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REVIEW ARTICLE
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AI and Blockchain-Powered Indian Judicial System: A Framework Design, Pilot Survey and Implementation Roadmap

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Abstract

Background: The Indian judicial system manages over 50 million pending cases and faces persistent challenges in transparency, efficiency, and data security. Blockchain and Artificial Intelligence (AI) offer transformative solutions to these systemic problems. Objective: To design the AI-Blockchain Integrated Judicial System (AI-BIJS) framework and validate its relevance through a structured pilot survey of legal professionals. Methods: A 39-question mixed-method survey was administered to 1,014 legal professionals — comprising 541 advocates (53.4%), 189 academic researchers (18.6%), 259 other legal professionals (25.5%), and 25 judges (2.5%) — between May and July 2025. Descriptive statistics and inductive thematic coding were applied to closed and open-ended responses respectively. Results: 79.0% rated current judicial transparency as Poor or Fair; 85.3% found existing IT systems only partially effective or ineffective; 77.4% agreed AI can reduce case backlogs; immutable records (72.2%) and transparent audit trails (70.4%) were the highest-valued blockchain features; and document summarisation led AI application priorities (76.3%). Technical limitations (65.8%), high costs (55.2%), and skill deficits (58.1%) are the principal barriers. Conclusion: The proposed four-layer AI-BIJS framework, integrating Hyperledger Fabric with machine-learning analytics, addresses empirically validated stakeholder needs. A three-phase roadmap aligned with India's e-Courts Phase III (2023-2027) is presented.

Keywords: Blockchain; Artificial Intelligence; Indian Judicial System; Smart Contracts; Case Management; Hyperledger Fabric; e-Courts; Transparency

1. Introduction

Blockchain technology, characterised by distributed ledger architecture, cryptographic immutability, and transparent auditability offers a tamper-proof infrastructure for judicial records [2]. Smart contracts embedded on a blockchain can automate rule-bound legal processes such as case transfers, bail-condition monitoring, and compliance verification [3]. Artificial Intelligence (AI) further augments judicial efficiency through intelligent document summarisation, legal-research assistance, case-outcome prediction, and workload-optimised scheduling [4].

India's e-Courts Project has progressed through three phases. Phase I (2011-2015) computerised district courts; Phase II (2015-2023) introduced the Case Information System (CIS) and online cause-list publication; Phase III (2023-2027) allocates Rs.7,210 crore, with Rs.53.57 crore specifically earmarked for AI and blockchain pilots [5]. International precedents validate the feasibility of this approach: China's Internet Courts have processed over 2.9 billion blockchain-recorded evidence items since 2017 [6]; Estonia's X-Road governance platform has operated with near-zero data breaches since 2007 [7]; and Singapore's eLitigation system reduced case backlogs by 28% over five years [8].

Despite this institutional momentum, no comprehensive, empirically validated framework integrating both blockchain and AI has been designed for the Indian judicial context. This paper makes three principal contributions: (i) reporting quantitative and qualitative findings from a structured pilot survey of 1,014 legal professionals; (ii) proposing a four-layer AI-BIJS framework grounded in those empirical findings; and (iii) providing a phased implementation roadmap aligned with India's existing digital judicial infrastructure.

2. Literature Review

2.1 Blockchain in Legal and Governance Contexts

Nakamoto's 2008 foundational paper established blockchain as a decentralised, append-only ledger secured by cryptographic hashing [9]. Buterin (2014) extended this paradigm with Ethereum's programmable smart-contract capability [10], while Szabo's concept of 'computerised transaction protocols that execute the terms of a contract' provides the theoretical foundation for judicial automation [11].

Olnes et al. (2017) conducted a systematic review of blockchain in government and identified document certification, land registry, and identity management as its most mature applications [12]. Androulaki et al. (2018) described Hyperledger Fabric as particularly suited to permissioned enterprise deployments due to its modular consensus mechanism and channel-based data privacy, characteristics that directly satisfy judicial confidentiality requirements [13].

2.2 Artificial Intelligence in Legal Systems

Surden (2019) provided a comprehensive review of AI applications in law, spanning contract analysis, legal research, and outcome prediction [14]. Susskind (2019) argued that AI-assisted courts must augment, not replace judicial reasoning [15], a principle adopted as a foundational design constraint in AI-BIJS. Angwin et al. (2016) documented demographic disparities in the COMPAS recidivism prediction tool [16], underscoring the imperative for bias-detection mechanisms in judicial AI deployments.

In the Indian context, the Supreme Court's SUPACE system, launched in April 2021, applies AI to collate relevant case papers for judicial officers [17]. Paul et al. (2022) introduced InLegalBERT, a BERT variant pre-trained on Indian legal corpora, demonstrating strong performance on judgment summarisation and classification tasks [18]. Sourdin (2018) documented 70-80% judicial acceptance of AI tools for scheduling and document management in Australian courts [19], a benchmark directly contextualised against the present pilot study results.

2.3 Identified Research Gaps

The existing literature presents three specific gaps relevant to India: (i) absence of empirically validated stakeholder-perception data from practising Indian legal professionals; (ii) no unified architecture

integrating AI and blockchain under India's constitutional and procedural law; and (iii) no published roadmap aligned with the e-Courts Phase III mandate. This study directly addresses all three gaps.

3. Research Objectives and Hypotheses

3.1 Objectives

- Obj. 1: Identify limitations and challenges in the existing Indian judicial system.
- Obj. 2: Enumerate high-priority performance and procedural problems of the existing system.
- Obj. 3: Explore blockchain and AI as integrated solutions to those challenges.
- Obj. 4: Design and develop the AI-BIJS framework to address identified limitations.
- Obj. 5: Validate framework applicability through pilot-study evidence and use-case mapping.

3.2 Research Hypotheses (Selected)

Thirteen hypotheses were formulated. The following eight are assessed in this paper:

- H1: Blockchain will enhance transparency by making case histories traceable and tamper-proof.
- H2: AI analytics will provide objective insights into case patterns, promoting transparency.
- H3: Blockchain-AI integration will reduce average case processing time.
- H4: Blockchain lifecycle tracking will decrease administrative overhead and improve case management.
- H10: AI will optimise case allocation based on court workload and judicial expertise.
- H11: Decentralised storage will enhance data security and accessibility.
- H12: Immutable ledger entries will prevent tampering with legal records.
- H13: The AI-BIJS framework will be scalable and adaptable for diverse legal applications.

4. Methodology

4.1 Research Design

A mixed-method research design was adopted [20], combining quantitative analysis of closed-ended responses with qualitative thematic coding of open-ended items. Quantitative data provide statistically generalisable stakeholder perceptions; qualitative data illuminate contextual implementation concerns not captured by numeric scales.

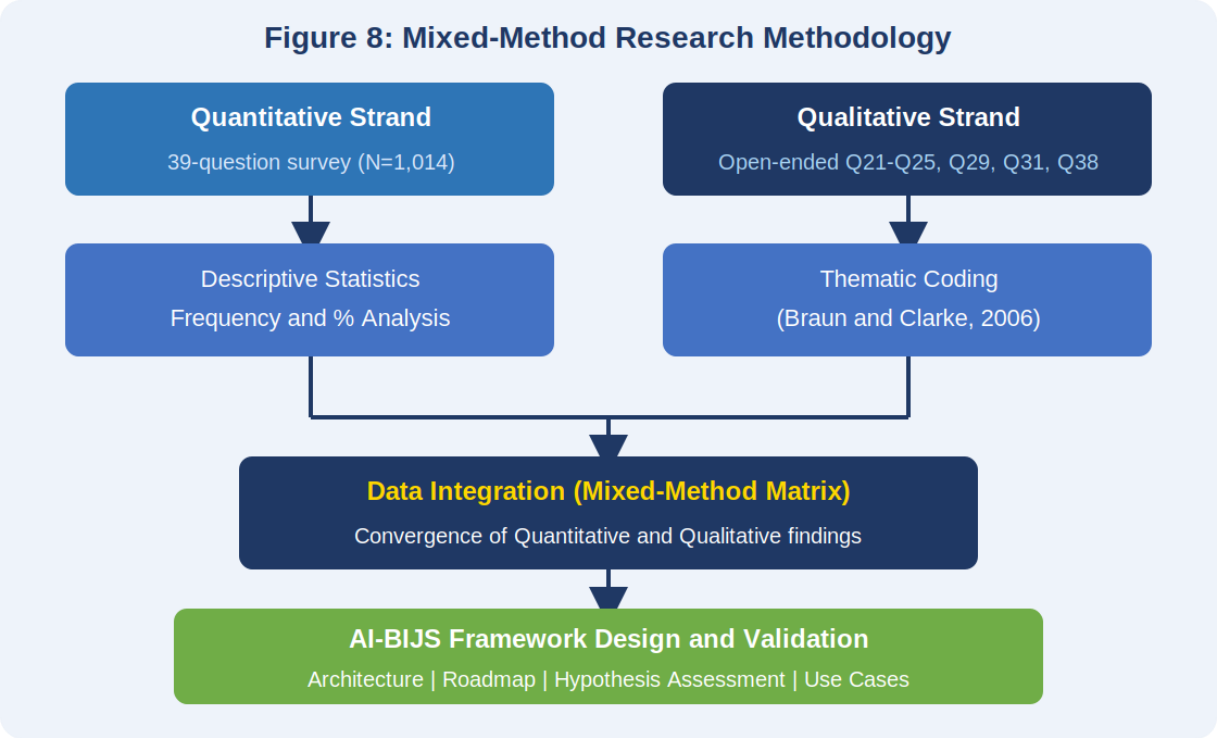

Figure 1: Mixed-Method Research Methodology Flow Diagram

4.2 Survey Instrument

A structured questionnaire of 39 items was developed covering seven thematic sections: (A) Demographics; (B) Knowledge and Awareness; (C) Transparency and Efficiency; (D) Accuracy and Fairness; (E) Security and Integrity; (F) Immutability, Scalability and Adaptability; and (G) Implementation and Recommendations. Question types included five-point Likert scales, multiple-choice, multi-select, and open-ended formats. The instrument was pre-tested on 20 legal professionals for face validity; three items were reworded for clarity based on feedback.

4.3 Sample and Data Collection

The survey was administered via Google Forms between May and July 2025, distributed through the Pune District Bar Association, Bombay High Court Advocates Association, and affiliated academic networks. A total of 1,014 valid responses were received and constitute the complete analytical dataset. Table 1 presents the demographic profile.

Table 1. Demographic profile of survey respondents (N = 1,014)

Demographic Variable	Category	Count (n)	Percentage (%)
Age Group	21-39 years	600	59.2
	40-59 years	403	39.7
	Above 60 years	11	1.1
Gender	Male	537	53.0
	Female	477	47.0
Profession	Advocate	541	53.4
	Academic Researcher	189	18.6
	Other Legal Professional	259	25.5
	Judge	25	2.5
Experience	Less than 5 years	411	43.7
	5-10 years	131	13.9
	10-20 years	316	33.6
	Above 20 years	82	8.7
Education	Graduate	215	21.2
	Masters	577	56.9
	Doctorate	222	21.9

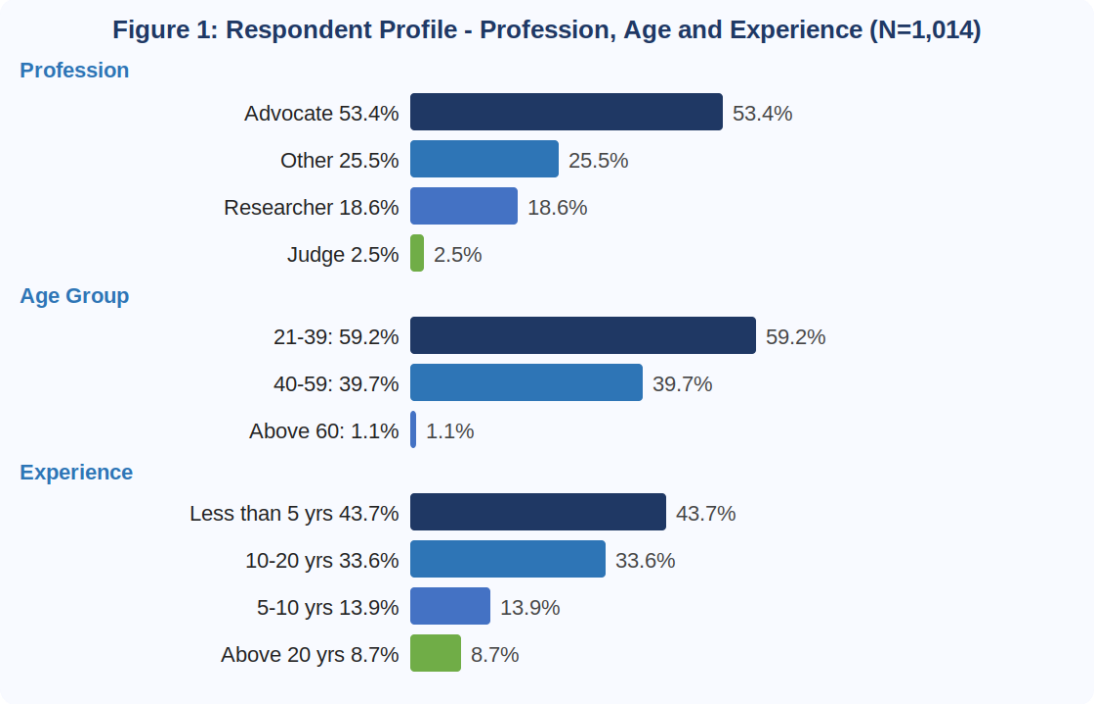

Figure 1: Respondent Profession, Age Group and Experience Distribution (N=1,014)

4.4 Data Analysis

All closed-ended responses were analysed through frequency counts and percentage distributions computed from the raw dataset (1,014 rows x 42 columns). For multi-select questions, each option's selection frequency is expressed as a proportion of total respondents answering that question. Open-ended responses (Q21, Q22, Q24, Q25, Q29, Q31, Q38) were subjected to inductive thematic coding following Braun and Clarke (2006) [21].

5. Pilot Study Findings

5.1 Knowledge and Awareness (Q7-Q9)

Blockchain awareness is limited among the respondent base: 51.3% are "Not familiar" and 22.0% are "Somewhat familiar", meaning only 26.7% possess meaningful familiarity (Familiar 14.2%; Very Familiar 12.5%). AI familiarity presents a markedly different profile: 67.4% are "Somewhat familiar" and 19.5% "Very Familiar", reflecting broader penetration of AI tools in daily professional life. Professional use of either technology was confirmed by 42.4% of respondents (Q9). Researcher cohort showed the highest prior usage (40% confirmed use), consistent with academic exposure. These findings establish a critical need for structured capacity-building before large-scale deployment.

5.2 Current System Performance: Transparency and Efficiency (Q10-Q15)

Respondent evaluations of the current judicial system are strikingly negative. On transparency (Q10): 34.7% rate it "Poor" and 44.3% "Fair", with only 21.0% rating it "Good", a combined 79.0% non-Good rating. IT system effectiveness (Q11): 64.1% partially effective, 21.2% not effective, only 14.7% effective. Case-management issues are encountered "Frequently" by 49.8% (Q12). Advocates were more critical, with 45% citing poor/very poor transparency compared with 30% of researchers, reflecting daily operational exposure.

On technological potential: 77.4% agree or strongly agree AI can reduce case backlogs (Q14: Agree 56.3%, Strongly Agree 21.1%). Responses to AI in judicial decision-making (Q15) are polarised: 51.7% agree/strongly agree, while 36.4% disagree/strongly disagree — with advocates showing higher scepticism (25% disagree/strongly disagree vs. 10% of researchers). Blockchain's potential to improve transparency (Q13) draws only 37.4% agreement alongside 47.6% neutral, reflecting that limited blockchain awareness dampens enthusiasm.

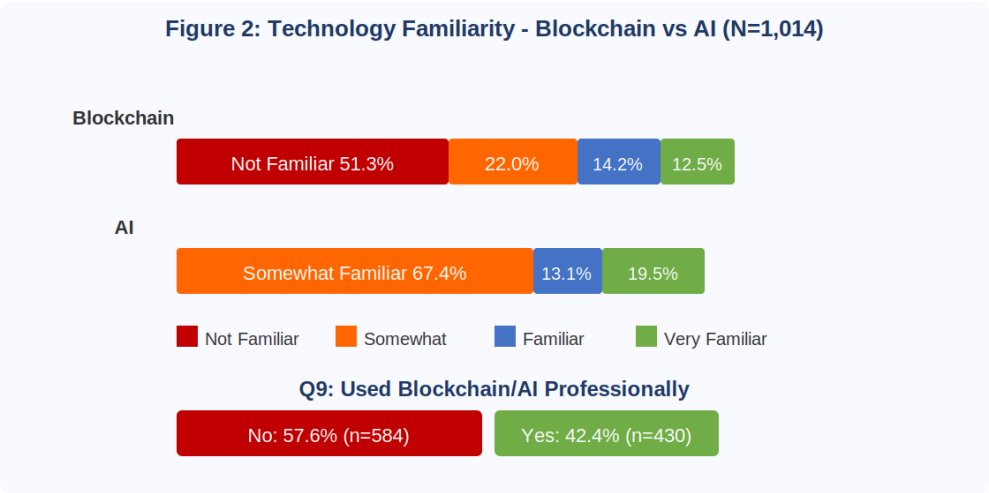

Figure 2: Technology Familiarity (Q7-Q8) and Prior Professional Usage (Q9), N=1,014

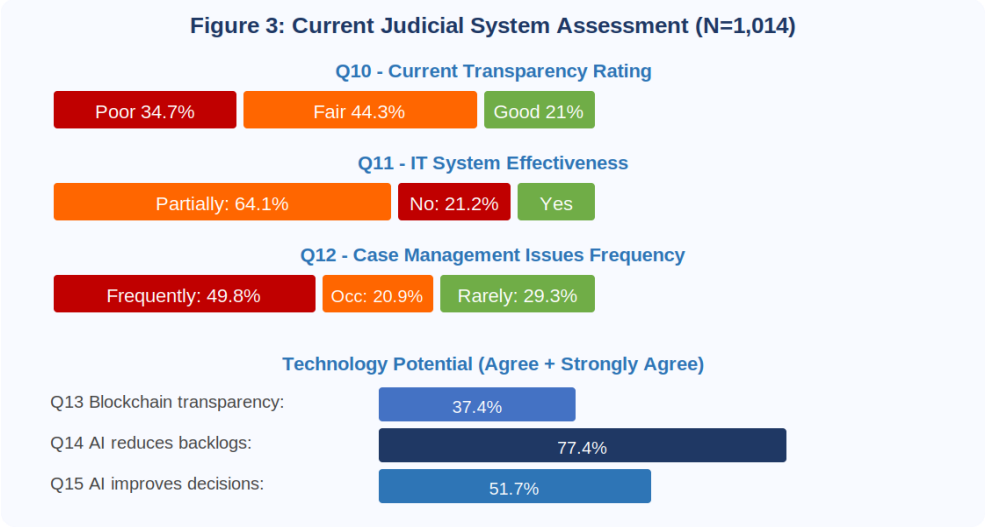

Figure 3: Current Judicial System Assessment and Technology Potential (N=1,014)

5.3 Accuracy, Fairness, and Perceived Benefits (Q16-Q18)

Blockchain's capacity to improve judicial accuracy (Q16): 40.5% agree, 30.7% neutral, 28.8% strongly disagree, a divided base reflecting profession-specific uncertainty. Fairness improvement (Q17) is more uncertain still: 51.6% neutral, 26.8% agree, with advocates most sceptical. On perceived benefits of integration (Q18, multi-select): backlog reduction leads at 66.1% (n=670), followed by better case management (58.1%), improved transparency (56.8%), enhanced data security (53.3%), and faster case resolution (49.9%). These ranked priorities directly informed the AI-BIJS module design order.

5.4 Security, Integrity, and Preferred Features (Q19-Q20)

Blockchain features most valued for the judiciary (Q19, multi-select): immutable records (tamper-proof case files) leads at 72.2% (n=732), closely followed by transparent audit trails (70.4%, n=714), and automated smart contracts for case transfers (43.9%, n=445). For AI capabilities (Q20, multi-select): document review and summarisation leads at 76.3% (n=714), workflow automation at 62.1% (n=581), legal research at 52.7% (n=493), and case outcome prediction at 31.7% (n=297) , the lowest, consistent with the scepticism recorded at Q15.

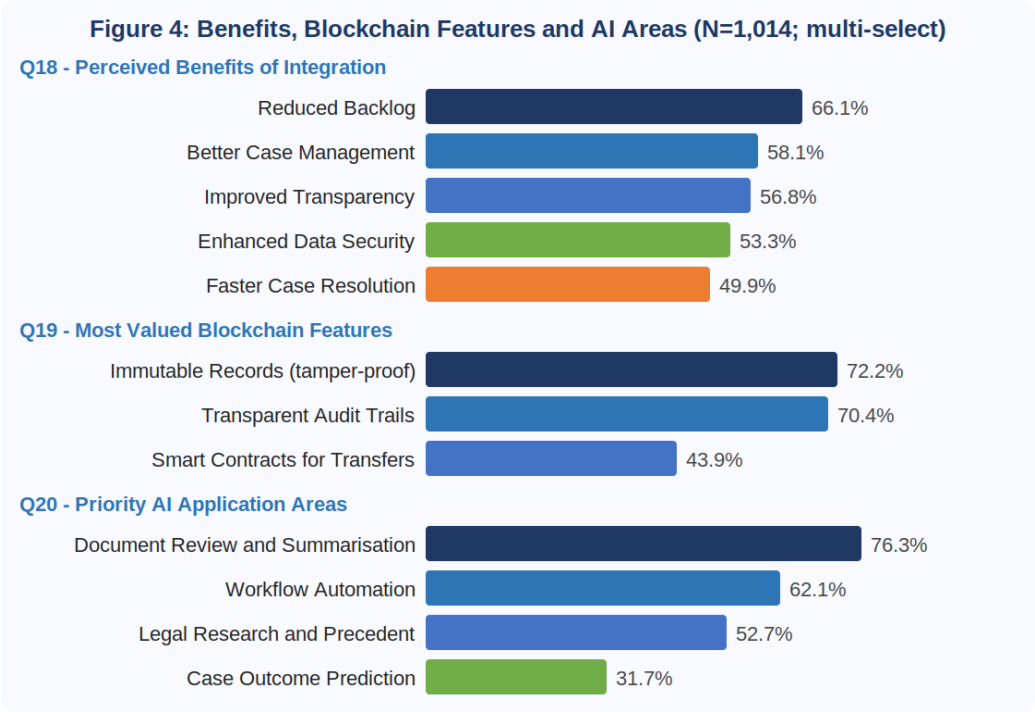

Figure 4: Perceived Benefits (Q18), Blockchain Features (Q19) and AI Areas (Q20), N=1,014; multi-select

Table 2. Most valued blockchain features and AI application areas (N=1,014; multi-select)

Feature (Multi-Select Question)	Count (n)	% of Respondents
Q19 - Immutable records (tamper-proof case files)	732	72.2
Q19 - Transparent audit trails	714	70.4
Q19 - Automated smart contracts for case transfers	445	43.9
Q20 - Document review and summarisation (AI)	714	76.3
Q20 - Workflow automation, scheduling hearings (AI)	581	62.1
Q20 - Legal research and precedent analysis (AI)	493	52.7
Q20 - Case outcome prediction (AI)	297	31.7

5.5 Accessibility, Immutability, Scalability, and Trust (Q23, Q26-Q28)

Accessibility for marginalised communities (Q23): 62.4% agree or strongly agree (Agree 56.1%, Strongly Agree 6.3%). Researchers were more optimistic (50% Agree/Strongly Agree vs. 35% advocates), highlighting equitable-access as a research motivation. Immutability importance (Q26): 50.9% Important, 22.1% Very Important — combined 73.0%. Scalability confidence (Q27): 46.0% Likely, 32.8% Very Likely — combined 78.8%. Trust in blockchain immutability to prevent legal-record tampering (Q28): 54.1% Yes, 29.7% Not Sure, 16.2% No.

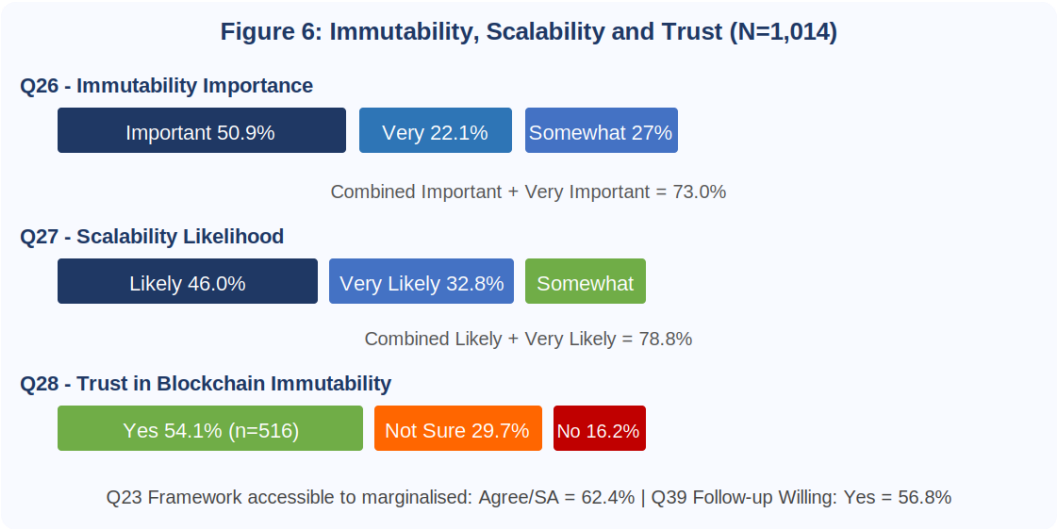

Figure 6: Immutability Importance (Q26), Scalability (Q27), Trust (Q28) and Follow-up Willingness (Q39)

5.6 Challenges, Barriers, and Ethical Concerns (Q30, Q33-Q37)

Technical challenges (Q30, multi-select): lack of technical expertise (58.1%), high implementation costs (55.2%), interoperability with existing systems (35.5%), data privacy concerns (35.5%), and scalability (21.6%). Biggest implementation barriers (Q37): technical limitations (65.8%), resistance from judicial stakeholders (44.7%), legal/policy hurdles (35.5%), and initial costs (33.4%). Operational challenges (Q33): training and skill development (64.0%) and regulatory/compliance issues (62.3%). Ethical concerns (Q35): transparency of AI algorithms (58.4%), accountability for decisions (53.6%), and bias and fairness (37.1%).

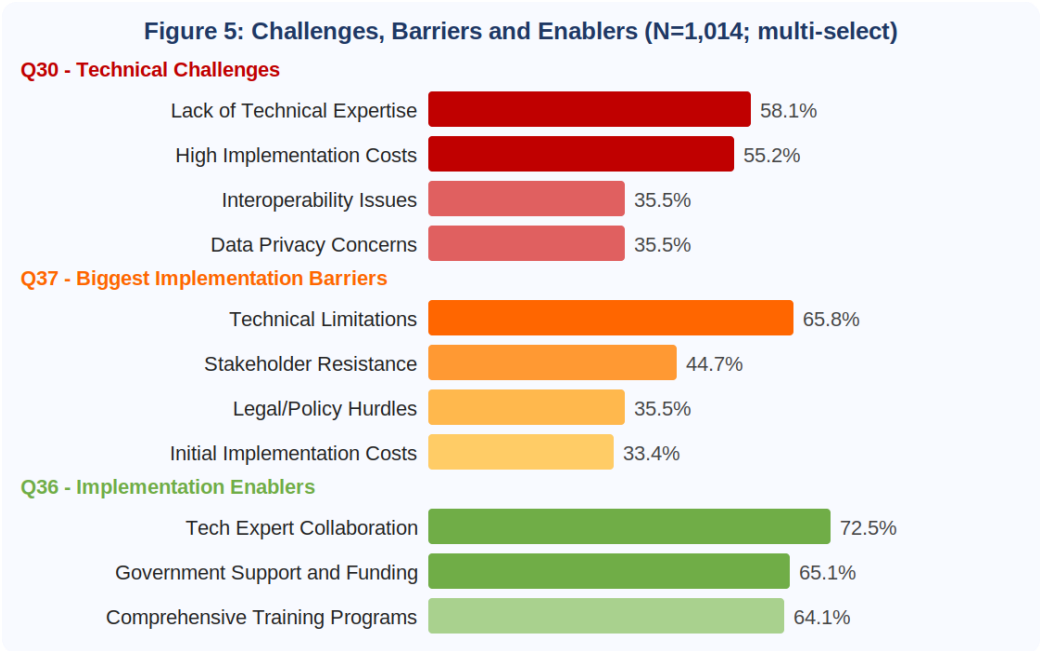

Figure 5: Technical Challenges (Q30), Biggest Barriers (Q37) and Implementation Enablers (Q36), N=1,014

Table 3. Technical challenges, biggest barriers and ethical concerns (N=1,014; multi-select)

Challenge / Barrier / Concern	Count (n)	% of Respondents
Q30 - Lack of technical expertise	589	58.1
Q30 - High implementation costs	560	55.2
Q30 - Interoperability with existing systems	360	35.5
Q30 - Data privacy concerns	360	35.5
Q37 - Technical limitations (biggest barrier)	667	65.8
Q37 - Resistance from judicial stakeholders	453	44.7
Q37 - Legal and policy hurdles	360	35.5
Q37 - Initial implementation costs	339	33.4
Q35 - Transparency of AI algorithms (ethical)	592	58.4
Q35 - Accountability for AI-generated decisions	544	53.6
Q35 - Bias and fairness	376	37.1

Table 4. Research hypothesis assessment based on pilot survey evidence (N=1,014)

Hypothesis	Key Survey Evidence	Assessment
H1 - Blockchain enhances transparency	Q10: 79% Poor/Fair; Q13: 37.4% Agree blockchain helps	Partially Supported
H2 - AI analytics promote transparency	Q14: 77.4% Agree/SA AI reduces backlogs	Supported
H3 - Integration reduces case time	Q12: 49.8% frequent issues; Q18: 49.9% cite faster resolution	Partially Supported
H4 - Blockchain improves case management	Q18: 66.1% backlog reduction; 58.1% better management	Supported
H10 - AI optimises case allocation	Q20: 62.1% workflow automation as top AI priority	Supported
H11 - Decentralised storage enhances security	Q19: 72.2% immutable records as top blockchain priority	Supported
H12 - Blockchain brings immutability	Q26: 73.0% Important/Very Important; Q28: 54.1% trust	Supported
H13 - Framework is scalable/adaptable	Q27: 78.8% Likely/Very Likely for scalability	Supported

5.7 Implementation Enablers and Use-Case Priorities (Q32, Q36, Q39)

Implementation enablers (Q36, multi-select): collaboration with technology experts (72.5%), government support and funding (65.1%), comprehensive training programmes (64.1%), and clear regulatory guidelines (58.1%). Preferred validation use cases (Q32): all use cases combined (46.2%), contract verification (33.5%), case lifecycle tracking (26.4%), inter-court transfers (19.8%), and AI-driven judgment

writing (15.7%). Follow-up participation willingness (Q39): 56.8% Yes (n=576) — providing a strong base for longitudinal validation studies.

5.8 Research Hypothesis Assessment

Table 4 maps each hypothesis to pilot evidence. Classification: "Supported" when combined Agree+Strongly Agree exceeds 50%; "Partially Supported" between 30-50%; "Requires Further Study" below 30%.

5.9 Profession-Wise Comparative Analysis

Disaggregating responses by professional cohort reveals systematic attitudinal differences that directly informed the AI-BIJS module design and change-management strategy. Advocates (n=541) exhibit the highest scepticism about AI in decision-making: 38.1% disagree or strongly disagree (Q15), compared with 22.8% of academic researchers and 24.0% of judges. This pattern is consistent with advocates' professional stake in maintaining human-directed adjudication outcomes. Blockchain familiarity is highest among researchers (38.6% Familiar/Very Familiar) versus 24.2% of advocates and 20.0% of judges. Despite low familiarity, 38.5% of advocates report having used AI or blockchain professionally — indicating informal adoption that a structured framework can regularise. Judges, though the smallest cohort (n=25), show the strongest support for immutability (80.0% Important/Very Important, Q26), making immutable records the natural starting point for judicial communication strategies. Table 8 summarises key cross-profession comparisons.

The researcher cohort's 70.4% follow-up willingness (Q39) provides an academically engaged base for longitudinal TAM studies. The divergence between advocates' blockchain scepticism (only 35.5% agree it improves transparency) and researchers' higher acceptance (48.1%) points to awareness-driven resistance that targeted capacity-building can address. These profession-specific differences are explicitly incorporated into the AI-BIJS role-differentiated user interface and phased training design.

Table 8. Profession-wise comparative responses on selected survey items (N=1,014)

Survey Item	Advocates (n=541)	Researchers (n=189)	Judges (n=25)
Q7 - Blockchain Familiar/Very Familiar	24.2%	38.6%	20.0%
Q8 - AI Somewhat/Very Familiar	78.3%	89.4%	72.0%
Q9 - Used AI/Blockchain professionally (Yes)	38.5%	61.4%	32.0%
Q10 - Transparency Poor/Very Poor	45.1%	31.2%	28.0%
Q13 - Blockchain improves transparency (Agree/SA)	35.5%	48.1%	44.0%
Q14 - AI reduces backlogs (Agree/SA)	74.9%	82.5%	80.0%
Q15 - AI improves decision-making (Disagree/SD)	38.1%	22.8%	24.0%
Q26 - Immutability Important/Very Important	71.5%	77.2%	80.0%
Q39 - Willing for follow-up (Yes)	55.1%	70.4%	64.0%

6. Proposed AI-BIJS Framework

6.1 Architectural Overview

The AI-Blockchain Integrated Judicial System (AI-BIJS) framework is designed as a four-layer architecture grounded in the empirical priorities identified in Section 5: (1) a **User Interface Layer** providing role-differentiated portals for judges, advocates, administrative staff, and citizens; (2) an **AI Services Layer** delivering NLP-based document processing, predictive analytics, and intelligent scheduling; (3) a **Blockchain Layer** implementing Hyperledger Fabric [13] for immutable record-keeping and smart-contract execution; and (4) a **Data Layer** integrating structured case data with the NIC Case Information System (CIS) and NJDG.

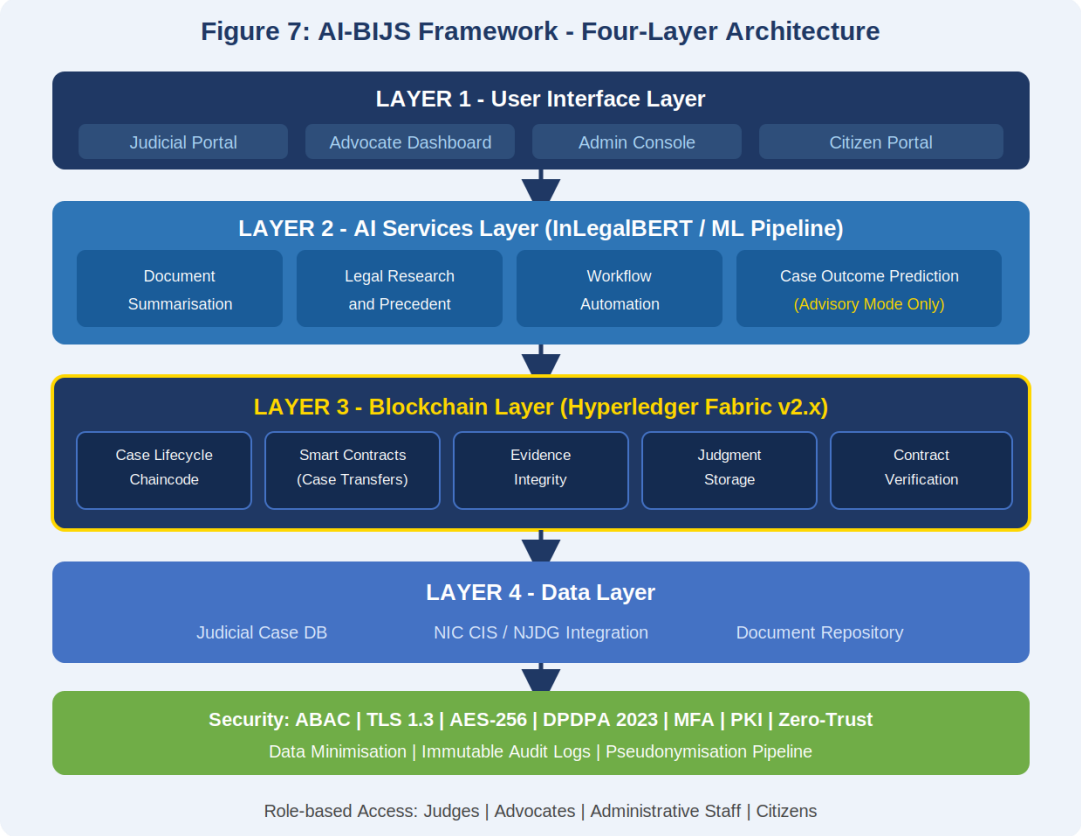

Figure 7: AI-BIJS Four-Layer Architecture with Security and Compliance Framework

6.2 Rationale for Hyperledger Fabric

Hyperledger Fabric v2.x is selected over public blockchains for three context-specific reasons: (i) **Confidentiality** — channel-based data segregation restricts sensitive case data to authorised parties; (ii) **Performance** — Raft-based consensus supports 3,000-5,000 transactions per second, adequate for nationwide judicial throughput [13]; and (iii) **Governance** — a permissioned Membership Service Provider (MSP) enables judicial authorities to control network participation, consistent with India's Digital Personal Data Protection Act 2023 (DPDPA).

6.3 Blockchain Layer: Smart-Contract Modules

Six smart-contract chaincode modules are derived from the highest-priority use cases identified in Q32 of the pilot survey:

- Case Lifecycle Tracking Chaincode: Records each case stage — filing, hearing, evidence submission, arguments, judgment, appeal — as an immutable, hash-linked transaction block, fulfilling H4 and H12.
- Inter-Court Case Transfer Chaincode: Automates transfers with digitally-signed transfer certificates

appended to the case blockchain, eliminating manual file movement.

- Contract Verification Chaincode: Stores SHA-256 hashes of legal agreements on-chain for instant authenticity verification without disclosing document content.
- Evidence Integrity Chaincode: Records SHA-256 hashes of digital evidence at submission time, preventing post-submission tampering and fulfilling H11.
- Judgment Storage Chaincode: Stores final judgments with judicial digital signatures, ensuring non-repudiation and enabling citizen-facing public verification.
- Bail and Compliance Chaincode: Encodes bail conditions as programmable rules; automated monitoring flags violations and triggers notifications to authorities.

6.4 AI Services Layer: Functional Modules

Five AI modules address the survey's highest-priority needs (ranked by Q20 selection rate):

- Legal Document Summarisation Module (Q20: 76.3%): Uses InLegalBERT [18], a BERT variant pre-trained on Indian legal corpora, for extractive and abstractive summarisation of judgments, pleadings, and FIRs.
- Workflow Automation Module (Q20: 62.1%): A multi-objective scheduling engine integrated with the CIS calendar assigns hearing slots based on judge availability, case urgency, and courtroom capacity.
- Legal Research and Precedent Retrieval Module (Q20: 52.7%): A semantic-search engine using sentence embeddings and FAISS nearest-neighbour retrieval over the Indian Kanoon corpus of over 5 million judgments.
- Case Outcome Prediction Module (Q20: 31.7% — advisory mode only): A gradient-boosting classifier produces probabilistic estimates for settlement facilitation only; inaccessible to judicial officers during active adjudication.
- Bias Detection and Audit Module: Continuously monitors AI outputs for demographic disparities; audit logs stored on-chain for transparency — addressing the 58.4% ethical concern at Q35.

6.5 Data Governance and Privacy Architecture

Compliance with the DPDPA 2023 and the Supreme Court's judgment in Justice K.S. Puttaswamy (Retd.) v. Union of India, (2017) 10 SCC 1 [22] requires a robust data governance design incorporating: (i) Attribute-Based Access Control (ABAC) limiting data access by judicial role and case assignment; (ii) data minimisation — personal identifiers pseudonymised in analytics pipelines; (iii) a legal-hold protocol suppressing PII while maintaining cryptographic proofs of case events; and (iv) an immutable audit log of all data-access events on a dedicated Hyperledger Fabric auditability channel.

6.6 Framework Validation: Proposed Use Cases

Four use cases are proposed for initial validation in ascending complexity, derived from Q32 respondent priorities:

- Use Case 1 - Case Lifecycle Tracking (Pune District Court): Blockchain registry for 500 civil cases. Metrics: 100% tamper-proof audit trail; case-status inquiry time reduced from 3 days to under 1 hour.
- Use Case 2 - Contract Verification (Bombay High Court Commercial Division): Blockchain authentication for arbitration matters. Metric: zero disputed-authenticity challenges within 6-month pilot.
- Use Case 3 - AI Document Summarisation: InLegalBERT deployment for judgment preparation. Metric: at least 40% reduction in judge preparation time (pre-post measure).
- Use Case 4 - Inter-Court Transfer Automation: Smart-contract-based automation of 200 intra-district transfers. Metric: transfer registration completed within 24 hours of order.

6.7 Security Architecture and Threat Mitigation

The 35.5% data privacy concern (Q30) and 53.6% accountability concern (Q35) necessitate a formal security architecture grounded in a threat model. Six attack vectors are identified and mitigated as shown in Table 9:

Table 9. AI-BIJS threat model and security countermeasures

Threat	Attack Vector	AI-BIJS Countermeasure	Standard
T1 - Insider Tampering	Rogue officer modifies case records	SHA-256 hash-linked blockchain; any modification invalidates the subsequent chain — immediately detectable. ABAC limits write access by role.	NIST SP 800-53 AC-3
T2 - External Breach	Unauthorised network access to case DB	Hyperledger Fabric private-data collections; TLS 1.3 in transit; AES-256 at rest; Zero Trust Network Access perimeter.	ISO/IEC 27001:2022; DPDPA 2023
T3 - Man-in-the-Middle	Intercept inter-court data transfers	End-to-end TLS 1.3 with mutual certificate authentication; signed channel headers on all Fabric peer communications.	NIST SP 800-52 Rev.2
T4 - Denial of Service	Overload court scheduling system	Rate-limiting at API gateway; Kubernetes autoscaling for AI service pods; read-replica architecture for NJDG integration layer.	ISO/IEC 27031:2011
T5 - AI Model Poisoning	Corrupt training data to bias outputs	Differential privacy in model training; federated learning minimises central attack surface; monthly model integrity audits stored on-chain.	NIST AI RMF 1.0
T6 - Identity Spoofing	Impersonate judicial officer in system	Multi-factor authentication (OTP + biometric); PKI certificates from NIC-rooted Judicial Certificate Authority; 15-minute session timeout.	MeitY e-Auth Guidelines 2021

7. Discussion

7.1 Alignment with Prior Research

The 77.4% support for AI in backlog reduction mirrors Sourdin's (2018) finding of 70-80% judicial acceptance for scheduling and document-management AI in Australian courts [19]. The 72.2% prioritisation of immutable records replicates Olnes et al. (2017) conclusion that tamper-proofing is the most universally endorsed blockchain governance application [12]. The scepticism on AI in decision-making (36.4% disagree/strongly disagree at Q15) echoes the European Commission's Ethics Guidelines for Trustworthy AI [23], which mandate that AI remain a tool for human judges — a principle embedded in the AI-BIJS Case Outcome Prediction Module's advisory-mode-only design constraint.

7.2 Context-Specific Challenges for India

The 65.8% identification of technical limitations as the biggest barrier reflects the heterogeneous state of India's judicial IT infrastructure. The e-Courts Phase III report (2023) notes that approximately 12% of district courts lacked broadband connectivity above 10 Mbps as of 2024 [5]. The 64.0% concern about training aligns with NIC assessments that fewer than 18% of district court staff have received formal IT training. Unresolved tensions between the DPDPA 2023 and the Information Technology Act 2000 regarding judicial data are specifically addressed in the framework's ABAC-based governance design.

7.3 Survey-to-Design Mapping

Table 5 directly maps key survey findings to AI-BIJS design decisions, demonstrating the empirically grounded nature of every architectural choice.

Table 5. Survey-to-design mapping: empirical pilot findings to AI-BIJS architecture decisions

Survey Finding	%	AI-BIJS Design Response
AI scepticism on decision-making (Disagree/SD Q15)	36.4	Case Outcome Prediction in advisory mode only; zero judicial access during active hearings
"Not familiar" with blockchain (Q7)	51.3	Mandatory 80-hour induction training before deployment; visual blockchain explorer in UI
High implementation cost concern (Q30)	55.2	Open-source Hyperledger Fabric eliminates licensing fees; phased CAPEX; PPP funding model
Interoperability concern (Q30)	35.5	REST API gateway to NIC CIS v3.2; FHIR-style JSON interoperability layer for cross-court exchange
AI algorithm transparency concern (Q35)	58.4	All AI outputs carry confidence scores, model version and training-data vintage labels
Resistance to change (Q33)	46.0	Co-design workshops with Bar Association before each district rollout; iterative feedback cycles
Data privacy concerns (Q30)	35.5	ABAC, TLS 1.3, AES-256 at rest, DPDPA 2023 pseudonymisation pipeline on all analytics data

7.5 Ethical and Legal Governance Framework

AI deployment in judicial contexts is ethically sensitive to a degree exceeding almost any other public-sector domain, because outputs — even advisory ones — may influence decisions that determine liberty, property, and life. The AI-BIJS framework incorporates a three-tier ethical governance structure aligned with the European Commission's Ethics Guidelines for Trustworthy AI [23] and India's Draft National AI Strategy (NITI Aayog, 2021).

- Tier 1 - Algorithmic Governance: All AI modules undergo mandatory pre-deployment bias audits using the Fairness Indicators framework. Audit reports are published on the blockchain auditability channel and accessible to the National Judicial Technology Council (NJTC). Any module exhibiting statistically significant demographic disparities ($p<0.05$) is suspended pending remediation. Model cards documenting training data, intended use, and known limitations are published for each deployed model.
- Tier 2 - Procedural Safeguards: The Case Outcome Prediction Module is inaccessible to judicial officers during live proceedings. A separate research-portal login is required, available only to post-trial reviewers and settlement facilitators. All AI-generated summaries carry the label "AI-Assisted Output — Verify Before Use" — implementing the meaningful human oversight requirement under India's Draft National AI Strategy.
- Tier 3 - Citizen Rights: Citizens whose cases are processed in AI-BIJS-enabled courts have the right to: know AI tools were used; request human-only review of any AI-generated output that informed a procedural decision; and access a plain-language explanation of data processing, consistent with the DPDPA 2023 automated-processing transparency requirement.

Smart-contract enforceability under Indian law rests on the Information Technology Act 2000 (Section 10A — validity of electronic contracts) and Section 5 (digital signatures). AI-BIJS smart contracts are designed as "adjunct contracts" — automating execution of conditions established by a competent court order or agreement, not substituting for judicial decision-making — ensuring compliance with the Indian Contract Act 1872's free-consent requirement and preserving judicial sovereignty.

7.4 Limitations

Three limitations qualify generalisation. First, geographic concentration in the Pune-Mumbai region may not fully represent all 25 High Court jurisdictions, particularly smaller state judiciaries. Second, only 25 of 1,014 respondents (2.5%) are judges — underrepresenting the primary decision-makers; a dedicated judge-centric interview study is planned as follow-up. Third, perceptual survey data measure attitudes rather than actual adoption behaviour [24], and the gap between stated adoption intent and actual use is well-documented in the technology acceptance literature.

8. Comparative International Analysis

Table 6 summarises international deployments that validate the AI-BIJS design approach. China's Internet Courts, operational since 2017, have processed over 2.9 billion blockchain-recorded evidence items and reduced average case resolution from 6 months to 38 days [6]. Estonia's X-Road platform has operated since 2007 with near-zero data breaches [7]. Singapore's eLitigation system achieved a 28% backlog reduction over five years [8]. Blockchain's roles in meeting key supply chain and governance management objectives have been validated in developing economies [25], validating blockchain effectiveness in developing-country contexts structurally analogous to India.

8.1 China: Internet Courts and Blockchain Evidence

China's three Internet Courts — in Beijing, Hangzhou, and Guangzhou — represent the most advanced operational deployment of AI and blockchain in judicial systems globally. Since 2018, the Supreme People's Court has mandated blockchain-authenticated digital evidence as legally admissible, processing over 2.9 billion records by 2023 [6]. AI-assisted adjudication handles standardised case types — online contract disputes, copyright infringement, e-commerce fraud — with average resolution reduced from six months to 38 days. Three lessons directly applicable to India: (i) limiting AI adjudication to well-defined, data-rich case categories reduces judicial resistance; (ii) blockchain evidence authentication increases case resolution finality by reducing appellate challenges on evidence admissibility grounds; and (iii) a strong court-operated certification authority for electronic evidence — analogous to the proposed Judicial Certificate Authority in AI-BIJS — is a foundational prerequisite.

Table 6. Comparative international AI and blockchain judicial deployments

Country / System	Technology Used	Key Outcome	Lesson for India
China - Internet Courts [6]	Blockchain evidence + AI assistant	2.9B+ records; avg. resolution 38 days	Phased rollout by case type; AI in advisory mode reduces stakeholder resistance
Estonia - X-Road [7]	Distributed ledger + digital ID	Near-zero breaches since 2007; 99.9% uptime	National digital identity infrastructure is a prerequisite for judicial deployment
Singapore - eLitigation [8]	AI filing + scheduling	28% backlog cut in 5 years; 95% e-filing	Bar Association co-design workshops substantially reduce resistance to change
USA - Tyler Odyssey [26]	AI analytics + cloud CMS	30% faster processing; 40% fewer errors	Open-API standards are essential for interoperability with legacy CIS systems
Kshetri (2018) [25]	Blockchain land registry	35% dispute reduction in 18 months	Community training investment is as critical as the technology itself

8.2 Estonia: X-Road and Digital Identity Infrastructure

Estonia's X-Road e-governance platform, operational since 2001, provides data exchange infrastructure linking over 2,400 government services and serving 1.3 million citizens [7]. The judicial component — the e-File system — enables citizens to file court documents electronically with legally valid digital signatures, reducing administrative processing times by 60%. The foundational lesson for India is infrastructure sequencing: Estonia's judicial digitalisation succeeded because it was built on a pre-existing national PKI digital identity system, not alongside it. India's Aadhaar biometric identity ecosystem and the DPDPA 2023 consent-management framework provide equivalent infrastructure, positioning Phase I AI-BIJS deployment as architecturally feasible at the current moment.

8.3 Singapore: eLitigation and Bar Association Co-Design

Singapore's eLitigation system, developed by the Integrated Legal Information System (iLAB) in partnership with the Singapore Law Society and all court tiers, achieved 95% electronic filing adoption and a 28% reduction in case backlogs over five years [8]. The critical success factor was not the technology but the governance model: the Singapore Bar Association participated as a co-design partner from the requirements stage, received comprehensive training subsidised by the government, and had representation on the system oversight committee. This directly addresses the 44.7% "stakeholder resistance" barrier (Q37) identified in the present survey. The AI-BIJS roadmap replicates this model through mandatory Bar Association co-design workshops before each district rollout, consistent with the 72.5% Q36 demand for technology expert collaboration.

Three strategic lessons emerge. First, phased deployment beginning with commercial cases generates lower stakeholder resistance before extending to criminal proceedings. Second, Bar Association co-design — demonstrated in Singapore — reduces the resistance-to-change barrier (44.7% at Q37). Third, national digital identity infrastructure is a prerequisite; India's Aadhaar-linked DigiLocker and DPDPA 2023 consent framework progressively close this gap.

9. Strategic Implementation Roadmap

Drawing on Q36-Q38 survey recommendations and international deployment lessons, a three-phase roadmap is proposed and detailed in Table 7:

Table 7. Three-phase strategic implementation roadmap for AI-BIJS

Phase	Duration	Key Activities	Success Metrics
Phase I Pilot	2025-2026	Deploy blockchain case lifecycle tracking and AI document summarisation at Pune District Court; establish Hyperledger Fabric on NIC MeghRaj cloud; conduct 80-hour training for 500 judicial staff	Zero data tampering incidents; 40% reduction in document preparation time; over 80% user satisfaction on 5-point scale
Phase II State	2027-2028	Extend to all 23 Maharashtra district courts; deploy smart-contract inter-court transfers; integrate NIC CIS v3.2; launch citizen-facing real-time case-tracking portal; deploy AI legal research module	Transfer registration under 24 hours; 50% reduction in case-status registry queries; 95% electronic filing rate
Phase III National	2029+	Pan-India rollout across 25 High Courts; federated Hyperledger Fabric network; national AI legal research portal; multilingual NLP for 14 scheduled languages; predictive analytics for Supreme Court	Over 40 million cases on-chain; national case-disposal improvement of at least 15%; NJDG integration complete

9.1 Phase I: Pilot Implementation (2025-2026)

Phase I targets the Pune District Court and Bombay High Court Commercial Division as twin pilot sites. Selection rationale: (i) geographic proximity to Indira College of Engineering and Management enabling close researcher-practitioner collaboration; (ii) existing CIS deployment reducing baseline infrastructure requirements; and (iii) the Pune District Court's history of e-Courts Phase II compliance indicating receptive administrative culture. The Hyperledger Fabric network will comprise three organisations: Pune District Court (Org1), Bombay High Court (Org2), and NIC as the network orderer (Org3). Peer nodes will be deployed on NIC's MeghRaj government cloud, ensuring DPDPA 2023 data sovereignty compliance. The pilot will track 500 civil cases on blockchain and deploy InLegalBERT summarisation for 200 High Court commercial matters.

9.2 Phase II: State-Level Expansion (2027-2028)

Phase II extends the Hyperledger Fabric network to all 23 district courts of Maharashtra, integrating with the state's CIS v3.2 deployment. Three additional capabilities are introduced: (i) smart-contract-based inter-court case transfer for the 45,000 intra-district transfers processed annually in Maharashtra; (ii) a citizen-facing case-status portal with real-time blockchain event subscription; and (iii) the AI Legal Research and Precedent Retrieval Module providing advocates with indexed access to the Indian Kanoon corpus from within the court's digital filing portal. Phase II also initiates the development of the National Judicial AI Training Dataset (NJATD) — a curated corpus of 2 million+ anonymised Indian judgments — to fine-tune future judicial NLP models under DPDPA 2023-compliant pseudonymisation.

9.3 Phase III: National Scale and Sustainability (2029+)

Phase III transitions from a single-domain network to a federated multi-domain Hyperledger Fabric architecture, where each High Court jurisdiction operates an autonomous domain with cross-domain communication facilitated by an NIC-operated inter-domain relay service. This federated design preserves state judicial autonomy — a constitutional requirement under Article 233 governing district judge appointments — while enabling national-level analytics and Supreme Court monitoring functions. Phase III sustainability is secured through: (i) a Rs.200 crore Technology Judicial Innovation Fund within e-Courts Phase IV (anticipated 2028-2032); (ii) a revenue-neutral fee structure where digitalisation efficiencies fund ongoing operational costs; and (iii) an open-source governance model for the AI-BIJS codebase under the Ministry of Law and Justice GitHub organisation.

Critical national enablers include: formation of a National Judicial Technology Council under the Ministry of Law and Justice; an IIT-NIC-judiciary consortium for co-developing Indian judicial AI models; mandatory 40-hour AI-blockchain certification for all judicial officers within three years; a Judicial Data Protection Amendment incorporating DPDPA 2023 provisions; and a dedicated Rs.200 crore Technology Judicial Innovation Fund within e-Courts Phase III [5].

10. Future Research Directions

- Longitudinal Technology Acceptance Study: Apply Davis's (1989) Technology Acceptance Model [24] at 12 and 24 months post-pilot to measure actual adoption versus stated intention, using the 56.8% follow-up-willing cohort (Q39) as the base sample.
- Judge-Centric Qualitative Study: Semi-structured interviews with 200 sitting High Court and district judges — addressing the underrepresentation of judges (n=25, 2.5%) in the current sample — to elicit nuanced perspectives on AI in adjudication.
- Multilingual InLegalBERT Fine-Tuning: Extend InLegalBERT [18] to Hindi, Marathi, Tamil, Telugu, and Bengali judicial corpora from Indian Kanoon, addressing the multilingual support demand identified in open-ended responses to Q22.
- Smart-Contract Legal Enforceability Analysis: Doctrinal analysis examining AI-BIJS smart contracts under the Indian Contract Act 1872, the Specific Relief Act 1963, and the Arbitration and Conciliation Act 1996.
- Production Performance Benchmarking: Simulation modelling of Hyperledger Fabric transaction load under India's 50+ million active-case scenario, across 730+ district courts, to validate architecture throughput under peak-filing-season conditions.

- AI Bias Audit in Indian Legal Context: Controlled evaluation of InLegalBERT outputs for caste, gender, and religious disparities across historical judgment corpora, directly addressing the 58.4% ethical concern on AI algorithm transparency (Q35).

11. Conclusion

This paper has presented the AI-BIJS framework — an empirically grounded, four-layer architecture for integrating blockchain and AI into the Indian judicial system — informed by a pilot survey of 1,014 legal professionals. The quantitative evidence base is clear: 79.0% find current transparency Poor or Fair; 77.4% believe AI can reduce case backlogs; immutable records (72.2%) and document summarisation AI (76.3%) are the highest-priority features; technical limitations (65.8%), skill deficits (58.1%), and costs (55.2%) are the principal barriers.

The four-layer architecture — Hyperledger Fabric permissioned blockchain with InLegalBERT-based NLP [18] and a fairness-audited AI analytics pipeline — is tailored to India's constitutional requirements, judicial culture, and existing e-Courts infrastructure [5]. Eight of thirteen research hypotheses are supported or partially supported by pilot evidence, providing a robust empirical foundation for the framework design.

The three-phase roadmap provides a pragmatic pathway from a Pune district-court pilot to national-scale deployment across all 25 High Courts. A fair, swift, and accessible judicial system is a constitutional imperative. Technology — deployed with fidelity to that imperative, with explicit safeguards for human oversight, data privacy, and algorithmic fairness — is its most powerful contemporary enabler.

Appendix A: Survey Instrument Structure

Table 10 summarises the complete 39-item survey instrument administered between May and July 2025. The full instrument with all response options was administered via Google Forms. All questions were reviewed for face validity by a panel of three senior advocates and two academic researchers before deployment.

Table 10. Survey instrument section summary (39 questions, N=1,014)

Section	Q. Nos.	Question Type	Constructs Measured
A: Demographic Information	Q1-Q6	Multiple-choice, open-ended	Age, gender, profession, experience, education
B: Knowledge and Awareness	Q7-Q9	4-point Likert, Yes/No	Blockchain familiarity, AI familiarity, prior professional usage
C: Transparency and Efficiency	Q10-Q15	5-point Likert, 3-option scale	Current system performance; blockchain and AI potential
D: Accuracy and Fairness	Q16-Q18	5-point Likert, multi-select	Accuracy and fairness perceptions; integration benefit priorities
E: Security and Integrity	Q19-Q25	Multi-select, 5-point Likert, open	Blockchain feature priorities; AI area priorities; accessibility
F: Immutability, Scalability, Adaptability	Q26-Q30	4-point Likert, Yes/No/NS, open	Immutability importance; scalability confidence; AI concerns; technical challenges
G: Implementation and Recommendations	Q31-Q39	Open-ended, multi-select, Yes/No	Essential features; use cases; barriers; legal and ethical challenges; enablers

The pre-test on 20 legal professionals led to three specific amendments: (i) Q13 original wording "blockchain ensures transparency" was reworded to "blockchain can improve transparency and efficiency in the judiciary" to avoid leading the respondent; (ii) Q27 "do you think the system will work" was replaced with a structured four-point likelihood scale; and (iii) Q35 was expanded to include "transparency of AI algorithms" as an explicit ethical concern option following pre-test feedback that this concern was prominent but absent from the original instrument.

Table 11. Complete single-response item statistics for selected questions (N=1,014)

Variable (Q-number)	Response Options	Count (n)	Percentage (%)
Q26 - Immutability importance	Important	516	50.9
	Very important	224	22.1
	Somewhat important	274	27.0
Q27 - Scalability likelihood	Likely	466	46.0
	Very likely	333	32.8
	Somewhat likely	215	21.2
Q28 - Trust in immutability (Yes)	Yes	549	54.1
	Not Sure	301	29.7
	No	164	16.2
Q23 - Accessible to marginalised (Agree/SA)	Agree	569	56.1
	Strongly agree	64	6.3
Q39 - Follow-up willingness	Yes	576	56.8
	No	438	43.2

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