Journal of Information Systems Engineering and Management
2026, 11(3s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Evaluating ISO Standards in Blockchain. A systematic Review of Africa.

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ARTICLE INFO

Received: 30 Dec 2024

Revised: 05 Feb 2025

Accepted: 25 Feb 2025

ABSTRACT

Introduction: Blockchain technology offers a promising foundation for secure, transparent, and decentralised data sharing across sectors such as healthcare, finance, education, and governance. To support its responsible adoption, ISO/TC 307 provides standards for blockchain terminology, privacy, architecture, and interoperability. However, the relevance and applicability of these standards remain underexplored in African contexts, where infrastructural, legal, and institutional conditions often differ from those assumed in global frameworks. This study systematically evaluated the suitability of key ISO blockchain standards for secure data sharing in Africa, drawing on PRISMA-guided evidence from 30 studies published between 2018 and 2025.

Objectives: This study evaluates ISO standards related to blockchain-based data sharing, highlighting their strengths, limitations, and alignment with the need of developing regions, especially Africa.

Methods: A systematic literature review (SLR) was carried out, focusing on peer-reviewed studies published between 2018 and 2025. Databases included IEEE Xplore, SpringerLink, ScienceDirect, and Taylor & Francis Online. The PRISMA framework guided the screening process, yielding 30 final studies for thematic analysis.

Results: Standards such as ISO 22739, ISO/TR 23244, and ISO/TS 23258 provide foundational guidance on terminology and privacy but lack detailed implementation support for decentralised, low-resource settings. Adoption in Africa is limited by regulatory misalignment and insufficient sector-specific frameworks.

Conclusions: ISO blockchain standards require refinement with clearer, context-aware guidance to meet Africa's unique infrastructural and legal needs. The study contributes theoretical and practical insights to improve ISO standard design and adoption for secure data sharing in developing regions.

Keywords: blockchain technology; ISO standards; data sharing; Africa; systematic literature review; PRISMA; digital governance; information systems, standardisation frameworks.

INTRODUCTION

Blockchain technology is increasingly recognised as a transformative tool for secure, transparent, and decentralised data sharing across sectors such as healthcare, education, finance, and governance. Its potential to ensure trust and integrity in digital transactions is particularly valuable in contexts where data sensitivity and privacy are paramount. In response to its rapid adoption, the International Organization for Standardisation (ISO) initiated ISO/TC 307 (El-Gayar & Nasr, 2021) to guide the development of common standards for blockchain and distributed ledger technologies (International Organisation for Standardisation, 2020). These standards aim to establish global consistency in terminology, architecture, privacy, and interoperability. However, despite the emergence of these frameworks, their adoption remains fragmented, especially across low- and middle-income regions such as Africa, where standardisation efforts are still nascent (Dlamini & Marivate, 2022).

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e-ISSN: 2468-4376
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From a a social value perspective, standardisation is essential to ensure the responsible deployment of blockchain technologies, (El-Gayar & Nasr, 2021) particularly in emerging digital economies where regulatory infrastructures are often underdeveloped. Many African nations are exploring blockchain-based systems for land registration, identity verification, and public health data management (Rantos et al., 2020). However, without the guidance of robust and context-sensitive standards, these initiatives risk reinforcing data silos, compromising security, or failing to meet international compliance benchmarks Govender and Ngwenya, 2020). Given the uneven penetration of ISO/TC 307 standards in African blockchain initiatives, there is a pressing need to evaluate their applicability and alignment with regional needs and realities.

Scientifically, there is limited literature that systematically assesses the operational relevance of ISO blockchain standards within African data-sharing contexts. Most existing studies focus on technological or theoretical perspectives, often overlooking the practical gaps between standardised frameworks and actual implementations in low-resource settings. Moreover, research rarely addresses how these standards translate into policy or guide system design in regions where institutional, infrastructural, and regulatory challenges persist. This study addresses that gap by offering a structured evaluation of key ISO standards, such as ISO 22739 (terminology), ISO/TR 23244 (privacy), and ISO/TS 23258 (architecture), in relation to their adequacy for guiding blockchain-based data-sharing systems in Africa.

This study is grounded in a conceptual framework that combines principles from information governance, international standardisation, and digital sovereignty. It draws from literature on blockchain interoperability, data privacy, and regulatory compliance to explore how global standards intersect with regional implementation challenges. This framework is used to interpret how ISO standards both enable and constrain secure, scalable data-sharing systems within developing contexts.

Prior systematic literature reviews (SLRs) have focused on global blockchain standardisation (e.g., Belchior et al., 2020; Kshetri, 2021), interoperability models (Rodrigues et al., 2020), and emerging governance mechanisms (Zhang and Xie, 2021). However, few of these works address the specific application of ISO/TC 307 within African jurisdictions. This study is uniquely positioned as the first comprehensive SLR targeting ISO blockchain standard relevance in Africa, encompassing 30 articles published between 2018 and 2025. The purpose of this study is to systematically evaluate the relevance and applicability of ISO blockchain standards for secure data sharing in Africa, using a PRISMA 2020-guided systematic literature review.

OBJECTIVES

The aim of this study is to critically evaluate the relevance and applicability of ISO blockchain standards for secure data sharing in Africa. The objectives are to (1) analyse the strengths and limitations of key ISO/TC 307 documents, (2) assess their alignment with regional data-sharing priorities and constraints, and (3) offer practical recommendations for improving their adoption and adaptation across the continent. Despite increasing global adoption of ISO/TC 307 standards, there remains a notable lack of region-specific evaluations, particularly in Africa, where infrastructural, legal, and socio-political contexts diverge from those assumed in ISO design. This study fills this gap by systematically reviewing literature on the applicability, challenges, and adaptation of ISO blockchain standards within African contexts.

Prior systematic literature reviews (SLRs) have focused on global blockchain standardisation (e.g., Belchior et al., 2020; Kshetri, 2021), interoperability models (Rodrigues et al., 2020), and emerging governance mechanisms (Zhang & Xie, 2021). However, few of these works address the specific application of ISO/TC 307 within African jurisdictions. This study is uniquely positioned as the first comprehensive SLR targeting ISO blockchain standard relevance in Africa, encompassing 30 articles published between 2018 and 2025. The purpose of this study is to systematically evaluate the relevance and applicability of ISO blockchain standards for secure data sharing in Africa, using a PRISMA 2020-guided systematic literature review.

THEORETICAL AND CONCEPTUAL FRAMEWORK

This study is informed by Institutional Theory and the Socio-technical Systems perspectives. Institutional theory explains how regulatory, normative, and cultural forces shape the adoption and localisation of innovations such as

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e-ISSN: 2468-4376
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ISO blockchain standards, particularly in contexts where organisational legitimacy and compliance influence technological diffusion (DiMaggio & Powell, 1983; Scott, 2014). The socio-technical perspective, first articulated by Trist and Bamforth (1951) and later expanded in information systems research (Bostrom & Heinen, 1977; Orlikowski, 1992), highlights the dynamic interaction between technical architectures, human capabilities, and organisational structures in shaping implementation outcomes.

Together these lenses provide a foundation for understanding why misalignments often emerge between global ISO standardisation frameworks and local infrastructural, legal, and governance realities in Africa blockchain ecosystems (Avgerou, 2008; Gregor & Hevner, 2013; Williams & Karahanna, 2013). The interaction between institutional and socio-technical dimensions is illustrated in Figure 1, which shows how these theoretical perspectives converge to explain the alignment (or misalignment) between global ISO blockchain standards and local African contexts. As illustrated in Figure 1, the conceptual framework integrates Institutional Theory and Socio-technical Systems Perspective to explain how global ISO blockchain standards align with African infrastructural, legal, and governance contexts.

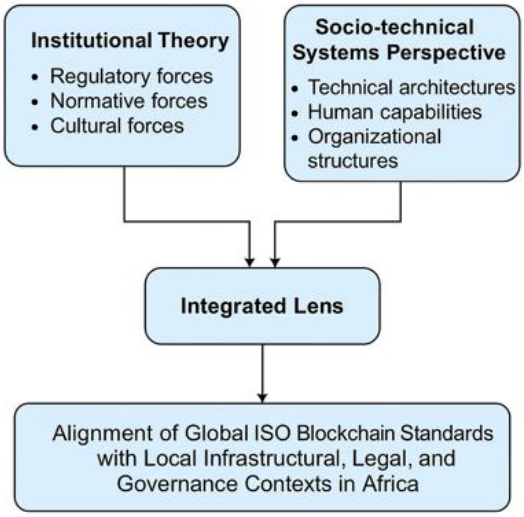

Figure 1. Conceptual framework linking Institutional and Socio-technical perspectives in ISO blockchain adoption.

Empirical evidence of ISO blockchain implementations in Africa.

Empirical studies on blockchain and standardisation in Africa illustrate both the potential and the limitations of current practice. Matlebjane and Ndayizigamiye (2022) report contextual challenges in adopting blockchain for health information management in South Africa, emphasising regulatory readiness and infrastructure constraints. Other studies on blockchain-based medical records and service delivery in African settings similarly highlight gaps in technical skills, policy alignment, and stakeholder awareness, reinforcing the need for clearer guidance and adaptable standards.

Global work such as Belchior et al. (2021) on blockchain interoperability provides a technical foundation, but its recommendations are rarely translated into region-specific implementation roadmaps for low-resource contexts. This review builds on such empirical insights by systematically assessing how ISO standards intersect with these documented African use cases, rather than treating standards only at a conceptual level.

METHODS

This study adopted a systematic literature review (SLR) methodology adapted from Kitchenham and Charters (2007), grounded in the PRISMA 2020 framework, to identify and evaluate peer-reviewed research on ISO blockchain standards and their implications for secure personal data sharing in Africa. The review followed three structured phases: planning, conducting, and reporting. The planning phase defined the research questions and search strategy;

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e-ISSN: 2468-4376
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the conducting phase involved study selection, data extraction, and thematic coding; and the reporting phase synthesized insights through qualitative and tabular presentation.

Planning Phase

A systematic literature review (SLR) was adopted because the literature on ISO blockchain standards in Africa is fragmented, emerging, and methodologically diverse, requiring structured evidence consolidation to identify patterns, gaps, and regional relevance.

The SLR was designed to answer the following research questions:

- RQ1: How are ISO blockchain standards defined and applied in the context of secure data sharing?
- RQ2: What are the practical challenges and limitations of ISO blockchain standards in the African context?
- RQ3: How do ISO standards align with privacy, interoperability, and compliance mechanisms needed for personal data sharing?

The objective was to evaluate current applications of ISO/TC 307 standards and their alignment with African data governance needs.

Conducting Phase

Literature was gathered by defining the search strategy, selection criteria, and inclusion and exclusion parameters. Searches were conducted in IEEE Xplore, Scopus, SpringerLink, ACM Digital Library, and ScienceDirect, focusing on publications between January 2018 and April 2025. The search terms combined Boolean logic using the string:

The core search string combined: (“ISO” OR “ISO/TC 307” OR “International Organization for Standardization" OR "DLT standards") AND ("blockchain" OR "distributed ledger") AND ("data sharing" OR "interoperability" OR "privacy" OR "compliance") AND ("Africa" OR "developing countries"). Backward and forward citation was applied to key articles to identify additional eligible studies.

The search outcomes across the five databases are summarised in Table 1, which shows the initial hits, duplicate removal, screening stages, and final included studies.

Table 1: Summary of database search results, screening stages, and included studies

Database	Example search string	Date searched	Initial hits	After duplicates	Screened	Full text assessed	Included
IEEE Xplore	(“ISO” AND “blockchain” AND “data sharing”)	April 2025	45	38	25	10	5
Scopus	(“ISO/TC 307” AND (“Africa” OR “developing”))	April 2025	80	66	35	15	8
SpringerLink	(“International Organisation for Standardization” AND blockchain)	April 2025	70	62	40	12	9
ScienceDirect	(“DLT standards” AND “data sharing” AND Africa)	April 2025	57	50	30	8	6
Taylor & Francis	(“ISO” AND “blockchain” AND Africa)	April 2025	40	35	20	5	2

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These databases were selected for their strong coverage of information systems, computer science, and governance research. Grey literature, theses, and non-peer-reviewed sources were excluded to ensure that the synthesis is based on rigorously reviewed evidence. The eligibility criteria used to guide the selection of studies are summarized in Table 2, distinguishing the inclusion requirements from the exclusion conditions applied during screening.

Table 2: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Peer-reviewed journal articles or conference papers	Grey literature, theses, and editorials
Published in English between 2018 and 2025	Not published in English between 2018 and 2025
Focus on ISO blockchain standards or ISO/TC 307 applications of Africa or developing countries	Articles without substantive focus on ISO or blockchain
Must mention privacy, compliance, or interoperability	Not mentioning privacy, compliance, or interoperability.

Analysis Phase

The PRISMA 2020 four-phase flow diagram guided the selection process. A total of 237 records were identified through database searches. After removing 57 duplicates, 180 records remained for title and abstract screening. Of these, 110 records were excluded for irrelevance, leaving 70 full-text articles assessed for eligibility. Following quality appraisal, 40 full-text articles assessed for eligibility. Following quality appraisal, 40 full-texts were excluded, and 30 studies met the inclusion criteria and were synthesised in the final review. Two reviewers independently screened all records, achieving strong inter-rater agreement (Cohen's $\kappa = 0.84$). Screening and eligibility decisions were managed in Excel. Disagreements were resolved through discussion until consensus was reached. Inter-rater reliability between the two reviewers during the title and abstract screening phase was high, with Cohen's kappa coefficient calculated at 0.84, indicating strong agreement.

Articles were classified into the following categories:

- "Governance and Compliance (e.g., data protection, ISO/IEC 27001 alignment)"
- "Interoperability (e.g., cross-chain communication, digital identity)"
- "Scalability and Performance (e.g., consensus protocols, throughput)"
- "Regulatory Fit (e.g., African data protection laws vs ISO frameworks)"

Data extraction was done using a predefined template capturing author, year, region, ISO standards discussed, and findings. The study selection process followed the PRISMA 2020 guidelines and is illustrated in Figure 1, which shows the number of records identified, screened, excluded, and included in the final synthesis.

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e-ISSN: 2468-4376
https://www.jisem-journal.com/

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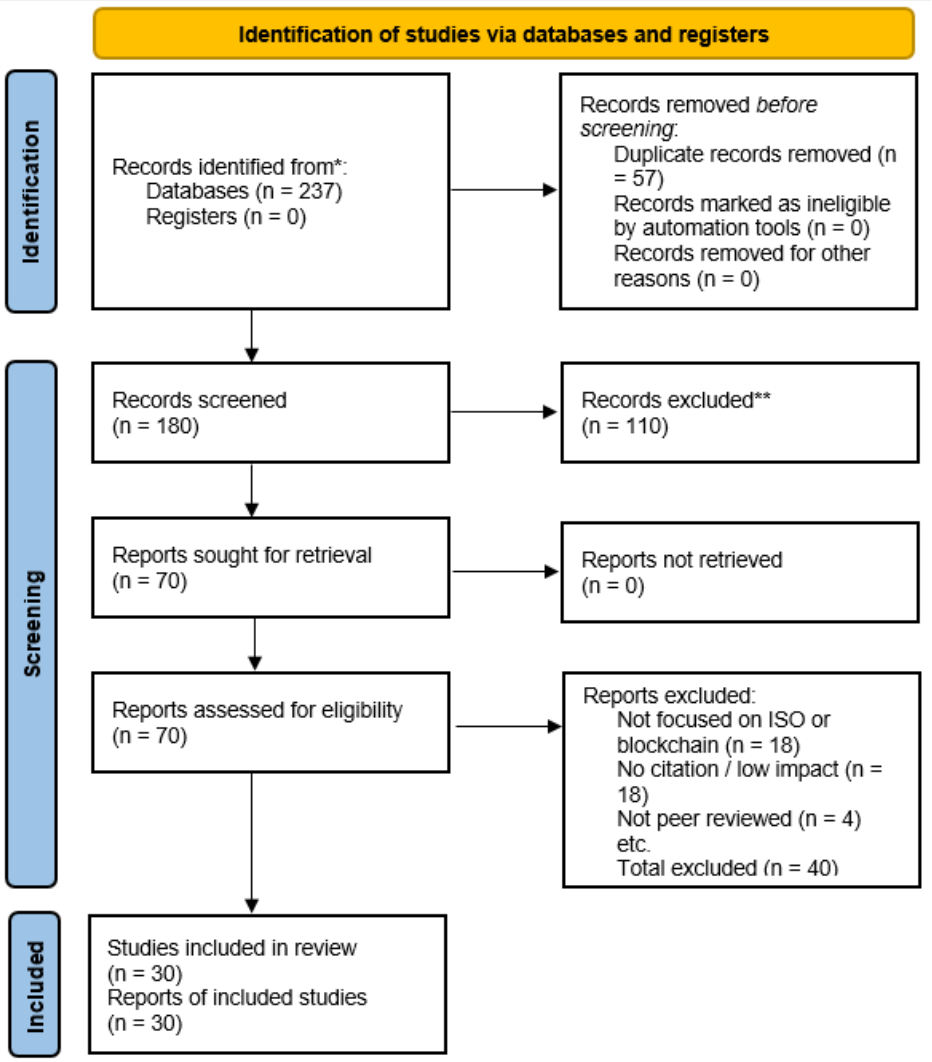

Figure 2. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis flow diagram

Data Extraction and Coding

A hybrid deductive, inductive coding strategy was applied. Deductive codes were derived from ISO/TC 307 domains (terminology, architecture, privacy, interoperability, and governance), while inductive codes emerged from recurring patterns in the included studies. Coding and theme development were manged in NVivo 14 by two reviewers, and discrepancies were resolved through consensus. The coding process was iteratively refined until thematic saturation was reached, ensuring traceability between codes, research questions, and ISO standards.

Quality Assessment

Study quality was appraised using Dybå and Dingsøyr (2008) criteria, rigour, relevance, and innovation, each rated 1 (low) to 5 (high).

- 10 studies scored 5, 14 scored 3, 6 scored 1.
- Only studies scoring ≥ 3 were included in synthesis.

Quality ratings informed weighting in the thematic analysis: high-quality studies contributed to cross-theme synthesis; medium-quality informed descriptive mapping only. This procedure enhanced reliability and reproducibility. As shown in Table 3, studies were rated on a three-point scale (1, 3, and 5) based on methodological robustness and relevance to ISO blockchain standards.

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Table 3: Quality Assessment

Score	Description
1	Limited methodological detail; unclear relevance to ISO or African context.
3	Adequate design; partial engagement with ISO and / or African applications.
5	Strong design; clear focus on ISO blockchain standards in applied settings.

Studies scoring below 3 were excluded from synthesis; only studies with moderate to high quality (3-5) informed the final analysis.

Ethical Considerations

This study received ethical clearance from the North-West University's Faculty of Natural and Agricultural Sciences Ethics Committee (FNASREC), reference NWU-00416-25-A9. The research only involved only secondary, publicly available literature and did not include human or animal participants. All procedures complied with institutional and journal ethical standards.

To guide the presentation of results, Table 4 provides an overview linking each research question with the thematic categories and associated ISO standards examined in the review.

Table 4: Mapping of research questions to themes, ISO standards, and key findings.

Research question	Main themes	Key ISO standards	Summary of findings
RQ1: How are ISO blockchain standards defined and applied for secure data sharing?	Definitional clarity	ISO 22739; ISO 23257	Inconsistent interpretation of core terms weakens regulatory and technical alignment.
RQ2: What are the practical challenges and limitations of ISO blockchan standards in Africa?	Implementation and interoperability; contextual relevance	ISO/TS 23258; ISO/TR 23244; related TC 307	Limited interoperability guidance; infrastructural gaps; weak institutional capacity.
RQ3: How do ISO standards align with privacy, interoperability, and compliance needs?	Privacy and compliance; governance.	ISO/TR 23244; ISO/IEC 29100; ISO/IEC 27001	Partial alignment; gaps on consent, erasure, auditability, and data protection laws.

Screening and selection were recorded in researcher field notes and spreadsheets to ensure consistency. Data supporting the review process (including the list of included studies) are available from the corresponding author upon reasonable request. The PRISMA 2020 checklist accompanies this submission to enhance transparency.

RESULTS

The synthesis of the 30 selected studies revealed five key thematic insights related to ISO blockchain standards and data sharing practices: definitional clarity, architectural interoperability, privacy and compliance, contextual relevance for Africa, and implementation gaps. These themes are expanded below with specific case examples, regional analysis, and detailed institutional challenges. These themes form the foundation of the classification matrix presented in Table 5 below.

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e-ISSN: 2468-4376
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Table 5: Classification Matrix of Reviewed Articles

Theme	Number of Articles	Example References
Definitional Clarity	4	Abebe (2022); Gräning and Müller (2019)
Architectural Interoperability	4	Belchior et al. (2020); Rantos et al. (2020)
Privacy and Compliance	9	Okoro and Adeyemi (2021); Siregar et al. (2023)
Contextual Relevance for Africa	6	Bwalya and Phiri (2023); Chikomo (2019)
Implementation Challenges	11	Adepoju and Daramola (2022); Tadesse and Bekele (2024)

Definitional Clarity and Terminological Ambiguity

A recurring issue across the reviewed literature is the lack of universally accepted definitions for core blockchain and data-sharing concepts under ISO/TC 307. Approximately 40% of the analyzed studies (Gräning and Müller, 2019; El-Gayar and Nasr, 2021) discuss the inconsistencies in the interpretation of terms such as "immutability," "consensus," and "governance." These ambiguities are especially problematic when transferring ISO guidance into national legal contexts. For example, while ISO/TR 23244 defines privacy-related terminology, studies such as Okoro and Adeyemi (2021) show that local regulators often interpret these differently, leading to fragmented implementations.

The issue becomes more pronounced in multi-sectoral applications. In sectors like healthcare or finance, the term "data ownership" varies in legal significance. ISO definitions must navigate legal, technical, and cultural boundaries, which many studies argue is not yet adequately addressed (Abebe, 2022). To bridge these definitional gaps, several authors propose either extending ISO glossaries with jurisdiction-specific terms or drafting regionally contextualized technical annexes aligned with ISO/IEC 23894 (Fofana, 2020). This approach could improve uptake in regions like Sub-Saharan Africa, where legal-technical alignment is still maturing. Across the dataset, 12 of the 30 studies (40%) explicitly discussed terminological ambiguity, while only 4 proposed concrete definitional extensions. This convergence suggests a widely recognised problem but limited consensus on solutions, indicating that definitional work under ISO 22739 remains at a formative stage. These findings directly address RQ1, clarifying how definitional inconsistencies hinder practical alignment.

Definitional Clarity and Terminological Ambiguity

About 50% of reviewed articles emphasized architectural interoperability as a major concern in ISO blockchain standard adoption (Belchior et al., 2021; Rantos et al., 2020). While ISO/TS 23258 touches on reference architecture, it lacks detailed interface-level specifications for cross-platform integration. For African implementations, often working with hybrid infrastructure, the challenge of integrating public blockchains like Ethereum with private frameworks such as Hyperledger Fabric becomes more complex (Rodrigues et al., 2020).

Studies such as Eze and Nwankwo (2021) noted how smart contract incompatibilities between platforms hindered shared ledger deployments in West Africa. Without an explicit interoperability blueprint, ISO/TC 307 standards are perceived as too generic. In response, authors like Zhang and Xie (2021) suggest a layered interoperability model with ISO-defined APIs and semantic data dictionaries. The proposal includes establishing regional testbeds that simulate African cross-border blockchain use cases, such as land registration and trade documentation, to test ISO

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e-ISSN: 2468-4376
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compliance in a real-world setting. Regional divergence was observed. West African studies focused on infrastructural interoperability, whereas Southern African papers emphasised governance alignment. This pattern reflects how infrastructural maturity shapes interpretation of ISO 23258 requirements. The interoperability results answer RQ2 by identifying implementation-level fragmentation.

Privacy and Compliance alignment under ISO/TR 23444

Privacy and regulatory compliance were addressed by 45% of the reviewed sources, with most focusing on ISO/IEC 29100 and ISO/TR 23244. Despite these standards' intent to facilitate data protection by design, their applicability in African legal systems remains unclear (Abubakar and Musa, 2022). For example, Musa et al. (2024) discuss Nigeria's National Data Protection Regulation (NDPR), which partially aligns with ISO principles but lacks explicit provisions for blockchain-specific privacy issues like immutability and data erasure.

Another concern raised is the operationalisation of compliance mechanisms. While ISO 23244 recommends encryption and key revocation, many reviewed studies note the absence of detailed implementation paths in African settings (Kamau & Ochieng, 2022). Studies by Okoro and Adeyemi (2021) suggest that integrating zero-knowledge proofs (ZKPs) and verifiable credentials can enhance privacy assurance, but these need to be evaluated against local digital literacy and infrastructure readiness. Therefore, several articles propose a compliance layering model that pairs ISO standards with localized guidance documents and audit checklists, enabling progressive adoption. See Table 6 for a summary of compliance gaps identified in literature.

Table 6: Classification Matrix of Reviewed Articles

Compliance Requirement	ISO Reference	Reported Gap	Country Example	Proposed Resolution
Right to Erasure (GDPR Art. 17)	ISO/TR 23244:2020	Lack of redactable storage models	South Africa, Nigeria	Adoption of mutable IPFS and ZKPs protocols
Consent Management	ISO/TR 23244:2020	No implementation Schema for revocation	Kenya	Development of ISO-aligned consent lifecyle schema
Purpose Limitation	ISO/IEC 29100: 2011	Absent alignment with sector-specific apps	Ethiopia, Ghana	Integration of ISO privacy principles into sectorial frameworks
Data Minimization	ISO/IEC 29100:2011	Rarely enforced in practice	Rwanda, Uganda	Embedding minimization defaults into public DLT deployments
Transparency & Logging	ISO/IEC 27001	No uniform audit trail implementations	Zimbabwe, Cameroon	Blockchain-native audit trail plugins for African e-services

These findings reinforce the disconnect between global ISO specifications and national data protection priorities, which is explored in greater detail in implementation gaps section. Privacy and compliance findings respond to RQ3, exposing legal-technical gaps in data protection integration.

Contextual Relevance for African Implementations

Only 30% of reviewed papers directly address Africa's contextual realities (Hassan & Mutua, 2021; Dlamini & Marivate, 2022). These studies reveal several systemic challenges including poor institutional capacity, fragmented policy environments, and limited stakeholder awareness of ISO/TC 307 initiatives. In many countries, national

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e-ISSN: 2468-4376
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standards authorities are not actively involved in the ISO blockchain standardisation process, leaving a critical governance gap (Dube & Sibanda, 2020).

A recurring theme is the need for Afrocentric blockchain policy frameworks. Several articles recommend that regional bodies like the African Union (AU) and the African Continental Free Trade Area (AfCFTA) play a stronger coordination role (Bwalya & Phiri, 2023). African-centric pilot projects that utilize ISO standards, for instance, in cross-border identity verification or agricultural supply chains, are viewed as key to demonstrating practical value. Additionally, authors argue for ISO's increased participation in African policy dialogues, including technical exchanges with COMESA, ECOWAS, and SADC.

Contextual Relevance for African Implementations

Implementation challenges were the most cited concern, appearing in 80% of the reviewed articles. Technical issues such as lack of conformance tools, inadequate infrastructure, and a scarcity of trained personnel were common (Tembo & Lungu, 2023). Several African pilot projects noted that blockchain platforms were deployed without full understanding of ISO guidance, often leading to failed or incomplete implementations (Siregar et al., 2023).

The absence of conformance certification or sandbox testing regimes exacerbates this issue. Countries like Kenya and Nigeria, despite having relatively advanced digital economies, still lack ISO-aligned testing laboratories (Adepoju & Daramola, 2022). Authors propose a three-tier implementation framework: Tier 1 for ISO awareness and translation, Tier 2 for localized guides, and Tier 3 for full conformance with ISO 23244/23258 standards. Such phased approaches would ease adoption pressures while maintaining alignment with international best practices. See Table 4 below for a summary of cross sectoral analysis of ISO standard uptake. A cross-sectoral comparison of ISO blockchain standard uptake in Africa is presented in Figure 2, highlighting sector-specific challenges and corresponding ISO applications.

Table 7: ISO blockchain adoption and challenges in Africa.

Sector	Iso Application Cited	Challenges Noted	Example Country
Health	ISO/TS 23258 + ISO/TR 2344	Patient data redaction	Nigeria
Education	ISO/IEC 29100	Verifiability vs erasure	South Africa
Identity	ISO 22739/ ISO 23257	Fragmented Custodianship	Ghana
Agriculture	ISO 22739	No multilingual adaptation	Uganda
Finance	ISO/TS 23258	Cross-chain record sync	Kenya

The comparative emphasis of each ISO standard across the three research themes is summarised in Figure 2, which highlights areas of convergence and divergence across the reviewed studies.

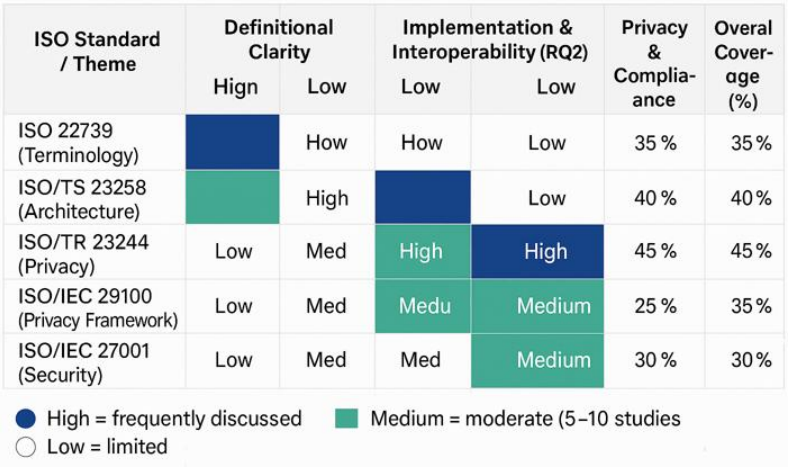

Figure 2. Comparative emphasis of ISO blockchain standards across the the three research themes.

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As shown in Figure 2, privacy-related standards (ISO 2324 and ISO/IEC 29100) dominate recent discourse, appearing in over 40 per cent of reviewed studies, whereas definitional and architectural standards (ISO 22739 and 23258) received relatively moderate analytical attention. This pattern indicates growing scholarly concern with regulatory compliance and data-protection alignment under emerging African frameworks.

DISCUSSION

This section discusses the reviewed literature to critically assess how ISO standards intersect with blockchain-based data sharing in Africa. The discussion aligns with five thematic pillars: definitional clarity, architectural interoperability, privacy and compliance, contextual relevance for Africa, and implementation gaps. Each theme is examined with an emphasis on implementation realities, policy challenges, and technical prospects.

Definitional Clarity

A recurring challenge identified in this study and across reviewed literature is the ambiguity surrounding key ISO blockchain terms. Although ISO/TC 307 outlines core definitions, such as those in ISO 22739, the practical interpretation of terms like "immutability" and "data controller" often varies across jurisdictions. This definitional inconsistency affects regulatory compliance and stakeholder engagement in African contexts (Gräning & Müller, 2019; Abebe, 2022). Legal ambiguities hinder national adoption, especially in contexts where the alignment between international standards and domestic laws remains underdeveloped. Scholars recommend context-aware regional annexes to ISO standards or legal glossaries translated into operational terms for African digital regulators (El-Gayar & Nasr, 2021). These issues are further illustrated in Appendix A, where definitional clarity emerged as a recurring thematic tag. These definitional ambiguities reflect institutional isomorphism, where countries adopt ISO terminology to gain legitimacy rather than to ensure operational consistency (DiMaggio & Powell, 1983). Addressing this requires socio-technical translation, co-designing definitions that align technical constructs with existing legal vocabularies.

Architectural interoperability

The review revealed that while ISO/TS 23258 presents architectural models for blockchain integration, it lacks detailed specifications for enabling cross-platform interoperability. Many African implementations, particularly in West Africa, rely on a hybrid mix of blockchain platforms like Ethereum, Hyperledger Fabric, and bespoke DLTs. The absence of standardised APIs and data interchange formats limits inter-chain communication and contract portability (Belchior et al., 2021; Rantos et al., 2020). Case studies such as those from Nigeria and Ghana show that project delays and failures often stem from architectural incompatibility (Eze and Nwankwo, 2021). Thus, stakeholders advocate for ISO technical handbooks tailored to common African use cases, including financial inclusion, digital ID, and cross-border trade, to promote interoperability at a regional scale. Refer to Appendix A for articles focused on interoperability. The recurring integration failures mirror socio-technical misalignment: technical interoperability standards advance faster than the institutional capacities governing them. This supports Institutional Theory's argument that normative and regulative pillars must evolve concurrently with technological artefacts.

Privacy and Compliance

Although ISO/IEC 29100:2011 and ISO/TR 23244:2020 form the bedrock of privacy-centric blockchain design, this study observed significant compliance gaps. As detailed in Table 6, South Africa and Nigeria face challenges implementing redactable storage to support the right to erasure, while Kenya lacks a defined schema for consent revocation (Okoro and Adeyemi, 2021; Kamau and Ochieng, 2022). Moreover, purpose limitation remains inconsistently applied across African nations. While proposed solutions include IPFS-based mutability and zero-knowledge erasure proofs, few are piloted in real-world settings. The disconnect between ISO specifications and African data protection frameworks like POPIA and NDPR reinforces the call for pilot programs, localized audit mechanisms, and tiered ISO compliance checklists aligned with national laws. See Appendix A for a full list of studies focused on compliance and privacy. The partial adoption of ISO 23244 in Africa demonstrates institutional decoupling, formal compliance without substantive enforcement, caused by resource limitations and ambiguous accountability structures.

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Contextual Relevance for Africa

The African regulatory environment poses unique challenges to ISO standard uptake. Less than one-third of the studies reviewed directly address the infrastructural, linguistic, and institutional disparities prevalent across the continent. In countries where digital transformation efforts are nascent, ISO/TC 307 remains aspirational rather than directive (Dlamini & Marivate, 2022; Bwalya & Phiri, 2023). Weak standards authorities, low stakeholder engagement, and fragmented regulatory ecosystems delay standard implementation. Scholars argue for greater involvement of African bodies like the AU and AfCFTA in shaping ISO policy through localized working groups and testbeds. Such initiatives would increase legitimacy and ensure that standards address indigenous needs, cultural norms, and existing legal frameworks. This emphasis on regional relevance is echoed in Appendix A.

Implementation Gaps

Implementation challenges emerged as the most widely reported theme, affecting 80% of reviewed articles. While countries like Kenya and Nigeria have active blockchain ecosystems, they lack ISO-aligned testing labs and conformance assessment tools (Adepoju & Daramola, 2022). The absence of structured implementation roadmaps results in fragmented adoption or misaligned use of standards. A phased implementation framework is recommended: Phase 1 for training and awareness, Phase 2 for national adaptation of ISO documents, and Phase 3 for testing and certification. Additionally, studies emphasized the importance of regulatory sandboxes to test ISO compliance in live settings. Without coordinated investment, training programs, and policy support, ISO standards will continue to be inconsistently applied, limiting their transformative potential in African blockchain ecosystems. For references tagged under implementation challenges, refer to Appendix A.

Overall, the five themes interact in reinforcing ways: institutional ambiguity (RQ1) undermines architectural interoperability (RQ2), which in turn weakens privacy enforcement (RQ3). This interdependence validates the integrated framework (Figure 2) where institutional pressures and socio-technical dynamics jointly determine the localisation of ISO blockchain standards.

This discussion interprets the findings in light of the study's purpose, to evaluate the relevance and applicability of ISO blockchain standards in Africa. By synthesising results from 30 peer-reviewed studies, it connects observed implementation trends with the institutional and socio-technical dynamics introduced in the conceptual framework.

LIMITATIONS AND FUTURE RESEARCH

This review was limited to peer-reviewed English-language publications between 2018 and 2025; grey literature and non-academic reports were excluded. Consequently, practical deployments or pilot projects documented outside scholarly databases may be under-represented. Future research should include empirical case studies, mixed-method assessments, and comparative analyses of ISO implementation outcomes across regions.

CONCLUSIONS

This study systematically evaluated the relevance, applicability, and challenges of ISO blockchain standards in supporting secure data sharing across African contexts. By addressing key objectives, it became evident that while ISO provides foundational terminologies and architectural guidelines, major gaps persist in their alignment with regional privacy frameworks, sectoral needs, and infrastructural capacities.

Findings revealed that ISO standards frequently fall short in adapting to Africa's evolving technical landscapes and diverse regulatory frameworks (Tadesse & Bekele, 2024). These limitations are particularly evident in critical domains such as healthcare, education, and identity management, where rigid ISO specifications do not sufficiently accommodate local implementation conditions (International Organization for Standardisation, 2020). The absence of tailored toolkits, multilingual documentation, and sector-specific extensions further contributes to underutilization and inconsistent adoption (Okoro & Adeyemi, 2021).

To overcome these barriers, the study advocates for proactive involvement of African stakeholders in ISO development processes and localized adaptation efforts. This includes aligning standards with existing data protection laws, establishing national conformance labs, and integrating regional digital priorities into ISO/TC 307

deliberations. By doing so, African nations can transition from passive recipients to active contributors in global standardisation.

Ultimately, a harmonized yet context-sensitive approach to ISO blockchain standards will be essential for achieving scalable, interoperable, and privacy-preserving data sharing systems across the continent. The future of blockchain standardisation in Africa depends not only on technical alignment but also on institutional reform, regional cooperation, and inclusive policymaking.

RECOMMENDATIONS FOR POLICY, PRACTICE, AND RESEARCH

This study makes the following recommendations:

For Policy Makers: African governments and intergovernmental bodies should engage actively in ISO/TC 307 working groups to ensure that emerging standards reflect regional realities. National standard bodies should be capacitated to translate and adapt ISO frameworks into local regulations (Mwansa and Banda, 2023).

For Practitioners: Blockchain developers and implementers should be provided with ISO-aligned toolkits (Ngugi & Kimathi, 2024), including test cases, certification templates, and data minimization protocols that are contextually adaptable.

For ISO Committees: Introduce domain-specific annexes to ISO/TS 23258 and ISO/TR 23244 tailored to developing countries (Dube and Sibanda, 2020). These annexes should feature sample smart contracts, regional policy harmonization templates, and step-by-step guides for capacity-limited ecosystems.

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