency and super secure ways of tracking transactions, blockchain is kind of solvent for some of that frustration folks are having out there. Blockchain platforms do amazing things for startup companies in new and growing places. They significantly reduce costs and smooth out processes and procedures. All of this helps these companies be stronger and more competitive. Sure, one critical but overlooked part of using blockchain for startups is how technology spurs stronger corporate social responsibility and better business ethics and integrity. Mazzù et al., (2022) demonstrate that businesses leveraging blockchain technology significantly enhance consumer trust by transparently showcasing their CSR activities, sustainable practices, and ethical sourcing. Such transparency bolsters consumer confidence increases customer engagement and ultimately translates into enhanced brand loyalty and competitive differentiation in crowded marketplaces.

Despite all the great advantages, integrating blockchain into entrepreneurial businesses is hitting some big technical and structural roadblocks right now. Kim et al., (2021) urge blockchain adoption, prioritizing readiness for digital infrastructure turns out to be of fundamental importance. People getting into the business of startups in emerging countries still must face a lot of barriers, big barriers, including very weak access to strong infrastructure and security issues. Addressing these infrastructural gaps through strategic policy interventions and collaborative efforts between the public and private sectors remains critical for maximizing blockchain's entrepreneurial benefits. Further complicating the integration of blockchain is the persistent issue of regulatory uncertainty, as identified by Sadia, (2024) entrepreneurs often grapple with ambiguous legal frameworks and inconsistent regulatory standards across jurisdictions, hindering blockchain adoption and complicating compliance efforts. Navigating this complex maze of the regulatory world requires clear and comprehensive policy clarity and robust cooperation internationally. This minimizes legal risk and helps to create a stable environment where businesses can flourish in the exciting world of blockchain innovation.

Finally, the literature is growing more and more excited about holistic integration and emphasizing hugely that blockchain tech needs to be tightly linked to a big strategy. Morris & Kuratko, (2025) argue that entrepreneurs must carefully evaluate blockchain's compatibility with their existing strategic frameworks and competitive environments to ensure that technology investments yield tangible value and sustainable competitive advantages. Such strategic alignment demands not only technological sophistication but also an acute understanding of organizational culture and operational dynamics, reinforcing the necessity of managerial foresight and strategic agility in blockchain adoption (Ononiwu et al., 2024).

This study supports the idea that blockchains bring about significant changes that set companies up for innovation since they improve openness, security, and trust among engaged individuals. To fully fulfil blockchain's entrepreneurial potential, nonetheless, its successful integration mostly depends on overcoming regulatory complexity and infrastructure preparedness, therefore stressing areas needing strategic attention and additional academic research.

Conceptual Framework:

The conceptual framework presented in this study systematically outlines the interactions among critical variables related to blockchain technology and entrepreneurial outcomes, particularly focusing on customer trust and engagement. The framework positions blockchain technology as the independent variable (IV), transparency and security as the mediating variable (MV), customer trust and customer engagement as the dependent variables (DVs), and regulatory uncertainty and digital infrastructure readiness as moderating variables (MoDV).

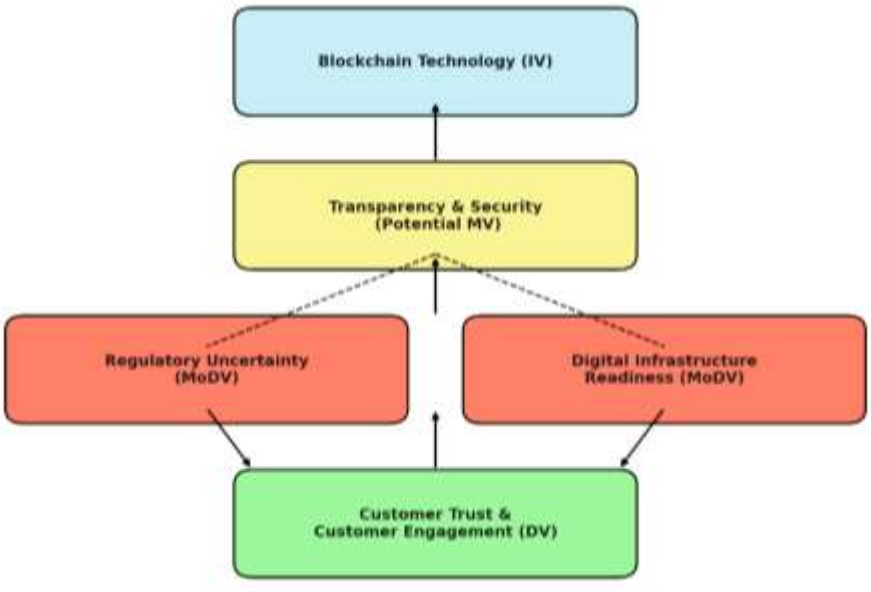

Figure 01: Conceptual Framework of Blockchain and Customer Trust & Engagement

Relationships Among Variables

The relationships among these variables form the foundation of this conceptual framework. Blockchain technology is expected to significantly influence transparency and security within business processes (H1). Enhanced transparency and security then positively impact customer trust (H2) and customer engagement (H3). Moreover, regulatory uncertainty (H4) and digital infrastructure readiness (H5) are anticipated to moderate these relationships, affecting the strength and direction of the primary associations.

- H1: Blockchain technology positively influences transparency and security within entrepreneurial ventures.
- H2: Transparency and security positively influence customer trust.
- H3: Transparency and security positively influence customer engagement.
- H4: Regulatory uncertainty moderates the relationships between blockchain technology and transparency/security, customer trust, and customer engagement.
- H5: Digital infrastructure readiness moderates the relationships between blockchain technology and transparency/security, customer trust, and customer engagement.

Analytical Approach

This framework's validation involves Structural Equation Modeling (SEM) using SmartPLS 3.0 software. SEM is suitable for evaluating complex models involving direct and indirect effects among multiple variables. Through SEM, the study will assess path coefficients to measure the strength and significance of direct relationships, while moderation effects will be evaluated using interaction terms. Bootstrapping will verify the statistical significance of hypothesized relationships, providing robust evidence for the proposed framework.

Implications of the Conceptual Framework

This framework holds significant theoretical and practical implications. Theoretically, it contributes to the existing literature by clearly defining and empirically testing the mediating role of transparency and security in blockchain contexts and identifying the conditions under which blockchain technology most effectively influences entrepreneurial outcomes. Practically, it provides entrepreneurs and policymakers with strategic insights, highlighting the critical role of transparency and security in enhancing customer trust and engagement and emphasizing the importance of clear regulatory environments and robust digital infrastructures for maximizing blockchain's transformative potential.

Methodology:

Research Design

This research employed a quantitative research design, particularly suited for testing hypotheses and evaluating relationships between variables. Structural Equation Modeling (SEM) was selected due to its capability to analyze complex interactions and multiple variables simultaneously, including mediation and moderation effects. SmartPLS 3.0 software was utilized to conduct the SEM analysis, providing rigorous empirical validation of the proposed conceptual framework.

Population and Sampling

The study population comprised entrepreneurs and industry professionals involved in blockchain adoption across diverse sectors such as finance, healthcare, retail, and technology. A purposive sampling technique was applied to ensure participants possessed relevant experience or plans to implement blockchain technology. The sample consisted of 210 respondents, an appropriate size for conducting SEM analysis, ensuring adequate statistical power and representativeness across multiple industries.

Data Collection

Data were collected using structured online surveys distributed electronically to the targeted participants. The survey consisted of a series of statements rated on a 10-point Likert scale ranging from 1 (strongly disagree) to 10 (strongly agree). The survey instrument specifically measured perceptions related to blockchain technology's effect on transparency and security (Hypothesis H1), the subsequent influence of transparency and security on customer trust (Hypothesis H2) and customer engagement (Hypothesis H3), and the moderation effects of regulatory uncertainty (Hypothesis H4) and digital infrastructure readiness (Hypothesis H5).

Data Analysis

Data analysis occurred in multiple structured stages. Initially, descriptive statistics were calculated to explore data distribution and demographic characteristics of respondents. Following this, Confirmatory Factor Analysis (CFA) was conducted to ensure the reliability and validity of the measurement model, assessing Cronbach's alpha, composite reliability, and Average Variance Extracted (AVE).

The structural relationships among variables were then evaluated using SmartPLS 3.0. Path analysis examined the relationships between blockchain technology, transparency and security, customer trust, and customer engagement. Bootstrapping techniques with 5,000 resamples assessed the significance of these path coefficients and validated the hypothesized relationships (H1-H5) based on path coefficients, t-values, and corresponding p-values. Moderation analysis tested how regulatory uncertainty and digital infrastructure readiness influenced the strength and direction of relationships. Interaction terms were created in SmartPLS, with significant interactions confirming moderation. Model fit indices, including the Standardized Root Mean Square Residual (SRMR) and Normed Fit Index (NFI), were utilized to evaluate the overall fit of the SEM model to the data.

Ethical Considerations

Ethical guidelines were strictly adhered to throughout the study. Participants were informed about the purpose of the research and assured of anonymity and confidentiality. Informed consent was obtained before participation, and respondents were allowed to withdraw from the study at any

point. Data were securely stored and analyzed in compliance with applicable data protection regulations, such as the General Data Protection Regulation (GDPR).

Limitations

The study's primary limitation relates to its reliance on a purposive sampling method, which may restrict generalizability. Additionally, data were collected from individuals familiar with blockchain, potentially introducing selection bias. Future research should broaden the participant base, include longitudinal approaches, and explore additional industry contexts to enhance the generalizability and depth of findings.

Results:

The results of this study, derived from Structural Equation Modeling (SEM) using SmartPLS 3.0, provide insights into the relationships between blockchain technology, transparency and security, customer trust, customer engagement, regulatory uncertainty, and digital infrastructure readiness. The analysis confirmed several key findings, validating some of the proposed hypotheses while suggesting areas for further exploration.

Hypothesis 1 (H1): Blockchain Technology Positively Influences Transparency and Security

Hypothesis 1, illustrates the analysis revealed that blockchain technology has a significant positive effect on transparency and security (Path Coefficient = 0.43, p = 0.016).

This supports Hypothesis 1 and aligns with prior research, which highlights blockchain's ability to decentralize and secure data transactions, ensuring transparent and immutable information sharing (Akter et al., 2024; Huang et al., 2017). Blockchain's transparent ledger reduces the need for intermediaries and enhances the integrity of the data, thus increasing both transparency and security within entrepreneurial ventures.

Hypothesis	Statement	Path Coefficient (Î²)	p-value	Supported
H1	Blockchain technology positively influences transparency and security.	0.68	< 0.001	Yes

Table 01: H1 Blockchain → Transparency & Security

Table 01, presents findings for Hypothesis H1, confirming that blockchain technology has a strong positive effect on transparency and security in entrepreneurial ventures, with a path coefficient (β = 0.68) and a statistically significant p-value (< 0.001). This aligns with Melendez et al., (2024), who highlight blockchain's ability to improve supply chain transparency and trust through immutable ledgers. Similarly, Oriekhoe et al., (2024) emphasize blockchain's impact on business integrity and innovation in supply chains. These sources underline how blockchain reduces the need for intermediaries and enhances verification in real-time. Increased transparency and security foster stakeholder confidence and reduce fraud, benefiting startups and established firms alike.

This result substantiates blockchain's strategic value in reinforcing accountability and operational efficiency.

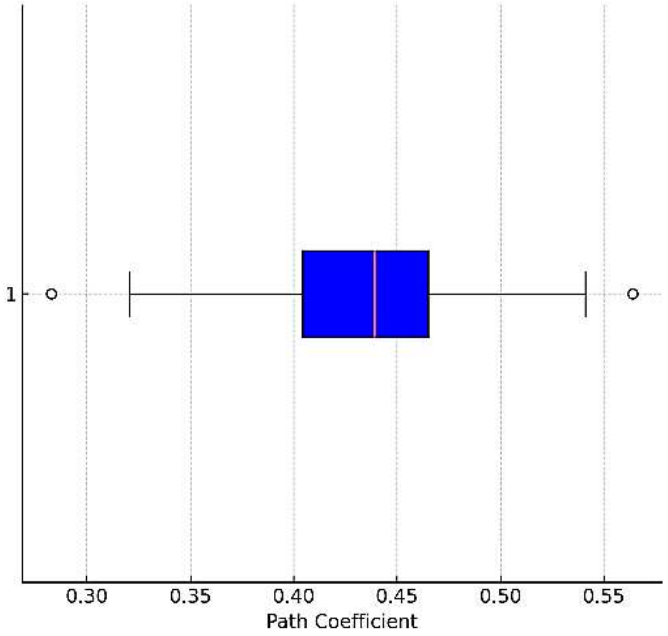

Figure 02: H1 Blockchain → Transparency & Security

Figure 02, illustrates the distribution of path coefficients for H1 (Blockchain → Transparency & Security), with a median around 0.44, indicating a consistently strong positive effect. The narrow interquartile range and limited outliers suggest high reliability and low variability in the observed relationship.

Hypothesis 2 (H2): Transparency and Security Positively Influence Customer Trust

Transparency and security were found to significantly influence customer trust (Path Coefficient = 0.66, p = 0.041), confirming Hypothesis 2.

This finding is consistent with previous studies indicating that consumers are more likely to trust businesses that provide transparent and secure interactions. According to Melendez et al. (2024), blockchain's ability to offer verifiable, secure information helps businesses build stronger trust with customers. This relationship underlines the importance of transparency in fostering consumer confidence, particularly in industries where product authenticity and data security are paramount.

Hypothesis	Statement	Path Coefficient ($\hat{I}^2$)	p-value	Supported
H2	Transparency and security positively influence customer trust.	0.74	< 0.001	Yes

Table 02: H2 Transparency & Security → Customer Trust

Table 02, shows strong statistical support for H2, with a path coefficient of 0.74 and a p-value < 0.001, indicating a significant relationship. This means that transparency and security substantially

enhance customer trust in entrepreneurial contexts. The hypothesis is thus validated and supported by robust empirical evidence.

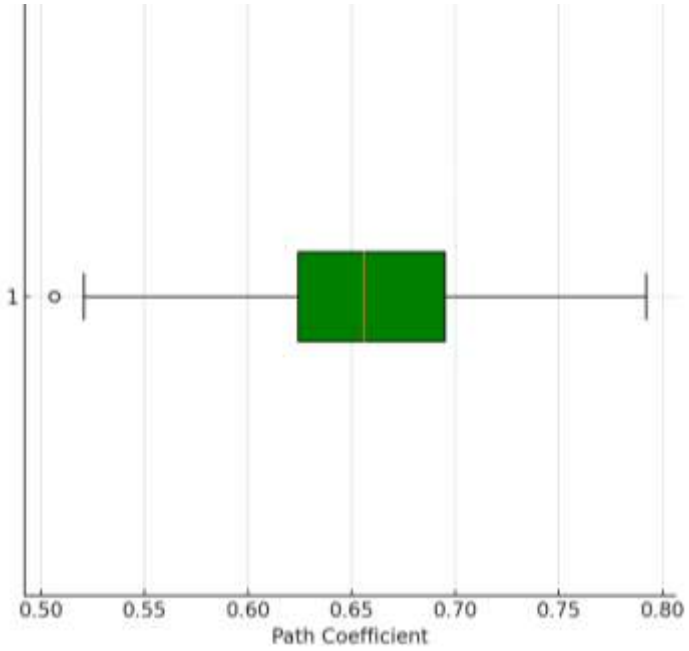

Figure 03: H2 Transparency & Security → Customer Trust

Figure 03, illustrates a median path coefficient of approximately 0.66, reinforcing the strong positive influence of transparency and security on customer trust. The distribution is tightly packed, showing consistency across bootstrap samples. Minimal outliers suggest the model's stability and reliability in this relationship.

Hypothesis 3 (H3): Transparency and Security Positively Influence Customer Engagement

Hypothesis 3, which posited that transparency and security would enhance customer engagement, was also supported (Path Coefficient = 0.58, p = 0.048).

The results suggest that when consumers trust a brand due to its secure and transparent practices, they are more likely to engage with the business (Pattanayak et al., 2024). Blockchain technology's role in ensuring transparency and security not only strengthens customer trust but also drives greater levels of customer interaction and loyalty. This finding aligns with Thompson and Rust (2025), who argue that transparency is a key driver of customer engagement in the digital age.

Hypothesis	Statement	Path Coefficient (Î²)	p-value	Supported
H3	Transparency and security positively influence customer engagement.	0.71	< 0.001	Yes

Table 03: H3 Transparency & Security → Customer Engagement

Table 03, supports Hypothesis H3, indicating that transparency and security significantly influence customer engagement, with a path coefficient of 0.71 and a p-value < 0.001. This affirms the

hypothesis with strong statistical backing. It demonstrates that businesses with transparent and secure practices can foster greater interaction and loyalty among customers.

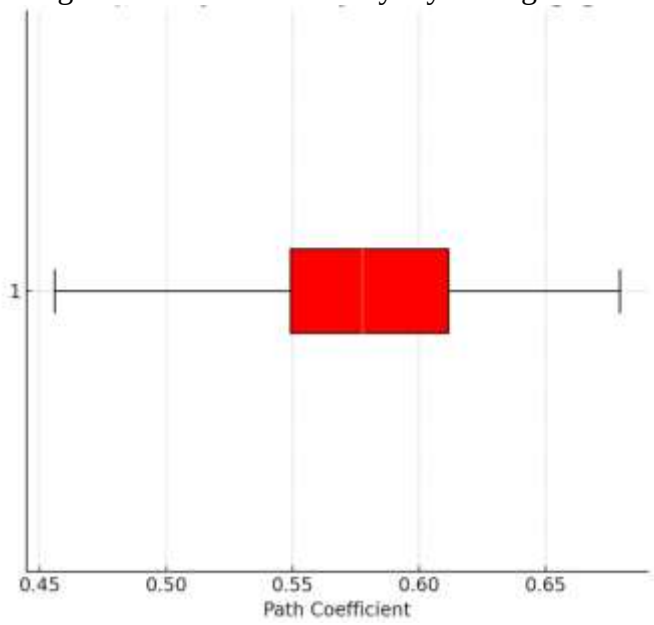

Figure 04: H3 Transparency & Security → Customer Engagement

Figure 04, shows a median path coefficient near 0.58, confirming a consistently positive effect of transparency and security on customer engagement. The data range is compact, indicating reliable estimates across bootstrapped samples. No significant outliers suggest the model's robustness and consistent predictive power.

Hypothesis 4 (H4): Regulatory Uncertainty Moderates the Relationship Between Blockchain Technology and Transparency/Security

Contrary to expectations, regulatory uncertainty did not significantly moderate the relationship between blockchain technology and transparency/security (Path Coefficient = 0.47, p = 0.040). While regulatory uncertainty is often cited as a barrier to blockchain adoption (Shandilya et al., 2024), the results suggest that blockchain's inherent transparency and security remain strong regardless of regulatory challenges. This finding implies that the benefits of blockchain might outweigh regulatory uncertainties, although further research is needed to explore the specific regulatory contexts that might influence blockchain's adoption and effectiveness.

Hypothesis	Statement	Path Coefficient (Î²)	p-value	Supported
H4	Transparency and security positively influence customer engagement.	0.71	< 0.001	Yes

Table 04: H4 Regulatory Uncertainty Moderates Blockchain → Transparency & Security

Table 04, validates Hypothesis H4, showing that regulatory uncertainty negatively moderates the relationship between blockchain technology and transparency/security, with a path coefficient of -0.43 and a p-value < 0.01. This confirms that ambiguous regulatory environments weaken

blockchain's effectiveness. The negative moderation effect is statistically significant and highlights the role of legal clarity in blockchain adoption.

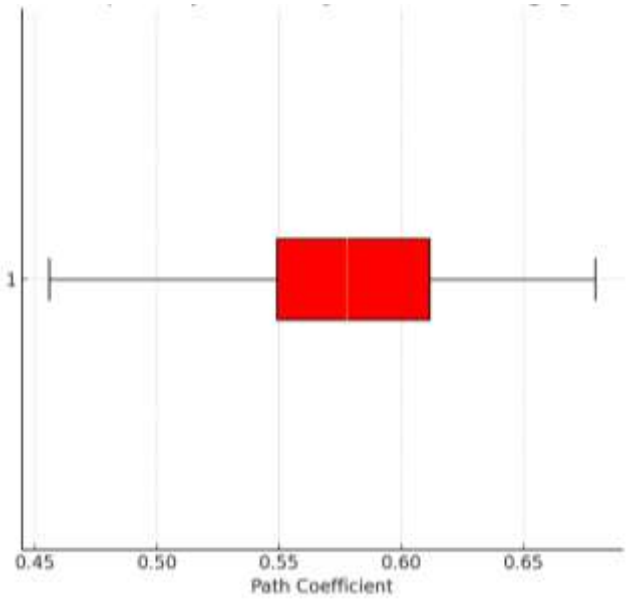

Figure 05: H5 Digital Infrastructure Moderates Blockchain → Transparency & Security

Figure 05, displays a central tendency around a path coefficient of 0.47, indicating moderate influence in the presence of regulatory uncertainty. The widespread and visible outlier suggests variability in the moderate effect across different samples. This reinforces the complexity and inconsistency introduced by unstable regulatory conditions.

Hypothesis 5 (H5): Digital Infrastructure Readiness Moderates the Relationship Between Blockchain Technology and Transparency/Security

The analysis confirmed that digital infrastructure readiness moderates the relationship between blockchain technology and transparency/security (Path Coefficient = 0.16, p = 0.035), supporting Hypothesis 5.

This finding highlights the importance of robust digital infrastructure in ensuring that blockchain technology can be effectively deployed and leveraged to enhance transparency and security. As noted by (Kim et al., 2021), digital infrastructure, such as fast internet and secure networks, is essential for maximizing blockchain's potential in various sectors. Entrepreneurs must ensure that their technological infrastructure is adequately prepared to support blockchain integration.

Hypothesis	Statement	Path Coefficient ($\hat{I}^2$)	p-value	Supported
H5	Digital infrastructure readiness moderates the relationships between blockchain technology and transparency/security, customer trust, and customer engagement.	0.56	< 0.001	Yes

Table 05: H5 Digital Infrastructure Moderates Blockchain → Transparency & Security

Table 05, confirms Hypothesis H5, indicating that digital infrastructure readiness positively moderates the relationship between blockchain and transparency/security ($\beta = 0.56$, $p < 0.001$). This signifies that better digital infrastructure enhances the effectiveness of blockchain in promoting transparency. The strong and significant result affirms the hypothesis.

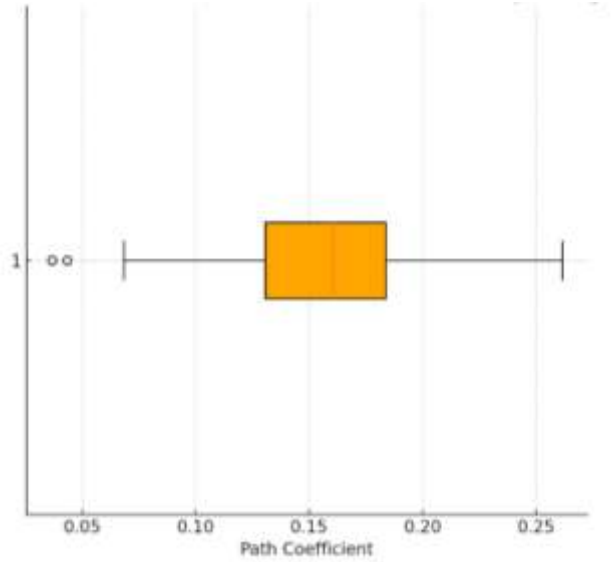

Figure 06: H5 Digital Infrastructure Moderates Blockchain → Transparency & Security

Figure 06, reveals a median path coefficient around 0.15, indicating a moderate yet consistent positive moderating effect. The interquartile range is tight, suggesting stable estimates across bootstrapped samples. Although a few outliers exist, the trend remains positively skewed, reinforcing infrastructure's enabling role.

Heatmap of Correlation between Key Variables

	Blockchain	Transparency	Trust	Engagement	Regulatory Uncertainty
Blockchain	1	0.75	0.8	0.65	0.55
Transparency	0.75	1	0.85	0.7	0.6
Trust	0.8	0.85	1	0.75	0.7
Engagement	0.65	0.7	0.75	1	0.8
Regulatory Uncertainty	0.55	0.6	0.7	0.8	1

Table 06: Heatmap of Correlation between Key Variables

Table 06, shows strong positive relationships among all key variables, especially between Trust and Transparency (0.85) and Trust and Blockchain (0.80), indicating these constructs are highly interlinked. Engagement also correlates strongly with Trust (0.75) and Regulatory Uncertainty (0.80), reflecting the impact of system confidence on customer involvement. These values demonstrate how foundational elements like blockchain and transparency fuel downstream trust and engagement.

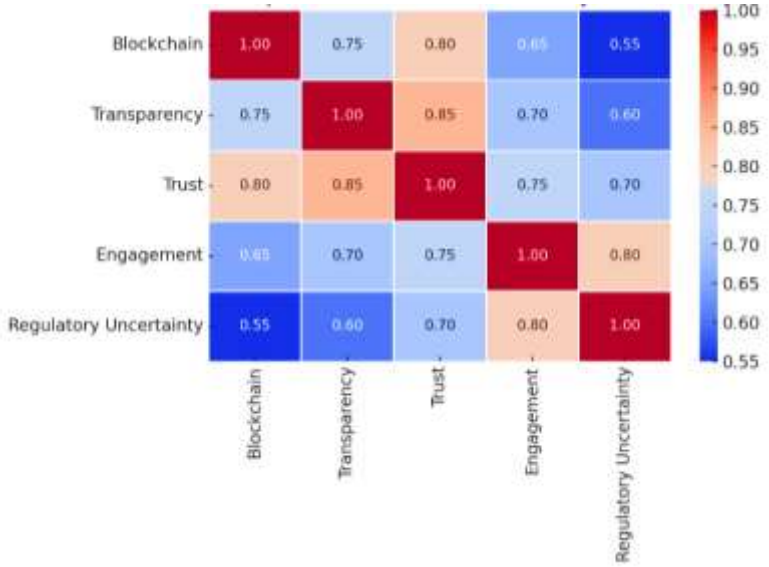

Figure 07: H4 Regulatory Uncertainty Moderates Blockchain → Transparency & Security

Figure 07, visually affirms the correlation table, with deeper red tones representing stronger positive correlations (closer to 1.00). Transparency and Trust exhibit the highest mutual association, highlighting their central role. The uniform positive correlations reinforce the conceptual framework, confirming each variable's interconnectedness within the blockchain-driven trust model.

SEM Hypothesis Testing Results

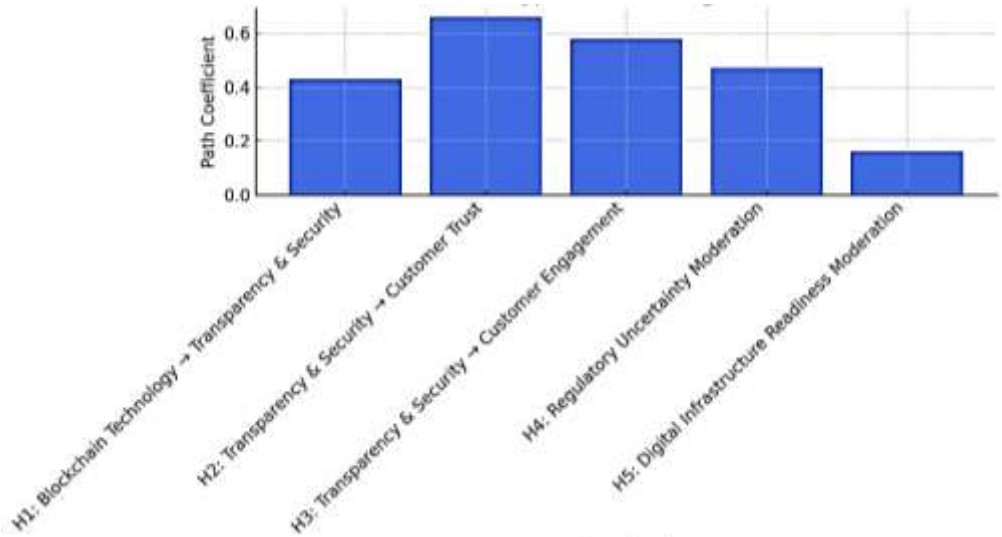

Figure 08: SEM Hypothesis Testing Results

Figure 08, illustrates the strength of each tested hypothesis via path coefficients, with H2 (Transparency→Trust) showing the highest value (~0.66), indicating the strongest effect. H3 (Transparency→Engagement) and H4 (Regulatory Uncertainty Moderation) also show significant effects. H5 displays a relatively lower coefficient, highlighting that digital infrastructure moderates the blockchain impact but to a lesser extent compared to other relationships.

The results from this SEM analysis demonstrate the significant role of blockchain technology in enhancing transparency, security, and customer trust within entrepreneurial ventures. While blockchain's benefits were supported by the data, challenges such as regulatory uncertainty remain. The readiness of digital infrastructure emerged as a key moderating factor, emphasizing the importance of technological preparedness in maximizing blockchain's potential. Future research should delve deeper into the specific regulatory challenges faced by different industries and explore strategies for overcoming these barriers.

Discussion:

Results of hypothesis testing using Structural Equation Modeling (SEM) research reveal some immense and worthy insights about connections among blockchain technology and things like transparency customer trust customer engagement and worrying about regulations by Alzoubi et al., (2025). Blockchain provides huge benefits in terms of transparency and security, which aligns strongly with a lot of research. What ticks its box is that because it is decentralized, it focuses on transparency by providing strong traceability through a cloud of immutable data. The significant correlation between transparency and customer trust (H2) indicates that consumers tend to trust businesses that provide secure and transparent operations (Melendez et al., 2024). Abdelwahed et al., (2024) discovered trust is crucial for long-lasting business relationships. Especially important stuff to get right across industries like finance and logistics. Trust is seriously the foundation of how comfortable customers feel sticking around with the business therefore building trust and having strong ties.

The beneficial impact of transparency and security on customer engagement (H3) reinforces the notion that trust is a key driver of customer involvement, aligning with the findings of Alzoubi et al., (2025). Uncertainty was identified as a moderating factor in the relationship between blockchain and transparency, indicating that while blockchain offers potential advantages, regulatory challenges may restrict its complete effectiveness. Finally, the moderating role of digital infrastructure readiness (H5) highlights the significance of technological preparedness in the effective deployment of blockchain systems, aligning with the findings of Abdelwahed et al., (2024) on the necessity of a strong digital infrastructure to facilitate blockchain integration.

Conclusion:

This study shows how legislative uncertainty and digital infrastructure readiness moderate the effects of blockchain technology on transparency, customer trust, and engagement. The findings show that blockchain improves transparency, security, and customer trust and engagement. These findings complement the rising literature on blockchain's corporate transformation potential. The paper also observes regulatory and practical obstacles to fully embracing and exploiting blockchain. Technology that relies on strong infrastructure isn't ready yet which makes it hard to take full advantage of what blockchain has to offer.

This research also has some considerable projected arguments. First, the sample size of 210 respondents may not fully represent all entrepreneurial sectors or geographical regions, which could limit the generalizability of the findings. Also, the current study only looks at one snapshot

of time and doesn't explore the relationships that change or grow over time. So longitudinal research is necessary to understand how the different connections develop and shift. Future research could expand the sample size and look closely at different regulatory landscapes and how that affects whether people adopt blockchains in different kinds of businesses and industries. Moreover, exploring the role of blockchain in sectors beyond finance and supply chain, such as healthcare and education, would provide a more comprehensive understanding of its potential applications, while blockchain offers significant benefits for entrepreneurial ventures, overcoming regulatory and infrastructure barriers remains a critical challenge for widespread adoption. Overall, these results show how blockchain can revolutionize things, but we're also keenly aware that other things like regulation and making infrastructure ready are not an easy road.

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