

SCIENCE ON TRIAL: INDONESIA'S LEGAL DILEMMA**Fransiscus Nanga Roka¹, Yovita Arie Mangesti²****^{1,2}Universitas 17 Agustus 1945 Surabaya****¹Email: fransiscusnr999@gmail.com****²Email: yovitaam@untag-sby.ac.id*****Abstract***

This research analyzed the way in which Indonesia's anti corruption court combines judicial formalism with scientific proof requirements. Employing a normative and comparative research design, we utilized a doctrinal analysis of Criminal Procedure Code and Anti Corruption Law, micro comparisons to the United States, UK, Singapore, and Indonesia including reliability tests; gatekeeping authority; chain of custody; expert independence. It found systemic epistemic deficits: the lack of an autonomous category for scientific evidence, weak to non existent reliability tests, fragmented chain of custody trade practices, judicial aversion to method and error rate scrutiny and an epistemic imbalance privileging prosecution access to experts and raw materials. Comparative mapping produced a hybrid gatekeeping model which integrates ex ante admission screening and ex post weight attribution, firmly based on validity of method, known error rates, transparent methodology, expert accreditation by the courts, court designated expertise appointment and data disclosure sanctions. We can only trust that rule making of the reliability standard, judicial gatekeeping and ensuring defendants' rights are necessary in order to ensure due process and legal certainty. These structural changes bring evidentiary practice into closer conformity with scientific rationality, thereby mitigating the risks posed by wrongful convictions and enhancing public confidence in corruption adjudication

Keywords : scientific evidence; anti corruption; judicial gatekeeping; chain of custody

INTRODUCTION

Now, scientific progress has conspired to transform the modern courtroom ineluctably into a theater where data and algorithms make laboratory results that play an ever-growing part in the determination of culpability. Nowhere in Indonesia is this change more visible than in corruption prosecutions, where complex criminality does not usually give us easy confessions and paper trails. Instead, investigators are forced to turn to digital forensics in order to recover deleted messages from encrypted phones, forensic accounting in order to trace complex networks of money laundering and metadata analysis to piece together moments of criminal intent. Science, as a freshly minted arbiter of truth, is being positioned into the gap left where public pressures for more robust anti corruption measures are.

But this courtroom revolution comes to a legal system ill designed for it. Indonesia's 1981 Criminal Procedure Code (KUHAP), written in the pre-internet era, details an inflexible hierarchy of evidence where testimony and documents rule supreme. On the other hand, scientific results usually have some probabilistic component, rely on expert judgment and require scrutiny of methodology and chain-of-custody procedures. The Anti Corruption Law (UU Tipikor) is identical in this added reinforcement of the state's law enforcement role yet it tells us nothing about how judges are supposed to evaluate whether or not forensic tools

have made good on their promise of empirical validity and reliability. The result is a kind of procedural dissonance, in which scientific truth comes pounding on the courtroom door, but the legal apparatus insists on retaining its language based squarely in analog worlds (Lynch, 2021).

Other courts did not simply sit back after technology started to re-write the evidentiary logic. The United States introduced the Daubert standard, which orders judges to act as “gatekeepers” and make sure experts are using tested and peer reviewed information rather than pseudoscience. Australia, in its Makita doctrine, further firmed up the link between expert opinion and empirical footings. By contrast, the Civil Procedure Rules in the UK, and CPR 19 specifically, force transparency and strict expert qualification. Hybrid models such as in Singapore and Japan combine judicial management with an adversarial testing of fact, science underpinning that the law improve rather than run roughshod over legal reasoning (Edmond, G., Roberts, P., & Robson, 2020).

These models express a common insight: courts need to evolve in order for scientific evidence to be trustworthy, intelligible and fairly deployed. But Indonesia is still at the mercy of uncertainty. Judges, bred on formalistic legal reasoning, may shy away from probabilistic testimony or laboratory results because they fear that scientific inthings contradict the legal requirement for things (kepastian hukum). But Prosecutors can present complex technical evidence with little input in terms of detailed methodology being available. Defense attorneys could have trouble attacking wrong scientific analysis with a lack of expert access. The courtroom is therefore a dormitive conflict zone—science might lose not because of its wrongfulness, but because law may be an inadequate medium for apprehending (Santos, 2022).

The structural problems have only been recently diagnosed by scholars—lack of accrediting experts, inadequate chain-of-custody rules, uneven judicial scrutiny of scientific reliability and a general absence of institutional oversight. But until now no systematic research has been conducted on how Indonesian judges do or do not combine legal formalism and scientific rationality. This research lacuna is important because the fate of corruption cases often influences political stability, state integrity and public perception about justice (Widodo, A., & Prasetyo, 2023).

Therefore, it is pertinent to pose this critical question in this paper: In what ways does the Indonesian judiciary grapple with formality of law versus rationality of science in adjudicating corrupt behaviour? Through a combination of (i) doctrinal analysis, (ii) comparative legal studies, and (iii) empirical observations relating to judicial decision-making in contemporary Indonesian trials, the resulting work aims to provide theorists with one conceptual foundation upon which modern Indonesian evidence law might be moulded so as better to serve the scientific demands of our times. The theory underlying this research is that the lack of clear reliability standards, of gatekeepers to evaluate scientific experts, and of a scientific literate judiciary is systematically distorting anti-corruption adjudication.

This question is important for two reasons. For one, it upholds the constitutionally mandated search for material truth (kebenaran materiil) and safeguards justice rather than technology which strengthens but not corrupts

justice. Second, it points the way towards regulatory reform that will preserve the defendants' rights and give courts a serious role in assessing scientific claims.

Finally, this intro places readers in a bigger story: A legal system at a crossroads where the struggle against corruption rests on more than just character and bravery, but epistemic excellence. Whether or not Indonesia decides to embrace a future in which science is recognized as a friend and ally, rather than an adversarial outsider, will be opinion-leaders on the benches of Indonesian justice courts for generations to come.

MATERIALS AND METHODS

Normative and Comparative Legal Research

The design of this research is to examine the normative and juridical barriers for acceptance and assessment of scientific evidence in Indonesian anticorruption court. The methodology is text centric with an emphasis on legal doctrine not human subjects, and is based on textual legal research, doctrinal interpretation, and systematic comparison (Smith, J., & Johnson, 2018). To guarantee the replicability and transparency of this process, it is divided into phases with a meticulous description that allows for legal scholars to replicate and verify our results at any stage.

Research Type and Design

The research uses a normative juridical approach through which to examine scientific evidence legal norms that are still in force in Indonesia. It also adopts a comparative legal perspective – a substudy compare (micro-comparative model) to examine the applicable main reliability standards, procedural safeguards and institutional apparatuses of certain foreign jurisdictions (Nguyen, 2020). This methodological framework also enables a fine-grained comparative mapping of Indonesian law and benchmark systems, including:

- a. United States: Daubert and FRE702.
- b. England & Wales: CPR Part 19 and Ikarian Reefer mediator (Taylor, 2019).
- c. Hybrid systems: Singapore Rules of Court 2021 and Japan's forensic regulations system (Lee, S., & Nakamura, 2021).

Approaches Used

1. Statutory Approach

Research of existing Indonesian legal products, such as KUHAP, UU Tipikor, and regulations from the Indonesian Supreme Courts (PERMA, SEMA), including evidentiary regulation. The application of rules on computer forensics as well as those pertaining to the chain-of-custody, audit evidence, and expert testimony is determined through reference to the **Stufenbau der Rechtsordnung** (hierarchy of norms) and legislative intent (Kelsen, 2017).

2. Conceptual Approach

Elaborates and examines theoretical theses concerning “epistemic integrity,” “judicial competence,” and “legal certainty” in evaluating scientific facts, with references to jurisprudential doctrines such as Kelsen's norm theory and Fuller's internal morality of law (Anderson, 2024)

3. Comparative Approach

Utilizes a macro-comparison method: detailing the institutional design or constituent engineering, in which all relevant evidentiary governance mechanisms

from the different comparator systems are put on display side-by-side and are thereafter evaluated through a pre-designed set of criteria (including the manner by which they have been operationalized by each system, and against other models), to figure out potentially transferable points as regards reform and review (Chen, J., & Smith, 2021).

Data Sources

The present study is based only on secondary legal materials, systematized and organized in the following manner:

The data selection complies with the inclusion criteria which were: evidentiary reliability, crimes of corruption, expert evidence and procedural criminal reform (Rodriguez, M., & Patil, 2020).

Data Collection and Interpretation Procedures

A detailed protocol allows reproducibility of research:

- NLP Keywords (reliability of evidence, scientific evidence, forensic governance, anti-corruption courts etc.)
- Search and extraction in the legal databases (HeinOnline, JSTOR, LexisNexis, ScienceDirect, DOAJ, MA jurisprudence database and Indonesian state gazettes).
- Categorization by doctrinal theme (relevance, weight of evidence, expert autonomy, chain-of-custody)
- Comparative coding with a criterion-based matrix (gatekeeping authority, methodology validity, institutional safeguards)
- Synthetic dogmatics for the development of proposals for normative reconstruction (Oliveira, 2021).
- Interpretacio juridica by the means of deduction (ratio legis and judicial interpretation analysis) developed recouring to cross-jurisdictional benchmark.

Validity, Reliability, and Replicability Measures

To maintain analytical rigor:

- a. Triangulation of the interpretation of statutes, judicial trajectory, and theoretical analysis (Zhang, 2020).
- b. Overlapping of enforcement of foreign legal norms through conflicting authoritative sources.
- c. Transparent coding matrix promoting the replication of comparative appraisals for future researchers.
- d. A temporal filter is also employed to make sure results pertain to current legal status until 2025.

COMPARATIVE JURISDICTIONAL ANALYSIS

United State

The assessment of scientific expert evidence in the US took on a new character as a result of The Daubert Trilogy including: (i) Daubert v. Merrell Dow Pharmaceuticals (1993); General Electric vs Joiner (1997), and Kumho Tire vs Carmichael (1999). These cases installed the judiciary as an agent acting as a gatekeeper to ensure that what is admitted in court as expert testimony possess sufficient epistemic reliability (before it enters the courtroom) (Faigman, D. L., Saks, M. J., & Sanders, 2017) (Kaye, 2021).

The courts concentrated on the testability, peer review, rate of error known or potential and general acceptance in the relevant scientific community. FRE 702 was later revised to include these thresholds, underlining the fact that expert

opinions do not rely on credentials but rather on scientific process (Smith, A., & Jones, 2019).

The American example shows the development of an adversarial system buttressed by judicial expertise. Although judges are non-scientists, the structured gatekeeping takes out “junk science” and facilitates litigants who prepare experts to be able to defend their methods in cross-examination. For civil law based systems it illustrates how the judiciary having knowledge of scientific validity tests can raise their level of evaluation without entirely foregoing legal traditions (Miller, S., & Cohen, 2020).

United Kingdom

On the other side of the Atlantic, the famous case *Ikarian Reefer* (1993) changed the expert witness role by emphasizing integrity. The UK system emphasises that the primary duty of an expert is to the court, and not to their employing party (Jones, 2021)

These principles are recognized in the Civil Procedure Rules (CPR) Part 19, which provides that:

1. mandatory declarations of expert independence
2. transparency of methodology and assumptions
3. requirement to disclose uncertainties
4. restrictions on advocacy masquerading as science.

This is a model of the courtroom as neutral laboratory, one in which honesty becomes its own procedural obligation. The UK is methodologically transparent rather than fixated, as is the tendency in the U.S.A., with assimilation thresholds. It offers an appealing blueprint for Indonesia: regulatory simplicity underwritten with moral fiber.

Singapore

Recent reforms in Singapore now embody a mixed response to the growing complexity of forensic evidence. Under the permission-based expert system, the parties must secure judicial authorization before presenting expert evidence. This limits partisan experts’ scope to inflate, and fortifies epistemic accountability under judicial supervision (Lee, 2023).

In addition, the new Rules of Court allow judges to:

1. appoint court experts when necessary
2. encourage joint reports
3. facilitate “hot tubbing” (concurrent expert examination)
4. scrutinize methodologies before trial (Tan, C., & Chen, 2024).

Singapore serves as an example of how institutional modernization, rather than dogmatic reform, can help procedural law to keep pace with advances in scientific knowledge. The model’s nimbleness derives from its future-proof understanding that law must change as science changes (Wong, S. H., & Lim, 2022).

Indonesia

By comparison, the evidentiary regime of Indonesia is still stuck in procedural ideas from the middle of last century. There is no requirement of "scientific reliability" in Criminal Procedure Code (KUHAP) and anti corruption law (UU Tipikor) as a condition for admissibility. Judges do not have a mechanism of structured gatekeeping, and forensic proffers usually are considered as

definitive facts rather than hypotheses that can be subjected to empirical analysis (Sari, D., & Hadi, 2021).

Expert testimony often functions as:

1. substituted judgment (judicial opinion which substitutes the reasoning of its own logic for that of the parties in a dispute)
2. prolongation of activities of probes from states
3. forced institutional acceptance as opposed to testing of method .

This liminal stage breeds partial justice: new evidence that defies legal precedent is strained through archaic logic, enabling knowledge to impersonate certainty (Wirawan, 2020).

Table 1. Comparative Gatekeeping and Expert Evidence Standards

Jurisdiction	Reliability Test	Judicial Gatekeeper Role	Expert Independence	Permission-Based Control	Methodological Review
United States	Daubert factors (testability, error rate, peer review, acceptance)	Strong	High (cross-examination focus)	No	Comprehensive
United Kingdom	Ethical declarations under CPR 19	Moderate	Very High (duty to the court)	No	High (transparency requirement)
Singapore	Judicial approval for expert submission	Strong	High	Yes	High
Indonesia	None	Weak	Low (institution-driven)	No	Limited / absent

ANALYSIS AND FINDINGS

Epistemic Deficiencies in Indonesian Anti-Corruption Trials

The research found an enduring epistemic fragility of Indonesia’s anti corruption adjudication. Expert evidence and other forensic items almost always arrived in courtrooms like enigmatic black boxes, opaque, unchallenged, unsubstantiated. Judges focused on genuineness rather than scientific reliability, as though truth could be discerned through intuition rather than instrumentation.

1. Expertise in Forensic Assessment is less among Judiciary

Specialist Anti Corruption Court judges had a strong doctrinal understanding, but no training in probabilistic reasoning, statistics and error-rate

interpretation. As a result, expert witnesses became the functional authorities on truth and courts were frequently reduced to instruments of passive review. The lack of judicial gatekeeping (a la Daubert in the United States) has allowed dubious methodologies infiltrate verdicts groundwork (Miller, 2020).

2. Chain of Custody Vulnerabilities

In contrast to the digital lab where every click leaves a mark, the anti-corruption evidentiary trail in Indonesia operated like a path brushed clean by wind. There were significant differences between agencies in the way documents were handled (KPK, Polri, Kejaksaan) and protocols for verification. The study found there is no national forensic validation criteria, increasing the risk of evidence tampering or procedural objections following a trial (Sari, N. D., Prasetyo, E., & Yusuf, 2023).

Table 2. Chain of Custody Governance Comparison

Jurisdiction	Chain-of-Custody Rule	Validation Protocol	Judicial Gatekeeping
United States	FRE 901 + Daubert	Mandatory	Robust
Singapore	Cybersecurity Standards	Lab Judicial supervision	Moderate-High
Indonesia	Fragmented internal SOPs	None	Low

The table illustrates Indonesia’s interpretive distance from jurisdictions in which scientific reliability is not “permissible,” but mandatory (Nugroho, 2022).

3. Inconsistency in Appellate Review

Case mapping revealed a fragmented jurisprudence among the Corruption Courts and the Supreme Court. Although the lower courts occasionally adopted these expert-challenging maneuvers, Supreme Court review has prioritized procedural finality rather than methodological adequacy. This fractured uniformity created legal confusion science might rule as king in one courtroom and be dismissed as a court jester in another.

The Legal Conundrum: Collision of Law and Science

Legal formalism in Indonesia has long extolled procedural purity evidence is “valid” if the ritual of documentation is done. But science won’t genuflect to ceremony; it insists on rigor, reproducibility and statistical humility (Saks, M. J., & Koehler, 2021). These two worlds dance to different beats:

Procedural legality asks: Is the evidence properly introduced?

Scientific truth asks: Is the evidence actually reliable?

The work observed the clash of these logics in several domains:

- a. Textualism vs Empiricism

Lawyers called for compliance with the rules; scientists wanted to know what the error rate was.

- b. Judicial Authority vs Expert Knowledge

Judges had the hammer but little to pick apart the technical underpinnings.

- c. Formal Justice vs Substantive Fairness

Untrustworthy forensic evidence led to dubious convictions, and due process has drained from the inside, a verdict buffed on the outside but rotting scientifically at

its core. And the ripple effects extend beyond individual cases. When procedural boxes are checked while epistemic integrity is abandoned, the judiciary might descend to being a ritual factory that stamps results without examining the truth (Wijaya, 2024).

"Science on Trial" paradigm

Science is not mere evidence, the researchers found, but becomes the defendant itself — interrogated for legitimacy by legal doctrines and an audience that may not speak its language (Bast, J. L., & Pink, 2020).

1. Science as Evidence and Object of Scrutiny

In Indonesian corruption cases, forensic findings were not treated as the reason of conviction but a ground to make innocent claims. Courts rarely demanded:

- a. methodology disclosure
- b. instrument validation
- c. lab error-rate reporting
- d. defense-side reproducibility access

As a result, scientific certainty itself was an illusion, something built up by authority rather than revealed through investigation (Prasetyo, H., & Hartono, 2023).

2. Epistemic Power Asymmetry

Research has also shown an asymmetry in information dissemination. Up to that point, the epistemic power had been exercised by prosecutors and forensic bodies: the access to raw data and scientific interpretation was in their hands. With overstretched defendants, who were commonly of modest means, it was difficult to properly test expert evidence. That bias perverted due processes lofty vow and transformed it from a grand duel that both sides adhere to into an unfair fight (Muslimah, D., & Santoso, 2021).

Synthesis of Findings

In all dimensions of analysis, the study identified an underlying weakness within Indonesia's legal system: it has not adapted to assess scientific robustness, leading to:

- a. lack of consistency in expert evidence
- b. weak forensic governance
- c. risk of wrongful convictions
- d. the undermining of confidence in evidence-based justice (Sari, N. D., Prasetyo, E., & Yusuf, 2023).

Science sheds light, but absent legal protections it can cast deceptive shadows.

NORMATIVE RECONSTRUCTION

Reconceptualizing "Scientific Evidence" in Criminal Procedure Code (KUHAP) and Anti Corruption Law (UU Tipikor)

Statutory comparisons were made and it became clear that in Indonesian procedural law there is no independent category of scientific evidence. Prior to that date, scientific evidence was categorized as expert testimony or documents and judicial review could only extend to procedural admissibility but not to methodological reliability.

The normative assessment resulted in a reorganisation of the evidence structure and there was a need to:

- a. Scientific evidence to be classified as its own type of evidence
 - b. Method specific validation and relevance assessment
 - c. Assurance of integrity via peer-reviewed epistemic norms
- The mapping below showed the operational implications of this sharpening:

Table 3. Results of statutory categorization analysis.*

Parameter	Current (KUHAP/UU Tipikor)	Regulation Proposed Evidence	Category (Scientific Evidence)
Legal identity	Subsumed expert/documents	under	Autonomous statutory category
Reliability criteria	Undefined	Validation	through methodological soundness
Source evaluation	Based on formal compliance	Based on reproducibility & scientific consensus	

These findings suggested that evidentiary change required the codification of scientifically grounded standards in the courts (Nguyen, P., Harris, M., & Kim, 2021).

Proposed Judicial Gatekeeping Model

Comparison with Daubert Trilogy (US), Makita (Australia) and Singapore ROC 2021 produced a hybrid model of scientific evidence that would necessitate judicial gatekeeping through both ex-ante (admissibility) and ex-post (weight) assessments for the science (Lee, S., & Tan, 2023).

The model emphasized:

1. Reliability testing (valid method, known error rate and standard protocols)
2. Relevance with respect to goal of fact-checking
3. Experts accreditation and registration
4. Court appointment processes for specialized forensic areas

The doctrinal conclusions are outlined as follows:

Table 4. Output of comparing extracted legal models.

Gatekeeping Stage	Current Practice in Indonesia	in Hybrid Reform	Output
Ex ante review	Procedural only	admissibility	Reliability test + relevance evaluation
Expert competency	Undefined	accreditation	Certified experts verified by professional bodies
Judicial competence	Minimal scrutiny	scientific	Active evaluation of methodology & bias risk

These results substantiated the possibility of a judge-based epistemic control mode that was not at odds with the tradition of civil law (Ramirez, C., & Wilson, 2020).

Safeguarding Epistemic Fairness

The doctrinal-comparative analysis has identified this as systemic epistemic power asymmetry of prosecutors vis-à-vis defendants. Findings indicated that the accused had no:

- a. Assured access to independent experts
- b. Rights to access the raw forensic data
- c. Mechanisms for scientific cross-examination
- d. Technology that allows for digital forensic guard against tampering with evidence.

The results yielded the following matrix of protections:

Table 5. Fairness and due-process gap analysis results

Fairness Component	Existing Safeguard	Required Protection Output
Access to experts	Discretionary	Defendant-entitled expert assistance
Data transparency	Rarely provided	Mandatory forensic image/raw-data sharing
Examination rights	Limited to opinion	Methodological interrogation permitted
Digital forensic risks	Largely unchecked	Chain-of-custody verification cryptographic

These findings indicated the necessity for legislative and procedural protections that promoted symmetry of epistemic access in corruption trials (Hadi, M., & Wijaya, 2021).

CONCLUSIONS & RECOMMENDATIONS

This research illustrates how Indonesia’s anti-corruption judiciary is structurally incapable of appraising scientific evidence to the standards established by contemporary forensic science. The results demonstrate serious epistemic shortfalls: science evidence is not understood as an autonomous form of evidence according to Criminal Procedure Code (KUHAP) and Anti Corruption Law (UU Tipikor); reliability testing and methodological gatekeeping receive tenuous support, if at all; chain of custody standards continues to be fragmented with lax enforcement; courts “abandon” themselves when faced with expert reports despite the limited judicial capacity for scientific truth-testing. These weaknesses create a great risk of miscarriages of justice and undermine the credibility of corruption adjudication in the public.

Comparative legal medicines can identify models which the U.S., U.K., and Singapore have indigenized, resulting in more effective judicial synthesis with scientific rationality. From these two systems, a hybrid gatekeeping model can be seen as being feasible for Indonesia. Such a model should comprise of both ex ante admission controls based on methodological validity, error rates documented in the literature, and transparency etc., as well as ex post scrutiny of the weight of scientific findings. In addition, court oversight of expert certification, appointment of court experts to address complex issues, and enforceable demands for raw-data disclosure could foster accountability and work

against the epistemic power disparities that characterize relationships between prosecutors and defendants.

A few suggestions are offered for turning these findings into reform. Such a need may be acknowledged by the legislature in revising both Criminal Procedure Code (KUHAP) and Anti Corruption Law (UU Tipikor) to regulate scientific evidence directly, as well as through adopting national standards on chain-of-custody and forensic validation. The Supreme Court should make judicial gate-keeping standards more formal, and offer more technical training to ensure that judges have a better understanding of science. There also needs to be procedural safeguards that ensure the defense has access to impartial experts and full forensic materials in order to preserve due process and equality of arms. In short, harmonising legal proof with scientific reliability is critical toward promoting both material truth and legal certainty in relation to Indonesian anticorruption trials. By incorporating epistemic integrity into evidentiary law and practice, Indonesia could improve the accuracy of adjudication, protect constitutionally guaranteed rights to a fair trial and due process, and build public trust in its counter-corruption efforts. main results should be presented clearly and briefly, insisting on their significance and degree of novelty. This section may also include also include discussion on theoretical and methodological implications of findings.

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