Review of Futures Markets (RFM)
ISSN: 1933-7116
Volume 34 Issue 2 (2026)
Website: https://fra.st

Impact of Beyond Government E-Marketplace: Evaluating the Long-Term Blockchain Technology on Public Procurement Transparency in India

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Received: 10/02/2026 Accepted: 16/09/2026 Published: 06/11/2026

Abstract
Technology involvement like blockchain is requisite because inefficiencies, a lack of transparency and corruption are the major drawbacks or issues frequently associated with public procurement which makes it a critical driver of economic growth. The work reported probes the long-term effects of this blockchain technology on public procurement emanating from India for informing public policymakers and procurement agencies towards the realization of possible benefits. Transforming public procurement transparency in India revolves around smart contracts and decentralized ledger technology, as well as supplier trust, government policies, system interoperability, data transparency, legal challenges, and resistance from stakeholders. This study has conducted a structured survey designed in quantitative procedures over 500 procurement professionals, policymakers, auditors, and compliance officers by stratified random sampling with a view to investigate the impact of blockchain on public procurement transparency and reduction of corruption with the adoption of rigorous analytical methodology. The study is based on the primary presumption that blockchain can promote procurement transparency and corruption reduction; and smart contracts, decentralized ledger technology, and interoperability with existing systems are all considered major drivers for such an impact. The major findings from this study point out that the availability of decentralized ledger technology, smart contracts, and data transparency mechanisms are central for improving procurement efficiency and fighting all forms of unethical practices. One of the important contributions of this research is the acknowledgement of supplier trust and compliance as an influencing factor of procurement transparency and the role played by stakeholder resistance toward blockchain adoption. Future studies should evaluate real-life case studies of blockchain-integrated procurement systems and assess their continued impact.

Keywords: Blockchain adoption, public procurement transparency, corruption reduction, smart contracts.

1. Introduction

The acquisition of goods, services, and infrastructure by governments is termed public procurement, a very potent tool for economic growth and development (Kumar, 2022). Unfortunately, public procurement practices are among the most inefficient sectors that suffer from corruption and a lack of transparency (Abioro, 2021). Public procurement accounts for roughly 13.20% of GDP in many countries, making the efficiency and integrity of this process immensely important to national economies (OECD, 2023), a trend supported by OECD (2025) Report that examines the digital transformation of procurement across OECD and non-OECD countries, highlighting three pillars: lifecycle integration, adoption of emerging technologies, and robust data capabilities.

Classical procurement systems lack transparency, involve tedious bureaucratic procedures, and present opportunities for fraud and favouritism (Obicci, 2024). The use of blockchain technology for public procurement could provide a transformational solution to these associated problems by rendering a decentralized, tamper-proof ledger system that assures transparency, efficacy, and trust among concerned stakeholders. and procurement planning in the public procurement stages. Adjorlolo et al. (2025) strived to develop a targeted framework for blockchain deployment in public procurement from an African country perspective, following their observation that tender evaluation was the most critical stage susceptible to corruption, followed by contract management. In the context of Morocco, Elalaoui Elabdallaoui et al. (2021) proposed a blockchain-based infrastructure to improve the mechanism of public procurement, especially in the context of lack of trust and transparency among critical stakeholders in the procurement process.

In India, government procurement accounts for nearly 30% (International Trade Administration: U.S. Department of Commerce, 2026) of India's approximately $4 trillion GDP (Worldometer, 2026). Bidding favouritism and contract management have continued to plague the sector despite several reforms. However, limitations remain in terms of real-time auditing, centralized control, and human intervention, which call for much stronger technological intervention case for blockchain (Vajrobol et al., 2025). Countries such as Estonia, the United Arab Emirates, Chile, and the United States of America, have already acquired blockchain-supported procurement systems to ensure that procurement processes are transparent and accountable (Bharadwaj, 2026). As a pioneer in digital reform, India now has space to adopt blockchain public procurement in fighting bribery, boosting regulatory compliance, and simplifying operational processes in public procurement (Gayatri, 2022; Mishra & Maheshwari, 2021). Singh et al.'s (2023) study that investigates the barriers in the adoption of blockchain technology in construction supply chain management identifies market-based risks and financial-barriers as the most influential barriers. Thus, the absence of absolute, transparent immutability limits real-time auditing and trust between parties. Therefore, there is a demand for studies on the potential use of blockchain technology in existing e-marketplace frameworks toward improving transparency in public procurement and reducing corruption.

The present research study is important in that it assesses the long-term impact of blockchain technology on public procurement transparency in India, considering smart contracts, decentralized ledger technology, supplier trust, government policies, and system interoperability. It also examines data transparency and auditability as mediation and looks into legal, ethical, and stakeholder resistance as moderating variables. Through systematic contemplation on all these issues, this investigation will enable better understanding among policymakers, procurement agencies, and businesses about blockchain-based procurement solutions.

1.1 Study Objectives

- Understand how smart contracts affect public procurement transparency in India.
- Analyse the role of decentralized ledger technology in curbing corruption in public procurement.
- Evaluate the impact of supplier trust and supplier compliance concerning transparency in procurement.
- Investigate the degree to which government policy has impacted the adoption of blockchain in public procurement.
- Assess how blockchain is interoperable with existing procurement systems and its significance for transparency and efficiency.
- Explore the role of data transparency and auditability as a mediator in the procurement process carried out using blockchain.
- Understand how legal issues and ethical dilemmas moderate the acceptance of blockchain for public procurement.
- Study stakeholder opposition and its implications concerning the effectiveness of blockchain in procurement processes.

2. Theoretical Framework and Hypotheses Development

Public procurement significantly contributes to economic development and governance but is the most susceptible to inefficiencies, corruption, and opacity (Fazekas & Blum, 2021). Blockchain technology promotes transparency and reduces corruption in public procurement through its decentralized ledger system and smart contracts (Ceke et al., 2022). A permissioned ledger can create a time-stamped, tamper-evident record of tender notices, bid submissions, evaluation actions, awards, delivery verification, and contract changes; smart contracts can encode compliance checks and flag unauthorised changes. These functions could make audit trails more complete and improve traceability for oversight bodies and suppliers (Weingärtner et al., 2021; OECD, 2025). Research conducted by Telles (2022) in the emerging economy context such as Aragon (Spain), Colombia and Puru, concluded that blockchain offered limited incremental value for public procurement at that time except in narrower problems such as cross-border certification/contract-data management or low-trust settings, and together with the research carried out by Sava & Dragoș (2022) indicate that adoption of blockchain technology supports technical feasibility and plausible transparency mechanisms. It is also important to note that blockchain technology adoption also requires integration with legacy

platforms, interoperable and high-quality data, procurement-and-technical capability, and rules for confidential supplier data, correction/deletion responsibility, and legal enforceability (Sanchez, 2019; OECD, 2025). It has also been proposed that blockchain technology may be adopted to connect fragmented supplier records and support public monitoring of projects (Akaba et al., 2020).

The present analysis is premised on two dominant frameworks, that is, Institutional Theory (Lammers et al., 2014) and Transaction Cost Economics (TCE) (Williamson, 1998). These theories provide a robust context for explaining how the dynamics of blockchain adoption within public procurement impact transparency and reduce corruption. Institutional Theory indicates that within a normative environment, organizations conform to formal and informal norms, rules, or regulations to achieve legitimacy and hence gain stability (Peters, 2011). Several institutional pressures regarding public procurement, such as government regulations, stakeholder expectations, and international best practices, compel the adoption of blockchain technology (Janssen et al., 2020). Here, the government can play a role in the establishment of a favourable policy environment for blockchain adoption in the procurement process, wherein compliance with institutional norms would greatly enhance transparency and efficiency.

As an extension of Institutional Theory, Institutional Isomorphism draws on coercive, mimetic, and normative influences exerting pressure on organizations to obtain similar structures and technologies (Lai et al., 2006). Coercive pressure emanates from legal recourse in favour of greater transparency in the procurement process, whereby increasing pressure is brought onto government agencies toward blockchain-based procurement. Mimetic pressures arise when organizations compare their practices in blockchain adoption to those of other successful government procurement systems (Mishra et al. 2025). Normative pressure comes from professional organizations and international bodies advocating for digital transformation and enhanced auditability in procurement. Based on the above discussion, the following hypotheses are proposed in the study:

H1: Smart contracts enhance transparency in public procurement.
H2: The decentralized ledger technology promotes transparency in public procurement.
H3: The trust of suppliers and compliance add positively to the transparency of public procurement.
H4: Government policy on the use of blockchain affects the capacity of blockchain to guarantee public procurement transparency positively.
H5: The interoperability of blockchain with existing procurement systems is very advantageous in terms of public procurement transparency.

Blockchain technology provides independence and transparency for transactions, rendering it capable of satisfying the institutional requirements for accountability and compliance with regulation (Paech, 2017). By producing tamper-proof records and automated execution of contacts, blockchain might be used to reduce the discretionary powers given to officials and eliminate opportunities for corrupt practices (Bagby et al., 2019). Thus, the following hypotheses are proposed in the study:

H6: Smart contracts in public procurement promote a reduction in corruption.
H7: The implementation of decentralized ledger technology reduces corruption within public procurement.
H8: Supplier trust and compliance will readjust the level of corruption in public procurement.
H9: Government policies surrounding blockchain usage will act as a major determinant in corruption reduction in public procurement.
H10: The interoperability of blockchain with existing procurement systems assists in corruption mitigation in public procurement.

Transaction Cost Economics (TCE) describes how organizations attempt to minimize transaction costs in selecting the appropriate governance structure (Marjosola, 2021). Transaction costs in public contracting arise from information-related asymmetry, opportunistic behaviour, and contractual complexity. High monitoring and enforcement costs afflict the traditional procurement systems, leading to inefficiencies and rent-seeking tendencies (Rokkan & Haugland, 2022). Blockchain's decentralized ledger and automated smart contracts will significantly bring down these costs by ensuring transparency, less verification, and no intermediaries. Data transparency and audibility play vital roles in decreasing transaction costs and increasing efficiency (Zhu, 2002), so they have been considered as the mediating variables in this study. Hence, the following hypotheses are proposed in the study:

H11: Data transparency and auditability mediate the relationship between blockchain adoption (smart contracts, decentralized ledger technology, supplier trust, government policy, and interoperability) and public procurement transparency.
H12: Data transparency and auditability mediate the relationship between blockchain adoption (smart contracts, decentralized ledger technology, supplier trust, government policy, and interoperability) and reduction in corruption.

Blockchain's advantages for public procurement notwithstanding, its implementation is naturally restrained by legal, ethical, and organizational issues (Mustafa et al., 2025). The regulatory regime around procurement-related use of blockchain, issues of data protection laws, compliance for cross-border procurement, and mechanisms for dispute resolution are still being raised (Michael, 2021). Ethical issues arise in connection with the anonymity of blockchain transactions and the risk of preventing suppliers who are not technologically savvy from entering the procurement process.

In addition, resistance from stakeholders such as procurement officials, suppliers, and policymakers have been observed to be a formidable barrier against the implementation of blockchain technology (Öztürk & Yildizbaşi, 2020). This resistance primarily arises due to the fear of job loss, lack of technical knowledge, and distrust regarding the veracity of the blockchain platform itself. Such factors throw a spanner in the works of the relationship between influencing factors for blockchain adoption and its stakeholder consequences of transparency in procurement and corruption reduction. This leads to the final set of hypotheses that are proposed in the study:

H13: Legal and ethical challenges of blockchain in procurement moderate the relationship between supplier trust compliance and public procurement transparency.
H14: Stakeholder resistance to blockchain adoption moderates the relationship between reduction in corruption and Interoperability of Blockchain with Existing Procurement Systems.

Based on the above proposed hypotheses, the Conceptual Framework Diagram of the proposed research is presented in Figure 1 below.

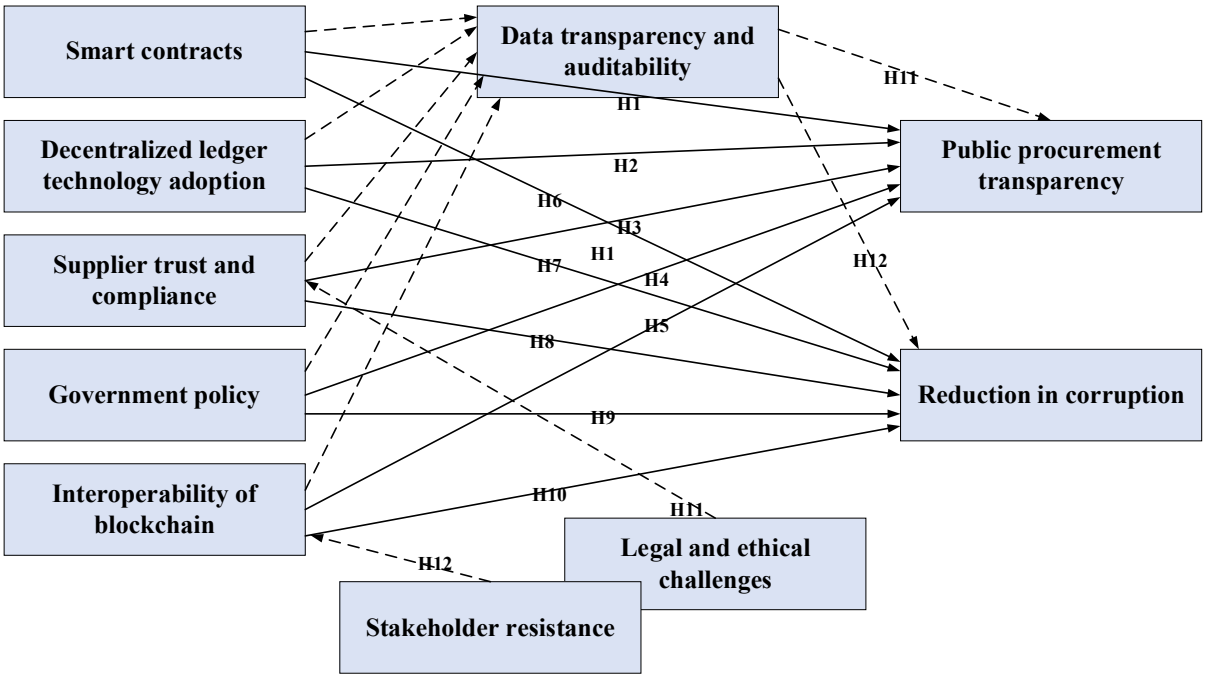

Figure 1: Conceptual Framework Diagram

3. Literature review

In public procurement, blockchain technology has been increasingly studied as a transformational force that guarantees increased openness, efficiency, and accountability. Recent research reported the promises of blockchain and its related technologies such as smart contracts and the Internet of Things (IoT) in resolving fraud, corruption, and inefficiency issues in procurement systems. According to Mircea et al. (2022), the effects of Blockchain and the Internet of Things (BIoT) on public procurement were studied using Structural Equation Modelling (SEM) to validate their model. The study found that the adoption BIoT was found to contribute significantly to sustainable public procurement through increased transparency and improved trust and reduced corruption and fraud in procurement processes. Further, it noted the importance of national and international policy measures in successful adoption of BIoT in procurement.

The study carried out by Alves Batista (2024) on records management vis-à-vis procurement accountability focused on the roles blockchain technology can play in addressing forgery and omission of records. This study utilized a comparative analysis of international legislations with an accounting of records frauds in Brazil. The results considered record management methods while showcasing the potentialities of blockchain as an accountability

enhancement tool to prevent fraudulent culture in procurement. So immutable records were shown to reduce tampering risk and enhance the accountability of procedures in procurement by transparency. Khalfan et al. (2022) discussed insights on the application of blockchain technology in project procurement drawing data from developing nations, especially Bangladesh. The qualitative study explored blockchain applications in project management and procurement, demonstrating its capacity to alleviate disadvantages such as poor transparency and ineffective procurement management. The study established that one of the arguments for procurement in developing countries relates to regulatory measures giving emphasis to awarding contracts to the lowest bidders, which often result in poor project quality being compromised and increased risks of corruption. The researchers, therefore, proposed a guideline for the use of blockchain in procurement, enhancing accountability and efficiency.

In support of advancing the arguments for the merit of blockchain technology, Benítez-Martínez et al. (2023) proposed a truthfulness governance system based on a permissioned blockchain model from neural blockchain technology and smart contracts. Their model creates an on-chain consensus system capable of securely storing procurement information so that corruption can be avoided. The study asserted that the major attributes of blockchain- transparency, immutability, security, inclusiveness, and disintermediation- were important in setting out new policies and governance frameworks against corruption. Their findings pegged blockchain technology strongly in support of sustainable public procurement that aims at the UNSDG (United Nations Sustainable Development Goals).

In an entirely different research context, blockchain adoption in Indonesia's government service delivery is discussed by Judijanto (2023), who used a mixed-methods strategy to include regression analyses and descriptive statistics. The study gauged the perceptions of government officials, service providers, and citizens, particularly regarding the impact of blockchain technology. The results showed an overwhelming sway of positive perceptions with statistically significant links between adoption of blockchain and the factors of enhanced transparency, diminishing fraud and corruption, and improved efficiency of government procurement. The study pointed out that blockchain plays an important role in bringing greater confidence for the public in government transactions. Özkan and others (2021) considered smart contracts in project procurement and adopted a qualitative research design underpinned by phenomenology. Their finding indicated that smart contracts achieve procurement efficiency in terms of cost, time, and quality. In addition, they established that smart contracts create a trust-less platform underpinned by parameters of transparency, traceability, and security. The study proposed that the introduction of smart contracts into the procurement processes will improve their efficiency and reliability, thereby warranting sustainable competitive advantages of project procurement management.

The importance of blockchain in public procurement was further reinforced by the work of da Silveira et al. (2021), which examined the perception of public procurement managers towards adopting blockchain. This research was carried out through a structured survey conducted with 92 municipal procurement managers in Rio de Janeiro, Brazil, and combined qualitative and quantitative methods. The study indicated that blockchain would make it

possible to track entire supply chains thereby exposing some unethical practices such as child labour, environmental exploitation, and counterfeit goods. The results inferred that the application of blockchain technology could strengthen procurement transparency while ensuring compliance with ethical and environmental standards. Another linkage study by da Silveira et al. (2022) further reinforced the role of blockchain in procurement transparency and addressing unethical practices in supply chain management. The results established that blockchain-enabled procurement systems can curtail fraudulent practices in procurement by providing an immutable and verifiable transaction history, highlighting the necessity for policy interventions that would promote the implementation of blockchain procurements in the public sector.

In turn, these studies advance a strong claim that if implemented, blockchain shall benefit public procurement in terms of transparency, efficiency, and the reduction of corruption. However, while these studies carried worthwhile appraisal, they have mostly dwelled in international contexts or qualitative assessments, paying less attention to the in-depth study of the impact of blockchain technology adoption on public procurement in an emerging economy context, such as India. Beyond this, little is known about supplier trust, interoperability of blockchain with existing procurement applications, and potential moderating effects of legal and ethical aspects in this respect. The proposed research fills the knowledge gap by empirically assessing the impacts of smart contracts, decentralised ledger technology, supplier trust, and government policies on procurement transparency in India. It will seek to establish data transparency as a mediating variable in the study, while also looking at stakeholder resistance as a moderating variable within the context of blockchain-enabling procurement, allowing for a balanced assessment of its effectiveness from an Indian standpoint.

4. Research Methodology

The research employs a quantitative approach with the aim of examining the impact of blockchain technology on public procurement transparency and corruption reductions. The primary data from public procurement professionals, policymakers, auditors, and compliance officers were collected using a survey method. The structured methodology being adopted guarantees the reliability, validity, and generalizability of the findings.

4.1 Sampling and Sampling Method

In total, a sample of 500 respondents was chosen to arrive at statistically valid data and to properly represent the various stakeholders in the procurement ecosystem in India. The study used stratified random sampling, in which respondents were classified by their role in procurement, like government procurement officers, policymakers/regulators, auditors, and compliance officers to achieve a proportionate representation. Stratification was chosen because the precision of estimates improves and the amount of sampling bias decreases. Because the subject is highly technical, respondents were obtained from all government procurement departments, regulatory and compliance agencies ensuring that only specialist experience respondents participated.

Now that all roles within procurement are sampled across different strata, heterogeneous views across procurement roles can be included without compromising

representativeness. Variation in adoption of blockchain by different roles in the organization makes it desirable to use stratified random sampling methodology to study differences in perceptions and problems. A final random selection within each stratum was applied to avoid selection bias. Inclusion criteria stated that participants must have at least year-long membership experience in the procurement/public sector operations and should appreciate blockchain and its workings in procurement processes.

4.2 Data Collection

Primary data were collected using a structured questionnaire, distributed via online and in-person interviewing to maximize response rates. The instrument was designed as a survey instrument on Google Forms and printed copies, making it accessible to those respondents with different technological preferences. To improve participation, procurement departments and regulatory bodies were contacted in advance for distribution among employees. The survey lasted six weeks, enough time to allow responses while ensuring a high response rate. A pilot study with the adoption of 30 respondents was undertaken before carrying out the actual survey to refine the questionnaire on ambiguities and clarity in the wording.

4.3 Questionnaire Adoption and Structure

The questionnaire was sourced and adapted from earlier studies on blockchain acceptance in procurement, transparency, and corruption mitigation. Constructs were obtained from grounded measurement scales in studies on blockchain governance, smart contracts, decentralized ledger technology, supplier trust, and procurement efficiency. The responses used to measure perceptions provided comparability across the responses on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Reliability of the constructs were then checked with Cronbach Alpha, where an alpha value greater than 0.7 was found to infer the reliability with an acceptable internal consistency.

4.4 Data Analysis

The collected data were analysed using descriptive and inferential statistics through IBM SPSS and AMOS. Descriptive analysis comprised of mean, standard deviation, and frequency distribution that were used to summarize demographic characteristics and general perceptions. Going forward, T-tests and ANOVA were conducted to test differences between demographic groups. Inferential analysis was conducted using Structural Equation Modelling (SEM) in AMOS to test the hypothesized relationship of blockchain adoption on procurement transparency and reduction in corruption. The confirmatory factor analysis (CFA) was performed to validate constructs-factors loadings and model fit indices (CFI, RMSEA, and TLI). The moderation effects of legal, ethical challenges, and stakeholder resistance were analysed using hierarchical regression models that examined how these factors influence the relationships between blockchain adoption and procurement outcomes. To find the robustness of results, variance inflation factor (VIF) tests were conducted to check for multicollinearity. The study also employed bootstrapping techniques (5,000 re-samples) to estimate confidence intervals for path coefficients, thus improving reliability in estimates.

4.5 Ethical Considerations

The study strictly followed the ethical guidelines for research and provided voluntary participation, informed consent, and responses confidentiality. Participants were informed that the data collected would be used only for research purposes. Personal identifiers that were linked to the data were removed during analysis. Institutional ethics approval was obtained to conduct the study.

5. Results

Table 1 presents the sociodemographic characteristics of the respondents.

Table 1: Sociodemographic Characteristics

Sociodemographic characteristics		Frequency %	Variance	T
Age	Below 25 years	9.6	.782	64.228
	25 – 34 years	40.8		
	35 – 44 years	38.6		
	45 – 54 years	8.0		
	55 years and above	3.0		
Gender	Male	62.2	.236	63.483
	Female	37.8		
Educational qualification	High School or Below	7.8	.461	79.818
	Bachelor's Degree	45.0		
	Master's Degree	44.2		
	Doctorate (Ph.D.)	3.0		
Role in procurement process	Government Procurement Officer	45.6	.342	60.962
	Policy Maker/Regulator	49.4		
	Auditor/Compliance Officer	5.0		
Years of experience in procurement/public sector	Less than 1 year	7.6	.761	84.429
	1 – 5 years	2.0		
	6 – 10 years	46.6		
	11 – 15 years	41.0		
	More than 15 years	2.8		
Level of familiarity with blockchain technology	Moderately familiar	47.0	.370	58.604
	Very familiar	46.6		
	Expert	6.4		
Involvement in blockchain-based procurement system	Yes	69.6	.212	63.327
	No	30.4		
Perception of blockchain future	Negative	10.2	.427	79.840
	Neutral	46.2		

in public procurement	Positive	43.6		

It may be observed from Table 1 that the largest segment of the respondents (40.8%) are aged between 25 and 34 years, followed closely by the 35-44 years age group (38.6%). It appears that middle-career professionals are highly represented in the procurement sector. The gender distribution is skewed toward males (62.2%) compared to females (37.8(%), reflecting possible male dominance in procurement roles. The bachelor's degree holders represent a higher percentage of responses (45.0%), followed closely by the master's degree holders (44.2%). Very few participants have a Doctorate Degree (3.0%) or have studied only up to the high school level (7.8%). These findings suggest that procurement professionals stand very highly in educational qualifications, which might shape their positive-handed approaches to accepting new technologies such as blockchain. Referring to professional roles, almost half of the respondents are government procurement officers (45.6%), while policymakers or regulators closely follow with 49.4%. Auditors and compliance officers comprise only 5.0% of the sample, which implies that most blockchain decision-makers are procurement officers and policy makers, but they might not have direct compliance oversight. Majority professionals have from 6 to less than 10 years (46.6%) or 11 to 15 years (41.0%) of experience, meaning the experienced professionals, rather than new entrants, are assessing the adoption of blockchain technology in our sample. In fact, only 2.0% have 1-5 years of experience and just 7.6% have less than a year of service in procurement, meaning that respondents are, by majority, individuals possessing considerable exposure in the sector. It is observed that the majority of respondents are familiar with blockchain technology with 47.0% being moderately familiar, 46.6% being very familiar, and 6.4% of the respondents consider themselves as experts. Therefore, there seems to be a general awareness but a lack of depth concerning expertise in this domain. The involvement in blockchain-based procurement systems is relatively high, with 69.6% of the respondents having some experience with such systems, whereas 30.4% of the respondents have had no involvement with this technology. This suggests that blockchain integration in procurement is clearly not yet universal. The perception of the future of blockchain in public procurement is largely neutral (46.2%) or positive (43.6%), with only 10.2% being negative. This expresses a general optimism regarding the role of blockchain in procurement, albeit with some reservations.

The salient parameters of blockchain technology's influence on procurement are presented in Table 2. A perusal of this Table indicates that the mean scores reflect positive perceptions regarding the merits of utilizing blockchain-accommodating decentralized ledger technology (M=3.99, t=132.763) and data transparency and auditability (M=3.98, t=116.837); both recorded high scores. The mean score for other components, such as smart contracts in public procurement (M=3.92, t-116.221) and corruption reduction (M=3.91, t-115.941), and supplier trust and compliance (M=3.96, t-116.798), also provided with excellent positive responses. Thus, it could be concluded that blockchain is seen as a good measure for increasing the transparency of procurements, decreasing corruption and increasing trust in procurement.

Table 2: Influence of Blockchain Technology on Procurement

Variables	Mean	t
Public procurement transparency	3.96 ± 0.75	118.600
Reduction in corruption	3.91 ± 0.75	115.941
Smart contracts in public procurement	3.92 ± 0.75	116.221
Decentralized ledger technology adoption	3.99 ± 0.67	132.763
Supplier trust and compliance	3.96 ± 0.76	116.798
Government policy on blockchain usage	3.94 ± 0.74	118.437
Interoperability of blockchain with existing procurement systems	3.90 ± 0.76	114.118
Data transparency and auditability	3.98 ± 0.76	116.837
Legal and ethical challenges of blockchain in procurement	3.97 ± 0.67	133.086
Stakeholder resistance to blockchain adoption	3.95 ± 0.74	119.628

Table 3A presents the list of the latent constructs and their respective indicator variables, adopted in the study. Furthermore, the study explored the factor loadings that manifest the strength of constructs in each case, presented in Table 3B. The figures were found to range from 0.299 to 0.808. Strong factor loadings for constructs such as decentralized ledger technology (i.e., DLT1 = 0.774, DLT2 = 0.791) suggest adequate construct validity. Regarding public procurement transparency (i.e., PPT2 = 0.808, PPT3 = 0.767) and compliance with supplier trust (i.e., SCP5 = 0.808), we have good internal consistency.

Table 3A: Latent Constructs and the Indicator Variables

S. No.	Latent Constructs	Indicator Variables
1.	Decentralized Ledger Technology (DLT)	A decentralized ledger ensures procurement records remain tamper-proof (DLT1) Decentralized technology in procurement enhances fair competition among suppliers (DLT2) The implementation of decentralized ledgers increases efficiency in procurement audits (DLT3) Blockchain decentralization ensures equal access to procurement information for all stakeholders (DLT4) The risk of data breaches in procurement has reduced due to decentralized ledger adoption (DLT5)
2.	Government Policy (GPB)	The government has provided clear policies on blockchain adoption in public procurement (GPB1) Government support for blockchain improves its adoption in procurement processes (GPB2)

		Regulatory frameworks ensure the secure implementation of blockchain in procurement (GPB3) The lack of blockchain-specific procurement policies hinders its widespread adoption (GPB4) Government policies have encouraged suppliers to participate in blockchain-based procurement (GPB5)
3.	Interoperability of Blockchain with Existing Procurement (IBE)	Blockchain is effectively integrated with current public procurement systems (IBE1) Lack of interoperability with existing procurement software hinders blockchain adoption (IBE2) Blockchain improves the efficiency of traditional procurement systems (IBE3) System compatibility challenges slow down the implementation of blockchain in procurement (IBE4) Organizations are investing in making procurement systems interoperable with blockchain (IBE5)
4.	Public Procurement Transparency (PPT)	Blockchain implementation has improved the transparency of public procurement processes (PPT1) The use of blockchain reduces hidden or unauthorized changes in procurement records (PPT2) Real-time accessibility to procurement data through blockchain enhances stakeholder confidence (PPT3) Blockchain-based procurement ensures a clear audit trail for all transactions (PPT4) Public access to procurement contracts has increased with blockchain adoption (PPT5)
5.	Reduction in Corruption (RC)	Blockchain technology has minimized opportunities for bribery in public procurement (RC1) Smart contracts reduce manual interventions, thereby lowering corruption risks (RC2) The decentralized nature of blockchain prevents procurement fraud and favouritism (RC3) Government officials have limited ability to manipulate procurement records due to blockchain adoption (RC4) The traceability of blockchain transactions discourages unethical practices in procurement (RC5)
6.	Smart Contracts in Public Procurement (SCP)	The use of smart contracts ensures automatic execution of procurement agreements (SCP1) Smart contracts eliminate the need for intermediaries, reducing delays in procurement (SCP2)

		The risk of contract manipulation is reduced through blockchain-enabled smart contracts (SCP3) Smart contracts enhance accountability among procurement stakeholders (SCP4) Automated payments via smart contracts ensure timely delivery of goods/services (SCP5)
7.	Supplier Trust and Compliance (STC)	Blockchain-based procurement increases supplier trust in government contracts (STC1) Suppliers are more likely to comply with procurement regulations when blockchain is used (STC2) The transparency of blockchain procurement encourages fair supplier participation (STC3) Suppliers feel more secure engaging in blockchain-enabled procurement systems (STC4) Compliance verification of suppliers is more efficient through blockchain-based records (STC5)

Table 3B: CFA Estimation: Factor loadings

	DLT	GPB	IBE	PPT	RC	SCP	STC
DLT1	0.774						
DLT2	0.791						
DLT3	0.694						
DLT4	0.328						
DLT5	0.299						
GPB1		0.668					
GPB2		0.688					
GPB3		0.725					
GPB4		0.683					
GPB5		0.66					
IBE1			0.672				
IBE2			0.697				
IBE3			0.623				
IBE4			0.665				
IBE5			0.63				
PPT1				0.667			
PPT2				0.808			
PPT3				0.767			
PPT4				0.752			
PPT5				0.754			
RC1					0.67		

RC2					0.768		
RC3					0.696		
RC4					0.768		
RC5					0.578		
SCP1						0.581	
SCP2						0.534	
SCP3						0.563	
SCP4						0.751	
SCP5						0.808	
STC1							0.72
STC2							0.704
STC3							0.697
STC4							0.728
STC5							0.742

The path analysis results are presented in Table 4. A perusal of Table 4 indicates a robust association between blockchain adoption factors and procurement outcomes. It is observed that for accessing data transparency and auditability, the important factors are smart contracts in public procurement ($\beta=0.713$, $p<0.001$); decentralized ledger technology adoption ($\beta=0.626$, $p<0.001$); supplier trust and compliant ($\beta=0.188$, $p=0.002$); interoperability of blockchain with existing procurement systems ($\beta=0.132$, $p<0.001$); and government policy on blockchain use ($\beta=0.109$, $p<0.001$). Hence, these findings suggest that smart contracts and decentralized ledgers are the most powerful drivers for procurement transparency, while interoperability and government regulations have other influencing roles. The factors interoperability with existing systems ($\beta=0.389$, $p<0.001$), data transparency and auditability ($\beta=0.552$, $p<0.001$), and decentralized ledger technology adoption ($\beta=0.198$, $p<0.001$) significantly impact public procurement transparency. The factors smart contracts ($\beta=0.254$, $p=0.006$), supplier trust compliance ($\beta=0.213$, $p=0.008$), and government policy ($\beta=0.130$, $p=0.004$) also have positive effects on transparency but are less influential. That makes blockchain adoption most effective if combined with existing procurement systems and complemented with strengthening transparency mechanisms. Corruption reduction in the procurement process is very strongly determined by existing system interoperability ($\beta = 0.759$, $p < 0.001$), data transparency and auditability ($\beta = 0.618$, $p < 0.001$), and by smart contracts ($\beta = 0.491$, $p < 0.001$). Also, supplier trust compliance ($\beta = 0.144$, $p = 0.007$), government policy ($\beta = 0.155$, $p = 0.002$), and adoption of decentralized ledger technologies ($\beta = 0.213$, $p < 0.001$) play their roles in corruption reduction. These findings, therefore, show that blockchain would likely be effective in reducing corrupt practices, particularly if procurement systems are made interoperable with the rest of the systems.

Review of Futures Markets (RFM)
ISSN: 1933-7116
Volume 34 Issue 2 (2026)
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Table 4: Pathway Analysis through SEM

Pathway			Estimate	S.E.	C.R.	P
Data transparency and auditability	<---	Smart contracts in public procurement	0.713	0.036	19.646	***
	<---	Decentralized ledger technology adoption	0.626	0.029	21.778	***
	<---	Supplier trust and compliance	0.188	0.029	3.075	0.002
	<---	Interoperability of blockchain with existing procurement systems	0.132	0.034	3.843	***
	<---	Government policy on blockchain usage	0.109	0.029	3.73	***
Public procurement transparency	<---	Smart contracts in public procurement	0.254	0.092	2.762	0.006
	<---	Supplier trust and compliance	0.213	0.055	4.021	0.008
	<---	Government policy on blockchain usage	0.13	0.057	2.533	0.004
	<---	Interoperability of blockchain with existing procurement systems	0.389	0.066	5.88	***
	<---	Data transparency and auditability	0.552	0.085	6.479	***
	<---	Decentralized ledger technology adoption	0.198	0.076	3.287	***
Reduction in corruption	<---	Smart contracts in public procurement	0.491	0.069	7.068	***
	<---	Supplier trust and compliance	0.144	0.042	2.066	0.007
	<---	Government policy on blockchain usage	0.155	0.043	3.277	0.002
	<---	Interoperability of blockchain with existing procurement systems	0.759	0.05	15.18	***
	<---	Data transparency and auditability	0.618	0.064	9.607	***
	<---	Decentralized ledger technology adoption	0.213	0.058	3.245	***

The results also indicate that the hypothesis H1 is supported in that smart contracts help in enhancing public procurement transparency by providing for automated, tamper-proof agreements with limited human intervention and manipulation possibilities. The hypothesis H2 is likewise validated since decentralized ledger technology retains a key role in the procurement process, enhancing transparency through secure and immutable records of transactions. Supplier trust and compliance contribute positively to the promotion of procurement transparency, thus confirming the hypothesis H3, which reiterates the roles played by accountability and adherence to the law in this respect. The hypothesis H4 stands supported and elucidates the government policy on blockchain, which is a significant consideration regarding how blockchain should enhance transparency in public procurement. The hypothesis H5 had likewise been ascertained, as the interoperability of blockchain with the preexisting procurement systems irrefutably strengthens transparency by ensuring seamless integration and efficient data interchange. The hypothesis H6 receives good support as smart contracts prevent corruption by lowering the risk of manipulation and fraud in the procurement processes. The hypothesis H7 gets verified through the role played by decentralized ledger technology in eradicating corruption by guaranteeing data integrity and preventing fraudulent alterations. The hypothesis H8 is also verified because supplier trust and compliance influence corruption reduction by discouraging unethical practices and promoting fair procurement procedures. The hypothesis H9 maintains its validity because government policies largely determine to what extent blockchain can combat corruption, thereby showing the need for a conducive regulatory climate. The results also evidently show support for the hypothesis H10, whereby the interoperability of blockchain with existing procurement systems is cardinal to mitigating corruption through providing real-time monitoring and accountability. Additionally, the study confirms that data transparency and auditability mediate blockchain adoption; the hypothesis H11 is supported, showing that data transparency and auditability bolster the relationship between blockchain adoption factors (smart contracts, decentralized legislation technology, supplier trust, government policy, and interoperability) and procurement transparency. The hypothesis H12 is similarly validated, establishing data transparency and auditability as major mediators in the relationship between blockchain adoption and corruption reduction. Accordingly, the final Pathway Diagram is presented in Figure 2.

Review of Futures Markets (RFM)
ISSN: 1933-7116
Volume 34 Issue 2 (2026)
Website: https://fra.st

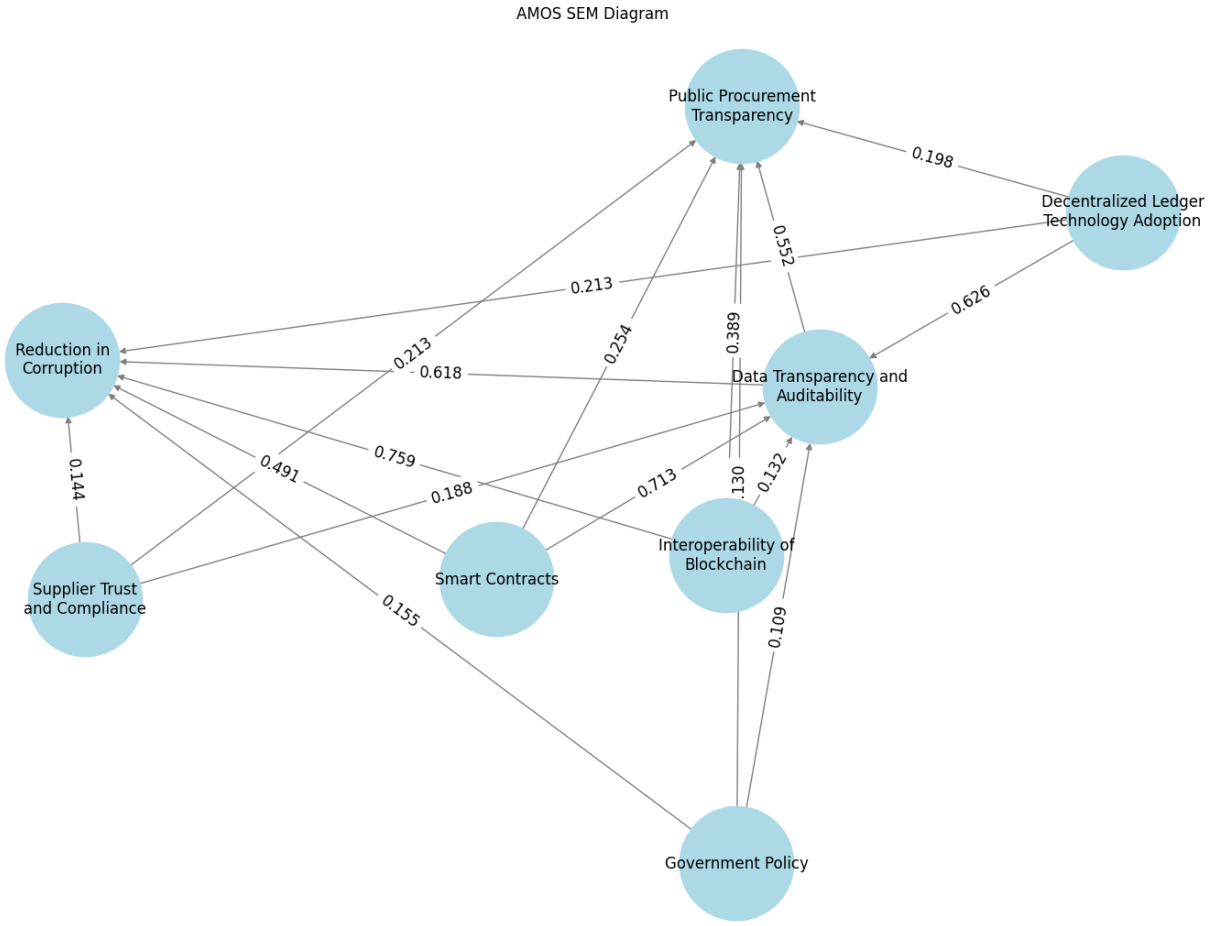

Figure 2: Pathway Diagram

The moderation analysis, presented in Table 5, provides some significant information regarding external factor effects on blockchain adoption in public procurement. The hypothesis H13 is supported since legal and ethical challenges in blockchain procurement moderate in a major way the relationship between supplier trust-compliance and public procurement transparency ($\beta = -0.238$, $p < 0.001$). This negative impact means that while supplier trust and compliance enhance transparency in general, the legal uncertainties and ethical challenges may weaken the effect of both in trust reduction from blockchain-enabled procurement processes. Similarly, the hypothesis H14 is validated, where stakeholder resistance to blockchain adoption acts as a moderator between the interoperability of blockchain with existing procurement systems and the reduction of corruption ($\beta = 0.184$; $p < 0.001$). This means that although interoperability offers advantages, resistance depends on the other stakeholders, be it procurement officer, supplier, or regulatory body. Thus, resistance will reduce the effect and exploit the full potential of blockchain in reducing corruption.

Table 5: Moderation Analysis

Moderating Factors	B	Se	t	F	P

Supplier trust compliance* Legal and ethical challenges of blockchain ---> public procurement transparency	-0.238	0.036	-6.834	42.58	<0.001
Interoperability of Blockchain with Existing Procurement Systems* Stakeholder resistance to blockchain adoption ---> Reduction in corruption	0.184	0.028	-5.178	31.87	<0.001

6. Discussion

The emerging understanding of blockchain technology as a game-changing paradigm in public procurement enhances the openness of transactions, cuts down steeply on corruption, and enhances the delivery of services. The findings in this study therefore confirm other literature, augmenting the argument that blockchain adoption radically reforms procurement processes. The major findings from this study point out that the availability of decentralized ledger technology, smart contracts, and data transparency mechanisms are central for improving procurement efficiency and fighting all forms of unethical practices. This further adds to the global debate of whether blockchain can bring in accountability within the public procurement systems, reduce areas of corruption risk, and provide evidence compliance. Against this backdrop, this study's major finding was that smart contracts and decentralized ledger technologies are pillars of procurement transparency. These results conform to previous studies conducted by Mircea and colleagues (2022), who have posited that the integration of blockchain and the Internet of Things (BIoT) significantly heightened procurement efficiency, curtailed fraud, and heightened trust among stakeholders. Among their features, smart contracts provide for the automation of the procurement processes, thus reducing human intervention, and the consequent risks of manual errors, favouritism, and fraudulent practices. In a similar context, with emphasis on transparency, security, and traceability, Özkan et al. (2021) argued that smart contracts enhance procurement efficiency. The current study extends this research by showing that, additionally to enhancing transparency, smart contracts allow procurement systems to interoperate with existing systems, thus promoting seamless integration of blockchain technology into the workflows of traditional procurement.

The study secures an understanding of decentralized ledger technology in procurement, confirming the earlier work carried out by Khalfan et al. (2022), who studied the applicability of blockchain in project procurement in developing economies. The authors asserted that decentralized ledgers alleviate poor procurement management and implementation in areas of weak regulatory oversight. This study further builds evidence in demonstrating that decentralized ledger technology fosters better governance of procurement processes, on the grounds of enhanced transparency and auditability of procurement data supported by empirical evidence. Furthermore, this study highlights interoperability with existing procurement systems as one important factor fostering procurement transparency and corruption reduction. This coincides with the argument of Benítez-Martínez et al. (2023) that blockchain-related immutability, security, and transparency form a governance framework whereby fraudulent

acts cannot thrive. The ability to combine blockchain with conventional procurement systems guarantees that procurement records cannot be tampered with decreasing the possible incidences of data manipulation and document forgery.

One of the important contributions of the current research is the acknowledgement of supplier trust and compliance as an influencing factor of procurement transparency. Prior studies mostly focused on the technology bases for incorporating blockchain in procurement; and only a few have researched the aspects of supplier trust (Ganguly and Roy, 2021; Roy and Ganguly, 2026). This study fills that gap by arguing that blockchain technology ensures trust through the processes of transactions and information that are clear and verifiable supplier records. The results of the study carried out by Alves Batista (2024) indicate that blockchain would be crucial in engaging with records management and accountability in procurement by avoiding forgery and ensuring compliance. Blockchain assures immutability in records, thereby reducing instances of tampering with records, thus promoting the environment of trusting relationship between suppliers and procurement officials. In procurement fraud cases, most records are altered to camouflage fraudulent acts.

The study further indicates the moderating role of legal and ethical concerns and resistance from stakeholders on blockchain adoption. One noted aspect was that both legal and ethical barriers decreased supplier trust's utility in fostering procurement transparency. This implies that even if blockchain offers transparency, some unresolved legal junctures and ethical dilemmas will deter full scope adoption. This is in line with the perspective of da Silveira et al. (2022), who argued that the jurisdiction of ethics and legality needs to be greatly addressed for effective adoption of procurement systems enabled by blockchain. This suggests that while blockchain makes verifiable and immutable transaction history, legal frameworks must be adapted to facilitate its seamless implementation in public procurement. Without clear legal guidelines, organizations may be reluctant to fully integrate blockchain into procurement systems due to concerns surrounding data privacy, contractual enforcement, and regulatory compliance.

An important pointer that emerges from the results of the current research is the role played by stakeholder resistance toward blockchain adoption. The outcome revealed that resistance on the part of stakeholders towards blockchain adoption hinders its ability to curb corruption, even where a certain degree of interoperability with existing procurement systems could be reached. Such an observation corroborates the findings of Judijanto (2023), who investigated the perception towards the adoption of blockchain technology in Indonesia concerning government service delivery. Although the perception towards blockchain was overwhelmingly positive, it observed that stakeholders' resistance, in particular due to the lack of awareness and technical know-how, remained a significant barrier. Such resistance is often driven by a fear of job loss, lack of knowledge about the technology, and trepidations regarding the financial and operational costs of implementation. The current study thus emphasizes that alleviating the concerns of the stakeholders involved should involve awareness and training efforts that will assist in facilitating blockchain adoption.

The current study also emphasizes the role of government policies in favouring procurement processes related to blockchain technology adoption. The study results point out that government policies affect transparency and anticorruption positively, albeit to a lesser extent than other blockchain adoption factors. This concurs with da Silveira et al.'s (2021) work, with the emphasis on a strong regulatory framework for successful implementation of blockchain in procurement. The study argues that blockchain enhances the accountability in tracking the supply chain and compliance to procurement. However, the effectiveness of blockchain hinges on governmental support and policy alignment. In the absence of clear policies requiring the use of blockchain, its adoption would be highly fragmented and restricted to pilot projects in the procurement process rather than full implementation. In addition, the study provides a wide understanding of blockchain in procurement processes by providing empirical evidence for it from an emerging economy context, India. The study has adopted a quantitative approach to investigate blockchain effectiveness in the Indian public procurement, in contrast to most of the work reported in the literature that have focused on developed economies or have adopted qualitative assessments. It seeks to introduce supplier trust and interoperability as new determinants through which procurement outcomes could be achieved via blockchain. Further, going beyond the earlier focus of the discourses on transparency and efficiency in the adoption of blockchain, it has factored in moderating aspects such as legal and ethical challenges and stakeholder resistance, subjects that have received limited acknowledgement in the literature.

7. Conclusions, Limitations and Scope for Future Research

The study has attempted to analyse the impact of blockchain technology on procurement transparency, the reduction of corruption, and trust by suppliers within public procurement in India. It focuses on the critical determining factors for the adoption of blockchain technology in enhancing public procurement processes. Adoption of smart contracts and decentralized ledger would improve efficiency and procurement transparency, while interoperability with existing systems of procurement and regulatory commitment would reduce the incidence of corruption. Also, the influence of legal and ethical implications on supplier trust compliance and stakeholder resistance moderating the extents of blockchain's efficacy in curbing corruption has been examined.

One significant original contribution of this research lies in the fact that it worked on the Indian public procurement domain, where the application of blockchain is still nascent. In comparison to previous studies largely focused on the developed economy context, the current study highlights the challenges and opportunities it generates specifically in an emerging economy context. The outcome reveals that for ensuring effective transparency and accountability, the process of using blockchain technology must go together with the established procurement frameworks. The research shows how legal challenges and ethical issues will moderate the improvements created by blockchain, a field not widely studied before.

This study has its own limitations. First, it focuses primarily on stakeholder perceptions of the procurement processes that has the potential of losing sight of the technical and operational challenges faced in the adoption of blockchain technology in these processes.

Second, it does not measure the long-term effects of blockchain implementation because, in India, blockchain-enabled procurement systems are still in their infancy. Therefore, future studies should evaluate real-life case studies of blockchain-integrated procurement systems and assess their continued impact. However, this study creates a good building block for Indian policymakers and procurement authorities to explore the use of blockchain technology in enhancing transparency, efficiency, and accountability in public procurement.

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