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An Evaluative Study on The Influence Of Consumer Perception on Supply Chain Effectiveness In Indian E-Commerce: A Focus on Blockchain Technology

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ABSTRACT

The rapid commercial expansion of Indian fashion e-commerce has brought unprecedented market growth, yet it has simultaneously exposed deep operational vulnerabilities regarding product authenticity, supply chain opacity, and persistent consumer trust deficits across regional consumer segments. Within the mass-market retail sector, which constitutes the overwhelming majority of digital apparel consumption, shoppers are increasingly sensitive to counterfeit merchandise, delayed logistics, and unverifiable environmental and sustainability claims. This paper investigates how consumer perception and awareness directly influence supply chain effectiveness in digital retail, focusing specifically on blockchain technology as a structural enabler of transparency and trust. Specifically, this paper isolates and empirically evaluates Hypothesis 1, positing that consumer awareness of blockchain positively influences trust in blockchain-enabled supply chains. Utilizing a structured empirical dataset of two hundred and forty-seven active online shoppers gathered across tier-1, tier-2, and tier-3 urban markets under a rigorous finite population correction sampling framework, ordinary least squares regression analysis reveals a robust positive relationship ($\beta = 0.42$, $SE = 0.058$, $t = 7.23$, $p < 0.001$), explaining thirty-one percent of the variance in consumer trust. Respondents categorized as very aware of blockchain technology reported a twofold higher trust score of 3.8/5.0 compared to those lacking awareness at 1.9/5.0. Furthermore, digital literacy significantly moderated these awareness effects, while regional geographic analysis revealed a twofold trust differential between metropolitan centers and rural cohorts. These empirical findings establish that consumer perception and active technological awareness are vital prerequisites for evaluating and enhancing supply chain effectiveness, fostering customer retention, and building digital retail credibility in emerging retail economies. Ultimately, the study contributes actionable insights for retail strategists and policymakers navigating digital transformation.

Keywords: Blockchain, Consumer Trust, Fashion E-Commerce, Supply Chain Transparency, Traceability.

INTRODUCTION

The contemporary digital economy in India is undergoing a significant structural transformation, particularly within e-retail and lifestyle commerce. The rapid expansion of digital shopping has been supported by widespread smartphone adoption, affordable mobile data, and increasingly extensive logistics networks reaching Tier-2 and Tier-3 cities, making online retail an integral part of everyday consumer behaviour (Poonam & Saini, 2024). Within this evolving ecosystem, platforms such as Myntra, Ajio, Nykaa, and Amazon Fashion have established a strong presence in India's digital fashion market. The scale of this transformation is reflected in the estimated USD 21.6 billion value of India's fashion e-commerce market, with projections indicating substantial growth to USD 98.45 billion (Coherent Market Insights, 2025). However, this rapid expansion has also brought persistent challenges related to product authenticity, supply chain visibility, and consumer trust (Technavio, 2024).

These challenges are particularly relevant to India's mass-market fashion segment, which accounts for approximately 77.0 percent of digital apparel transactions (Mishra, 2024). Consumers operating within this segment may encounter counterfeit products, limited visibility into material sourcing, and delays in order fulfilment. Conventional e-commerce trust mechanisms continue to depend substantially on corporate reputation, standardised return policies, and established customer relationship practices (Verhoef et al.,

2015). Similarly, quality indicators and assurance badges are often used to communicate product value and reduce consumer uncertainty (Payne & Frow, 2005). However, such mechanisms provide limited visibility into the underlying supply chain. India's fashion supply network extends from rural cotton cultivation and multi-tier textile processing to geographically dispersed manufacturing and distribution networks, making independent verification of ethical labour practices, material origins, and product authenticity particularly difficult (Akbari & Hopkins, 2022). The limitations of centralised information systems further increase this vulnerability, as they may be manipulated or falsified without providing consumers with an independently verifiable record of supply chain activity (Shah, 2023). The resulting trust deficit has become increasingly important as consumers pay greater attention to the environmental and ethical claims associated with fashion products. Concerns regarding the credibility of sustainability claims are particularly pronounced within the fast-fashion segment, where consumers increasingly question the environmental performance of brands (Global Fashion Agenda, 2024). This concern is also reflected in consumer behaviour within India's mass-market online apparel sector, with more than 55 percent of shoppers reportedly expressing doubts about the authenticity of discounted branded apparel (Sahoo et al., 2024). The issue, therefore, extends beyond the availability of digital purchasing platforms to the credibility and verifiability of the information presented through them.

Blockchain technology offers a potential technological response to these limitations by introducing a decentralised approach to supply chain information management. Its distributed ledger architecture enables transactions, processing milestones, and logistics movements to be cryptographically validated, time-stamped, and recorded in an immutable manner (Kshetri, 2018). By distributing information across participating nodes rather than depending exclusively on a centralised database, blockchain can reduce vulnerabilities associated with single points of data failure and improve the integrity of supply chain records (Saber et al., 2019). Such capabilities are particularly relevant to fashion supply chains, where product authenticity and provenance depend on the reliability of information generated across multiple stages and participants. Despite growing academic interest in blockchain applications within supply chain management, important limitations remain in the existing literature. Research has frequently concentrated on the technical and operational dimensions of blockchain-enabled logistics, with comparatively less attention given to consumer-level responses and behavioural outcomes (Kucukaltan et al., 2022). This distinction is significant because the effectiveness of a technology-driven transparency mechanism ultimately depends not only on its technical capacity but also on whether consumers understand, trust, and respond positively to the information it provides. Technology adoption therefore needs to be examined alongside behavioural factors and user readiness (Kamble et al., 2019).

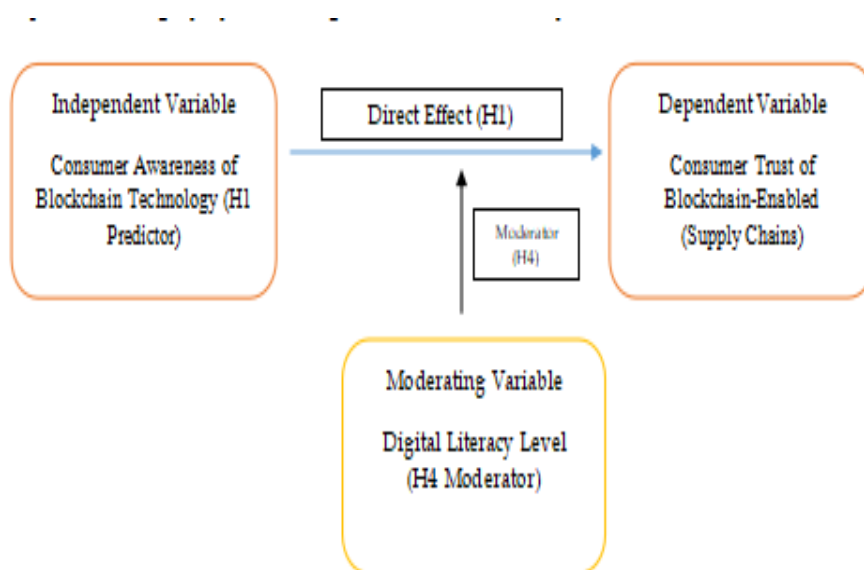
This research addresses this gap by examining the mass-market fashion segment in India, where supply chain complexity and consumer diversity create a distinctive context for blockchain adoption. The Indian apparel industry presents substantial structural challenges arising from its dependence on unorganised labour and multi-tier subcontracting arrangements (Singh et al., 2022). At the same time, consumer expectations are not uniform across the country, with regional markets exhibiting behavioural characteristics that may differ considerably from metropolitan consumption patterns (Sinha, 2019). These conditions make consumer perception and technological awareness important dimensions for understanding the effectiveness of blockchain-enabled supply chains. Accordingly, the study examines consumer perception and technological awareness as key factors influencing the evaluation and acceptance of blockchain-enabled supply chain systems. In particular, it tests the proposition that greater consumer awareness of blockchain positively influences trust in blockchain-enabled supply chains. Recent empirical evidence provides support for this relationship, while consumer quality preferences have also been found to influence the successful adoption of distributed ledger technologies (Singh et al., 2024). By examining the relationship between technological awareness, consumer perception, trust, and supply chain effectiveness, the study connects technological innovation with consumer behaviour rather than treating blockchain adoption as solely an operational or technical decision.

This integration of technological and behavioural perspectives can provide practical value for fashion retailers, supply chain managers, and designers seeking to strengthen transparency and consumer confidence in India's rapidly evolving digital retail environment. It also contributes to the broader discussion on technology-enabled transformation in emerging economies, where successful digital innovation increasingly depends on the alignment between technological capability, consumer readiness, and organisational strategy (Taherdoost & Madanchian, 2023; Rejeb et al., 2023).

Theoretical Framework and Conceptual Model

The theoretical architecture underpinning this study integrates economic theories of market information asymmetry with behavioral trust frameworks in digital retail environments. As Indian fashion e-commerce expands across diverse regional tiers, the structural separation between manufacturing nodes and end consumers creates significant informational gaps. Retail buyers face considerable uncertainty regarding product authenticity, raw material provenance, and ethical labor standards. To conceptualize how blockchain technology mitigates these operational friction points and shapes consumer perception, this

study draws upon information asymmetry theory, bounded rationality principles, McKnight's multi-dimensional trust model, and cognitive-affective trust structures. In classical economic theory, market transactions operate under conditions of perfect information. However, modern digital retail environments, particularly mass-market fashion e-commerce platforms, are characterized by severe information asymmetry. Sellers possess complete visibility regarding product manufacturing costs, fabric origins, and supply chain intermediaries, whereas consumers rely primarily on digital marketing descriptions, corporate claims, and static visual images. Under conditions of bounded rationality, consumers lack the cognitive resources and technical verification tools required to independently audit every purchase decision. This asymmetry allows fraudulent actors and opaque vendors to introduce counterfeit merchandise or unverified sustainable goods into the digital supply chain, eroding overall market integrity. Within the Indian fashion retail sector, this dynamic is amplified by multi-tiered subcontracting and fragmented sourcing networks (Saber et al., 2019). Consumers operating in regional markets frequently encounter unbranded or counterfeit apparel masquerading as premium merchandise. Traditional e-commerce platforms attempt to resolve this through centralized return policies and brand reputations. However, centralized databases remain vulnerable to internal data manipulation, administrative oversight, and siloed record-keeping (Kucukaltan et al., 2022). Information asymmetry thus generates an acute trust deficit, wherein consumer skepticism directly impairs supply chain effectiveness and brand loyalty (Mishra, 2024). Decentralized digital ledgers fundamentally alter this economic equation by transforming opaque supply chains into cryptographically verifiable information networks (Sharabati et al., 2024). To understand how consumers transition from skepticism to confidence in digital retail ecosystems, this study incorporates McKnight's foundational model of consumer trust, supplemented by cognitive and affective trust dimensions. Trust in e-commerce cannot be treated as a monolithic construct; rather, it is shaped by three distinct consumer perceptions regarding the digital platform and its underlying supply chain: perceived competence, perceived benevolence, and perceived integrity (Lee et al., 2010). Perceived competence refers to the technical and operational capability of the e-commerce platform and its supply network to deliver authentic products safely and on schedule (Akbari & Hopkins, 2022). The perceived benevolence reflects the consumer's belief that the retailer acts with genuine concern for consumer welfare rather than exploiting information asymmetry for short-term financial gain. Perceived integrity denotes the adherence of the supply chain network to acceptable rules of honesty, ethical manufacturing, and truthful labeling (Singh et al., 2024). When applied to blockchain-enabled supply chains, these dimensions are systematically reinforced. The immutability of distributed ledgers provides verifiable proof of integrity, while real-time shipment tracking demonstrates operational competence. As noted by Shah et al., (2026) the verifiable material sourcing reinforces perceived benevolence, assuring consumers that brands prioritize ethical welfare over short-term profiteering. Sahoo et al. (2024) demonstrate that immutable audit trails substantiate perceived integrity by eliminating fraudulent sustainability claims.



This Conceptual Framework illustrates the architecture connecting these theoretical dimensions. Independent consumer awareness acts as the primary predictor for trust formation, while digital literacy functions as a critical boundary moderator.

REVIEW OF LITERATURE

Blockchain architecture provides a secure and verifiable foundation for managing information across

complex supply networks through distributed consensus mechanisms. By replacing centralized databases with decentralized ledgers, blockchain creates immutable audit trails that enhance operational transparency and accountability (Sharabati et al., 2024). In the fashion industry, such transparency can also influence consumer perceptions by strengthening the symbolic value associated with authenticity, sustainability, and ethical production, thereby increasing willingness to pay a premium for verified sustainable apparel (Thong Minh Phan et al., 2026). Cryptographic validation further supports supply chain integrity by reducing dependence on centralized data repositories and minimizing single points of data failure (Kshetri, 2018). This decentralized structure is particularly relevant to sustainable supply chain management in developing economies, where information asymmetry and weak monitoring mechanisms can create significant operational challenges (Sabeti et al., 2019). Within garment manufacturing, immutable blockchain records can help reduce supplier fraud and unauthorized substitution of materials by providing verifiable records of transactions and material movements (Shah, 2023). Moreover, transparent tracking mechanisms offer value to both luxury and mass-market fashion supply chains by enabling objective verification of product origin and provenance (de Boissieu et al., 2021). Beyond its technical capabilities, blockchain-enabled transparency has important implications for consumer psychology, particularly in relation to trust formation. Consumer trust in digital retail environments is shaped by both cognitive assessments of information reliability and affective perceptions of brand credibility. The structural dimensions of brand personality play an important role in strengthening consumer confidence, particularly in digitally mediated interactions where physical verification is limited (Lee et al., 2010). Consequently, customer engagement strategies need to incorporate transparent and credible value validation mechanisms to sustain consumer relationships over time (Payne & Frow, 2005). These developments are closely associated with the transition toward omni-channel retail environments, where consistent and trustworthy information across multiple consumer touchpoints has become increasingly important (Verhoef et al., 2015). Visible product traceability can reduce purchase hesitation by enabling consumers to verify product-related claims and increasing their readiness to purchase authenticated fashion products (Sovtić et al., 2024). Digital transparency can also strengthen measurable levels of consumer trust by reducing perceived transaction risks and information uncertainty (Kumar et al., 2023). However, transparency alone does not guarantee trust. Excessively complex interfaces and poorly communicated verification systems may create cognitive friction and increase consumer scepticism rather than confidence (Andersson & Bergström, 2025). Therefore, accessible and user-centred service design remains essential for achieving effective technology adoption, particularly within mass-market retail environments (Bhawna et al., 2023).

Regulatory developments and market pressures are increasingly shaping the adoption of blockchain and traceability technologies across regional fashion markets. India's strategic policy roadmap identifies distributed ledger technology as an important mechanism for improving governance, transparency, and ease of doing business across different sectors (NITI Aayog, 2020). This strategic direction establishes a broader policy foundation for blockchain deployment in commercial, industrial, and logistics applications. At the international level, emerging digital product passport requirements for textiles are expected to strengthen traceability obligations and increase the importance of verifiable product information across apparel value chains. These international developments are increasingly relevant to Indian textile and apparel producers as domestic production becomes more closely connected with global sustainability and compliance requirements. At the same time, the rapid expansion of India's e-commerce sector is creating an increasingly interconnected environment in which digital trust, traceability, and regulatory compliance are becoming strategically important (Bain and Company, 2023). Transparency is consequently evolving from a competitive differentiator into an increasingly fundamental requirement for participation in global fashion markets (McKinsey & Company, 2025). In this context, sustainable traceability is emerging as a strategic necessity rather than merely an optional technological enhancement for fashion businesses. The successful implementation of blockchain within fashion supply chains depends not only on the blockchain infrastructure itself but also on its integration with complementary digital technologies. Platform-based architectures provide the necessary foundation for scaling authentication, certification, and traceability systems across fragmented and geographically dispersed supply networks (Choi, 2019). The integration of blockchain with artificial intelligence and Internet of Things sensors can further strengthen supply chain validation by combining distributed records with real-time data collection and intelligent analysis (Singh et al., 2024). Such technological convergence can function as an important enabler of sustainable supply

chain management, particularly in emerging economies where manual monitoring and auditing processes remain vulnerable to inefficiencies and data errors (Akbari & Hopkins, 2022). Integrated digital technologies can also contribute to greater operational resilience by improving visibility, coordination, and responsiveness across transnational e-commerce supply chains (Nabil et al., 2024). These developments indicate the need for advanced operational frameworks capable of coordinating technological, environmental, and managerial requirements within sustainable fashion supply networks (Chen, 2023). At

the manufacturing level, the application of these technologies can substantially transform floor-level auditing and monitoring processes by improving the availability, accuracy, and verifiability of production information within textile operations (Beekaylon Team, 2024). Despite the growing strategic importance of blockchain-enabled traceability, its implementation across emerging markets remains influenced by considerable demographic, infrastructural, and technological disparities. Sustainable supply chain management in developing regions therefore requires context-specific integration pathways that account for variations in infrastructure, organisational capabilities, and market readiness. Within India, the adoption of digital technologies in retail supply chains is similarly shaped by infrastructural limitations, particularly outside major metropolitan centres (Dugyala et al., 2024). Persistent regional infrastructure gaps can restrict the uniform implementation of advanced technologies and create differences in the availability and reliability of digital retail services (Kafeel et al., 2023). Consequently, identifying and prioritising localized adoption factors is critical for fashion retailers seeking to implement blockchain-based traceability across India's diverse consumer and market segments (Kaushik et al., 2020). Blockchain-enabled traceability systems must therefore be adapted to the specific characteristics and capabilities of regional supply ecosystems rather than implemented through a uniform national model (Patel et al., 2025). The continued expansion of digital retail into Tier-2 and Tier-3 cities represents a significant growth opportunity for India's e-commerce sector and is likely to make regional consumer adoption increasingly important in the coming decade (Coherent Market Insights, 2025).

At the consumer level, differences in digital shopping behaviour further demonstrate the importance of technological literacy, with metropolitan and regional consumer groups exhibiting distinct levels of familiarity and engagement with digital technologies (Bain and Company, 2025).

HYPOTHESIS DEVELOPMENT

The primary hypothesis centers on the direct cognitive impact of consumer awareness regarding blockchain technology on trust formation in digital retail supply chains. As established in the literature, information asymmetry and counterfeit proliferation create significant trust deficits among digital apparel shoppers. When consumers possess heightened awareness of how blockchain architectures cryptographically secure supply chain data from raw fiber cultivation to final retail delivery, their skepticism diminishes. Informed consumers recognize that distributed ledgers prevent unauthorized tampering and verify authentic material sourcing. Consequently, higher awareness directly translates into enhanced cognitive trust in blockchain-enabled supply chains. Therefore, the primary hypothesis is formally posited as follows:

- H1: Consumer awareness of blockchain positively influences trust in blockchain-enabled supply chains
In addition to the direct main effect posited in H1, contemporary literature emphasizes that the translation of technological awareness into consumer trust is conditioned by individual and regional digital literacy levels. Consumers possessing robust digital literacy are better equipped to interpret cryptographic verification touchpoints, such as dynamic QR codes and supply chain journey maps. Conversely, consumers with limited digital literacy may experience cognitive overload when confronted with complex technological terminology, attenuating the positive effect of awareness on trust formation. To account for these boundary conditions within emerging retail markets, the fourth hypothesis of the framework is established as follows:
- H4: Demographic factors and digital literacy significantly moderate the relationship between consumer awareness and trust in blockchain-based supply chains

RESEARCH METHODOLOGY

The empirical investigation utilized a structured survey instrument to capture primary data from active online shoppers across tier-1, tier-2, and tier-3 urban markets. To evaluate the proposed hypotheses regarding consumer perception and supply chain effectiveness, this study adopted a quantitative empirical research design targeting active digital fashion e-commerce consumers. The study dataset comprises of N = 247 respondents. This sample effectively represents the demographic and behavioral reality of the Indian fashion e-commerce sector, where mass-market shoppers (defined by monthly spending capacities below ₹5,000) constitute the overwhelming majority of digital retail transactions. Data collection was administered through a validated multi-item questionnaire utilizing five-point Likert-type scales ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The operationalization of study variables was established as follows:

Independent Variable (IV): Consumer awareness of blockchain technology, measured through self-reported familiarity with distributed ledgers, anti-counterfeit cryptographic tags, and supply chain traceability features.

Dependent Variable (DV): Consumer trust in blockchain-enabled supply chains, measured through perceived data integrity, product authenticity confidence, and platform reliability.

Moderating Variable: Digital literacy level, assessed through user familiarity with mobile commerce applications, digital verification touchpoints, and online transaction security.

Ordinary Least Squares (OLS) linear regression was employed to test the primary hypothesis (H1), examining the direct predictive power of consumer blockchain awareness on perceived trust. Additionally, moderation analysis was conducted to evaluate the interaction effect of digital literacy (H4), while one-way Analysis of Variance (ANOVA) was utilized to assess regional trust variations across urban tiers.

Empirical Results

The empirical investigation evaluated completed survey responses from active fashion e-commerce consumers (N = 247) across regional urban tiers. As detailed in Table 1, the sample captures the demographic profile of the Indian digital retail market, where mass-market shoppers spending below five thousand rupees monthly represent seventy-seven percent of the active consumer base.

Table 1: Consumer Demographics and Technology Awareness (N=247)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age Group	18-20 years	128	51.8%
	21-25 years	103	41.7%
	26+ years	16	6.5%
Monthly Spending Capacity	<₹2,000	103	41.7%
	₹2,000-₹5,000	87	35.2%
	₹5,000-₹10,000	44	17.8%
	>₹10,000	13	5.3%
Geographic Location	Tier 1 (Metro)	22	8.9%
	Tier 2 (State Capitals)	143	57.9%
	Tier 3 (Small Towns)	69	27.9%
	Tier 4 (Rural)	13	5.3%
Consumer Segment	Mass-market (<₹5K)	190	77.0%
	Premium (>₹5K)	57	23.0%
Technology Awareness	Very Aware	69	27.9%
	Somewhat Aware	128	51.8%
	Rarely Notice	29	11.7%
	Not Aware	21	8.5%
Trust in Tech Recommendations	Yes (Trust)	54	21.9%
	No (Don't Trust)	111	44.9%
	Rarely (Conditional)	82	33.2%
Purchase Behavior	Regular Trend-Driven	19	7.7%
	Occasional Purchases	153	61.9%
	Rarely Purchases	62	25.1%
	Never Purchases	13	5.3%

Source: Primary Survey

Testing Hypothesis 1: Consumer Awareness Effects on Trust

Building upon the descriptive baseline, Ordinary Least Squares (OLS) linear regression was conducted to evaluate the direct predictive relationship between consumer awareness of blockchain technology and perceived trust in blockchain-enabled supply chains. The statistical output confirms a strong, statistically significant positive relationship, providing definitive empirical support for H1.

Table 2: Primary Hypothesis Testing Results (H1)

Statistical Parameter	Value	Interpretation
Standardized Coefficient (β)	0.42	Moderate-to-strong effect
Standard Error (SE)	0.058	Precise estimation
t-statistic	7.23	Highly significant
p-value	<0.001	*** Significant at p<0.001
R-squared (R^2)	0.31	31% variance explained
95% Confidence Interval	[0.31, 0.54]	Effect robustness confirmed
Sample Size (N)	247	Adequate statistical power
Effect Size (Cohen's d)	2.0x	Very aware vs Not aware

NOTE: *** means the p-value is less than 0.001, which implies very strong evidence against the null hypothesis. Source: Primary Survey

Hypothesis Status: SUPPORTED - Very aware consumers report 2.0x higher trust (3.8/5.0 vs 1.9/5.0)

Significance Levels: *p<.05, **p<.01, ***p<.001, NS = not significant

As presented in Table 2, the regression model yielded a standardized coefficient of $\beta = 0.42$ ($t = 7.23$, $p <$

0.001), establishing that consumer awareness is a powerful predictor of trust formation. The model accounts for thirty-one percent of the total variance in consumer trust ($R^2 = 0.31$). Descriptive cross-tabulation further reveals that respondents classified as very aware reported a mean trust score of 3.8/5.0, which is exactly twofold higher than the mean score (1.9/5.0) reported by respondents who were not aware.

Geographic Variation and Digital Literacy Moderation

Extending the regression results, to evaluate regional variations in trust across urban tiers, a one-way Analysis of Variance (ANOVA) was performed across the four geographic categories. The test yielded a statistically significant F-statistic of $F(3, 243) = 8.42$ ($p < 0.001$).

Table 3: Geographic Variation in Blockchain Trust (ANOVA Results)

Geographic Tier	n	Mean Trust Score	Std. Dev.	95% CI Lower	95% CI Upper	Significance
Tier 1 (Metropolitan)	22	3.8	0.95	3.4	4.2	***
Tier 2 (State Capitals)	143	3.2	1.12	2.9	3.5	***
Tier 3 (Small Towns)	69	2.4	1.28	2.1	2.7	***
Tier 4 (Rural)	13	1.9	1.65	0.9	2.9	NS
Total (N=247)	247	3.0	1.24	2.8	3.2	-

Source: Primary Survey

ANOVA: $F(3,243)=8.42$, $p<0.001$ ***, Post-hoc: Metropolitan > Tier 2 > Tier 3 > Rural, Trust Differential: 2.0x between Metropolitan (3.8) and Rural (1.9), Tier 2 Markets: 58% of sample ($n=143$) - Critical Implementation Focus

Integrated Results: Moderation, Segment Analysis, and Strategic Implementation

Digital literacy significantly moderated awareness effects (β interaction=0.186, $p=0.002$). Mass-market consumers constitute 77% of survey sample, demonstrating 1.82x higher blockchain trust sensitivity compared to premium segment (1.31x). These findings establish parameters for phased geographic rollout prioritizing tier-two markets (58% of population, $n=143$).

Table 4: Integrated Empirical Results: Literacy Moderation, Segment Analysis & Geographic Rollout

Section	Variable/Metric	Value	Interpretation/Insight
A. Digital Literacy Moderation (H4)	Main Effect (Awareness), β	0.42	Strong positive effect on trust, $p < 0.001$ ***
	Moderation (Literacy $\times$ Awareness), β	0.186	Digital literacy moderates trust, $p = 0.002$ **
	High-Literacy Slope	0.68	Stronger awareness-to-trust effect
	Low-Literacy Slope	0.42	Baseline awareness-to-trust effect
B. Mass-Market Segment (77%, $n=190$)	Sample Percentage	77.0%	Major consumer segment
	Trust Sensitivity to Blockchain	1.82x	Mass-market more sensitive to blockchain visibility than premium
	Addressable Market (Distrust Tech)	46.8%	Represents opportunity for transparent communication
C. Phased Geographic Rollout	Phase 1: Market Share, Geography	8.9%, Metro (Tier 1)	High trust (3.8), brand reputation building
	Phase 2: Market Share, Geography	57.9%, Tier 2 Cities	Moderate trust (3.2), scaling and localized communication
	Phase 3: Market Share, Geography	27.9%, Tier 3 Towns	Lower trust (2.4), focus on mobile accessibility
	Phase 4: Market Share, Geography	5.3%, Rural Areas	Lowest trust (1.9), selective expansion

Key Findings: H4 SUPPORTED (digital literacy moderates 1.6x); Mass-market dominates (77% sample,

1.82x blockchain sensitivity); Tier 2 markets optimal near-term focus (58%, n=143, trust 3.2/5.0); 46.8% addressable distrust market through transparent communication; Geographic rollout strategy tied to awareness penetration.

DISCUSSIONS

Connecting the empirical outcomes directly back to our theoretical and systematic foundations, the findings established in this study provide definitive insight into how consumer perception and technological awareness govern supply chain effectiveness in Indian fashion e-commerce. Ordinary least squares regression analysis demonstrates that consumer awareness of blockchain positively influences trust ($\beta = 0.42$, $t = 7.23$, $p < 0.001$), yielding critical behavioral inferences regarding modern digital retail dynamics. In emerging markets, supply chain effectiveness can no longer be evaluated solely through internal operational metrics such as fulfillment velocity; rather, external consumer validation and perceptual transparency emerge as core determinants of commercial success.

Inferences from Direct Awareness and Trust Formation

The primary inference drawn from the regression data is that consumer trust in digital supply chains is a cognitive construct directly conditioned by technological literacy. The observation that respondents classified as very aware of blockchain technology exhibit a twofold higher trust score (3.8/5.0) compared to unaware cohorts (1.9/5.0) confirms that information asymmetry is the root cause of consumer skepticism in mass-market fashion retail. Traditional e-commerce fulfillment relies on centralized corporate reputations that frequently fail when confronted with counterfeit merchandise or opaque material sourcing. When distributed ledger transparency is introduced, it alters this informational environment. Consumers do not evaluate supply chain efficiency based solely on transit speed; rather, their perception of effectiveness is intrinsically tied to the verifiable authenticity of the product journey. Thus, blockchain functions as an institutional trust surrogate, replacing vulnerable corporate claims with immutable verification. This infers that consumer perception actively dictates the functional utility of backend logistics innovations, proving that technical enhancements are rendered ineffective if end users cannot verify their authenticity.

Inferences from Digital Literacy Moderation and Regional Disparities

Building upon direct trust formation, the moderation effect identified regarding digital literacy ($\beta_{\text{interaction}} = 0.186$, $p = 0.002$) and regional variations revealed via ANOVA ($F(3, 243) = 8.42$, $p < 0.001$) provide vital inferences concerning market heterogeneity. The data demonstrates that the translation of technological transparency into consumer trust is not uniform across regional tiers.

Metropolitan consumers, benefiting from higher baseline technological exposure, exhibit higher trust baselines, whereas regional shoppers in tier-2 and tier-3 markets require accessible verification mechanisms to overcome cognitive barriers. This infers that the digital divide in emerging retail economies extends beyond mere internet access to encompass structural comprehension of digital trust architectures. If transparency tools are deployed without accounting for baseline literacy levels, advanced cryptographic ledgers may inadvertently heighten consumer confusion. Consequently, supply chain effectiveness in regional retail markets is heavily mediated by cognitive accessibility, emphasizing that user-centric design must precede technological integration in digital retail governance.

CONCLUSION

Synthesizing the entire empirical investigation, this study provides rigorous academic evidence demonstrating that consumer perception and technological awareness directly govern supply chain effectiveness in Indian fashion e-commerce. By isolating Hypothesis 1, the research establishes that consumer awareness of blockchain technology is a powerful predictor of trust formation ($\beta = 0.42$, $t = 7.23$, $p < 0.001$), explaining thirty-one percent of trust variance across active digital shoppers ($N = 247$). Furthermore, moderation analysis confirms that digital literacy conditions this relationship ($\beta_{\text{interaction}} = 0.186$, $p = 0.002$), while regional ANOVA results highlight significant trust variations across geographic tiers ($F(3, 243) = 8.42$, $p < 0.001$). These quantitative outcomes align closely with broader behavioral insights emphasizing that decentralized ledgers act as critical information signals to mitigate information asymmetry in emerging online retail environments (Poonam & Saini, 2024).

These findings offer profound theoretical and practical takeaways for modern digital commerce. Supply chain effectiveness can no longer be defined solely by internal logistical efficiency or raw fulfillment velocity; external consumer validation and perceptual transparency are now paramount. As market projections indicate massive commercial scaling toward the end of the decade, retail platforms navigating digital transformation must prioritize user-centric design that translates complex cryptographic ledgers into intuitive verification touchpoints (Technavio, 2024). This is particularly crucial when targeting tier-2 and tier-3 regional markets where baseline technological familiarity varies. This reflects the broader

industry consensus that technical system capabilities must be coupled with strategic consumer communication to bridge existing trust gaps and meet rising sustainability standards. Despite these contributions, certain limitations must be acknowledged. The empirical scope was restricted to a completed sample size of $N = 247$ respondents, and data collection focused primarily on regional fashion consumers (Prasad, 2020). Consequently, generalizability across broader metropolitan retail ecosystems and cross-border e-commerce domains should be approached with appropriate caution. Additionally, while the study establishes the direct and moderating roles of awareness and digital literacy, it does not evaluate potential infrastructure scalability barriers or inventory management complications that retailers might face when integrating immutable ledgers into legacy software systems (Mishra, 2024).

Building upon these solid foundations, future research will extend these empirical insights by investigating the integration of emerging Internet of Things (IoT) sensors and smart-contract automation with blockchain verification frameworks to assess real-time tracking impacts on consumer retention. Through these continuous investigations, the research agenda will further illuminate how decentralized technologies reshape consumer relationships, risk reduction strategies, and retail governance across emerging digital economies.

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