RECONSTRUCTING FORENSIC EXPERT ACTIVITY: INSTITUTIONAL INDEPENDENCE, METHODOLOGICAL VALIDITY AND COMPARATIVE ARCHITECTURES OF EVIDENTIARY RELIABILITY

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https://doi.org/10.5281/zenodo.20094052

ARTICLE INFO

Received: 03rd May 2026
Accepted: 05th May 2026
Online: 07th May 2026

KEYWORDS

forensic expert activity; expert independence; admissibility; Daubert standard; ISO/IEC 17025; ENFSI; methodological validity; accreditation; comparative criminal procedure; transition jurisdictions

ABSTRACT

This article advances a doctrinal-comparative reconstruction of forensic expert activity, treating it not as a derivative procedural step but as a sui generis legal institution situated at the intersection of empirical inquiry, procedural form and institutional design. Drawing upon the analytical framework developed by post-Daubert American scholarship, the European Network of Forensic Science Institutes and the Russian doctrinal tradition, the study disaggregates the principle of expert independence into three operational layers — institutional, procedural and methodological — and argues that all three must be guaranteed concurrently if forensic evidence is to discharge its evidentiary function. The paper compares four governance archetypes: the adversarial American model, the centralised Scandinavian and Russian state systems, the hybrid public-private British arrangement, and the networked European model coordinated through ENFSI and ISO/IEC 17025. The analysis demonstrates that declaratory clauses concerning expert independence are insufficient absent operational guarantees and accreditation infrastructure. The article concludes by extracting normative implications for transition jurisdictions seeking to align domestic forensic governance with international standards of reliability.

Modern adjudication relies on knowledge that lies beyond the cognitive reach of judges, prosecutors and counsel. From DNA profiling and digital forensic reconstruction to forensic accountancy and accident reconstruction, the volume and methodological sophistication of expert input has reshaped the architecture of fact-finding in virtually every developed legal system. Yet the legal status of that input remains theoretically unsettled. Two questions recur. First, what kind of legal phenomenon is forensic expert activity — a procedural step, a scientific inquiry conducted under the supervision of a court, or something altogether different? Second, by what institutional and methodological devices can the reliability of the resulting evidence be guaranteed in a manner that withstands adversarial testing and cross-jurisdictional comparison?

These questions are not merely academic. The reliability of forensic conclusions translates directly into outcomes affecting liberty, property and reputation. Where forensic methodologies are weak or institutional independence is compromised, the cost is borne not by the discipline but by individuals — through wrongful convictions, unjust acquittals, or distorted commercial settlements. The 2009 report by the U.S. National Research Council, which concluded that several long-accepted forensic disciplines lack a firm scientific foundation, made this risk impossible to ignore in jurisdictions on both sides of the Atlantic. A parallel European response, channelled through the European Network of Forensic Science Institutes and ISO/IEC accreditation, has reframed the problem from one of admissibility doctrine to one of institutional design.

The present article approaches the subject from a doctrinal-comparative standpoint. Its central claim is that forensic expert activity is a sui generis legal institution whose epistemic authority depends on the simultaneous satisfaction of three conditions: institutional independence, procedural insulation and methodological validity. None of these conditions is reducible to the others; none is sufficient on its own. The article first reconstructs the conceptual coordinates of forensic activity, then examines the doctrinal trajectory traced by the Frye–Daubert sequence in U.S. evidence law[1], then surveys four comparative archetypes of forensic governance, and finally extracts normative implications for transition jurisdictions, with the Republic of Uzbekistan offering an illustrative case study.

Two doctrinal traditions have historically competed for the conceptual ownership of forensic expert activity. The procedural tradition, dominant in continental Europe and the post-Soviet space, treats forensic examination primarily as an investigative or judicial action governed by the rules of criminal or civil procedure. The cognitive-epistemological tradition, more pronounced in Anglo-American thought, conceives forensic activity primarily as scientific inquiry whose validity is measured against the standards of empirical research, with procedural rules supplying only an external frame.

Each tradition captures part of the truth and obscures another part. Reading forensic activity as merely procedural risks reducing the expert to a functionary executing a request — a posture that suppresses the scientific scrutiny on which reliability depends. Reading it as merely scientific risks detaching it from the procedural guarantees that allow contradictory examination, a defining feature of fair trial. The more defensible view, which this article adopts, is that forensic expert activity is a composite legal phenomenon. It is scientific in its method, procedural in its form, and evidentiary in its function. The three dimensions are conceptually distinct but operationally inseparable[2].

This composite character has six structural elements that together describe what forensic activity actually is in legal practice. First, competence: the expert's standing to conduct the inquiry, grounded not only in formal credentials but in domain-specific training and continuing professional development. Second, the object of examination: a physical, biological or digital trace whose nature determines the methodologies available. Third,

[1]Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).

[2]Saferstein R. Criminalistics: An Introduction to Forensic Science. 12th ed. New Jersey: Pearson Education, 2020. P. 4–9.

methodology: the validated set of techniques applied to the object, including observation, comparison, instrumentation, statistical inference and increasingly algorithmic analysis. Fourth, the procedural envelope: the rules under which examination is commissioned, conducted and reported. Fifth, documentation: the obligation to record reasoning and result in a form that permits review, challenge and replication. Sixth, evidentiary appraisal: the court's evaluation of the conclusion against the totality of evidence, in light of the other five elements.

Each element supplies a distinctive form of accountability. Competence is policed through certification; methodology through accreditation; the procedural envelope through criminal and civil procedure; documentation through evidentiary rules; appraisal through judicial reasoning. When all six elements operate simultaneously, the institution functions. When any one is weakened — for example, when methodology lacks accreditation or documentation lacks reproducibility — the entire chain of evidentiary reasoning is compromised. This is precisely what the National Research Council report identified in 2009: the surface of admissibility was intact, but the underlying methodologies in several disciplines had not been subjected to the empirical validation that admissibility purported to assume[3].

The most influential doctrinal articulation of methodological validity in evidence law is the United States Supreme Court's decision in Daubert v. Merrell Dow Pharmaceuticals[4]. Replacing the older Frye standard, which required only that scientific evidence be generally accepted in its field, Daubert and its progeny placed trial judges in the role of methodological gatekeepers. The Court enumerated four non-exhaustive factors — testability, peer review and publication, known or potential error rate, and general acceptance — and instructed lower courts to assess whether expert testimony rests on a reliable foundation before admitting it. Rule 702 of the Federal Rules of Evidence was subsequently revised to codify the gatekeeping function[5].

The doctrinal significance of Daubert lies less in its specific factors than in the conceptual move it accomplished. Admissibility ceased to be a question of professional reputation and became a question of methodological validity. Fields that had long enjoyed unchallenged courtroom acceptance — bite-mark analysis, certain forms of handwriting comparison, fire-pattern reasoning — were obliged to demonstrate the empirical foundations of their inferential techniques. The result has been a sustained scholarly literature interrogating the scientific basis of long-established forensic disciplines, including fingerprint identification[6] and pattern-matching evidence more broadly[7].

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[3]National Research Council (US). Strengthening Forensic Science in the United States: A Path Forward. Washington, DC: National Academies Press, 2009. P. 14–24.

[4]Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993).

[5]Federal Rules of Evidence, Rule 702 (United States, as amended through 2023).

[6]Mnookin J.L. The validity of latent fingerprint identification: confessions of a fingerprinting moderate // Law, Probability and Risk. 2008. Vol. 7. No. 2. P. 127–141.

[7]Champod C., Lennard C., Margot P., Stoilovic M. Fingerprints and Other Ridge Skin Impressions. 2nd ed. Boca Raton: CRC Press, 2016. P. 92.

Three observations follow from the post-Daubert experience that are pertinent to comparative analysis. First, the gatekeeping doctrine is structurally incomplete without an institutional infrastructure to generate the empirical evidence required to assess validity. Second, even where the doctrine is robust, its enforcement depends on the willingness of trial courts to engage seriously with methodological questions; in practice, many do not[8]. Third, the burden of methodological scrutiny tends to fall on the defence, which often lacks the resources to mount a credible methodological challenge — an asymmetry that Daubert alone cannot correct[9]. These observations explain why post-Daubert doctrine has been complemented, rather than replaced, by accreditation regimes that operate upstream of the courtroom.

Comparative analysis reveals at least four distinct governance archetypes, each with characteristic strengths and structural weaknesses.

(i) The adversarial archetype, exemplified by the United States, treats forensic experts as witnesses retained by the parties. Reliability is policed through cross-examination, judicial gatekeeping under Daubert, and the testimony of opposing experts. The model exposes weak methodologies through adversarial pressure and supports rapid scientific innovation through competitive dynamics. Its principal vulnerability is asymmetry of resources between prosecution and defence, which can leave methodological flaws unchallenged in the absence of adequately funded defence experts[10].

(ii) The state-centred archetype, found in Russia, France in part, and several post-Soviet jurisdictions, places forensic activity within institutions affiliated with the executive — typically ministries of justice, internal affairs, or health. The Russian Federal Law on State Forensic Expert Activity codifies expert independence and the duties of forensic institutions[11], while the French Code of Criminal Procedure regulates the qualification and selection of court experts[12]. The model's strengths lie in uniformity of methodology and centralised quality control. Its principal weakness is the structural risk of administrative dependence: when forensic institutions are housed within the same executive hierarchy as the investigating authorities, institutional independence becomes a matter of administrative practice rather than constitutional design.

(iii) The judge-centred archetype, characteristic of Germany, treats the forensic expert primarily as an auxiliary of the court. Under § 73(2) of the German Code of Criminal

[8]Edmond G., San Roque M. The cool crucible: forensic science and the frailty of the criminal trial // Current Issues in Criminal Justice. 2012. Vol. 24. No. 1. P. 51–68.

[9]Cole S.A. Forensic science and wrongful convictions: from exposure to contributory factor // New England Law Review. 2009. Vol. 42. P. 89–97.

[11]Russian Federation. Federal Law of 31 May 2001 No. 73-FZ on State Forensic Expert Activity in the Russian Federation. Articles 4–8.

[12]Code de procédure pénale de la République française. Article 157, alinéa 2.

Procedure, courts may appoint experts other than those officially listed only where special circumstances justify the choice[13]. The expert reports to the court rather than to a party; cross-examination, while available, plays a smaller role than in the adversarial archetype. The model produces a high baseline of professional standards through the courts' continuing relationship with a regulated pool of experts. Its limitation is reduced contestability: when the appointed expert is wrong, there are fewer institutional pathways for the error to be detected.

(iv) The networked archetype, developed in the European Union through ENFSI and codified in ISO/IEC 17025[14], governs forensic activity through transnational accreditation and collaborative methodology development. Laboratories satisfy uniform standards regardless of national affiliation; methodologies are validated through cross-laboratory comparison; the United Kingdom's Forensic Science Strategy explicitly aligns domestic practice with these networks[15]. The networked model's strength lies in its capacity to harmonise quality across jurisdictions while preserving methodological diversity. Its weakness is institutional: networks can issue standards but cannot themselves enforce them within national legal orders, which means that uptake remains uneven across member states.

A fifth configuration, sometimes overlooked in typological discussion but doctrinally distinctive, is the consolidated Nordic arrangement. Sweden, Norway and Finland have each centralised forensic activity within a single national authority — Nationellt forensiskt centrum in Sweden, the Oslo Universitetssykehus forensic department in Norway — separated administratively from prosecuting authorities and accountable, in different ways, to ministries of justice or health. The Nordic model derives its strength from concentration: a single institution accumulates the entirety of national casework, generates substantial empirical datasets across disciplines, and develops methodological expertise that smaller fragmented systems struggle to match. Pathological forensic expertise in particular has benefited from this centralisation[16]. The model's vulnerability lies in monoculture: when a single institution exercises a national monopoly, methodological errors propagate without easy correction, and the absence of competing laboratories reduces opportunities for inter-institutional comparison.

The British arrangement, frequently described in the literature as a hybrid public-private model, occupies a separate analytical position. Following the closure of the Forensic Science Service in 2012, England and Wales devolved laboratory provision to a market of accredited private providers, with police forces operating in-house capacity for routine work. The Chartered Society of Forensic Sciences and the Forensic Science Regulator supply professional governance, and ISO/IEC 17025 accreditation operates as the operative threshold for evidentiary admissibility in significant categories of casework. The model has been criticised on grounds of fragmentation, capacity loss and price-driven shortcuts, but it

[13]Strafprozessordnung (German Code of Criminal Procedure). § 73(2), § 404(2).

[14]ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. Geneva: International Organization for Standardization, 2017. Cl. 4–7.

[15]UK Home Office. Forensic Science Strategy. London: HMSO, 2016. P. 14–18.

[16]Saukko P., Knight B. Knight's Forensic Pathology. 4th ed. London: CRC Press, 2016. P. 12–18.

has also generated valuable lessons regarding the conditions under which market provision can or cannot deliver scientific reliability — lessons that any jurisdiction contemplating non-state forensic providers must reckon with directly.

Asian developments warrant separate mention. The Asian Forensic Sciences Network has become an important regional vehicle for harmonisation, coordinating proficiency testing, methodological standardisation and capacity-building across more than two dozen institutional members[17]. Several Asian jurisdictions — notably India through the National Forensic Sciences University and Japan through the National Research Institute of Police Science — have invested heavily in dedicated forensic research infrastructures and in academic programmes designed to professionalise the discipline at the level of doctoral training. This is one area where transition jurisdictions can leapfrog older institutional debates by aligning directly with current international standards rather than inheriting the legacy structures of mid-twentieth-century state forensics. The Republic of Uzbekistan's accession to AFSN in recent years offers a concrete pathway for such alignment, conditional on domestic institutional readiness to absorb the standards the network promotes.

Across all four archetypes, the principle of expert independence appears in some form. Yet declaratory recognition of independence is one thing; operational guarantees are quite another. This section argues that the principle is best understood as comprising three distinct but mutually reinforcing layers.

Institutional independence concerns the structural separation of forensic institutions from the agencies whose investigations they support. A forensic laboratory administratively subordinate to the prosecuting authority cannot offer the same epistemic guarantee as one structurally independent of it, however scrupulous individual examiners may be. Institutional independence is therefore measured not by the integrity of personnel but by the configuration of organisational charts: who controls the budget, who appoints the leadership, and who supervises performance.

Procedural independence concerns the expert's freedom from instruction during the conduct of a particular examination. The expert chooses the methods, conducts the analysis and formulates the conclusions. Procedural independence is operationalised through specific rules: prohibitions on directing experts to reach particular conclusions, restrictions on ex parte communication, requirements that all materials provided to the expert be disclosed to the opposing party, and explicit liability for attempts to influence the result.

Methodological independence concerns the expert's freedom to apply validated scientific methods rather than methods preferred by the requesting authority. This dimension is the most easily compromised, because methodological choice often appears to the lay observer as a technical matter immune from outside influence. In practice, methodological choice is highly consequential: a laboratory that reflexively applies a familiar but suboptimal methodology to every comparable problem is functionally less independent than one that selects methods according to the demands of each case. Risinger and colleagues have

[17] Asian Forensic Sciences Network (AFSN). Strategic Framework. Singapore: AFSN Secretariat, 2022. P. 4.

demonstrated how observer effects can distort methodological choice even where examiners believe themselves to be neutral[18].

These three layers must operate concurrently. Institutional independence without procedural rigour permits informal influence; procedural rules without methodological autonomy reduce the expert to a regulated technician; methodological autonomy without institutional grounding leaves the expert exposed to administrative pressure on personnel decisions. A serious independence regime addresses all three.

Comparative experience confirms this layered analysis. The Scandinavian model achieves high independence through institutional consolidation in a single national centre, separated from the prosecuting authority. The British dual-public-private model relies on accreditation to support methodological autonomy, while institutional independence is supported by market structure. The German judge-centred model substitutes judicial supervision for some of the structural guarantees relied upon elsewhere. No single configuration is uniquely correct, but each must answer the same three-layered question. Crucially, the post-Daubert literature on observer effects, contextual bias and methodological drift makes clear that none of these configurations is self-sustaining: each requires continuing institutional reflection to remain effective[19].

If institutional independence supplies the structural foundation for forensic reliability, accreditation supplies its methodological scaffolding. ISO/IEC 17025 — General requirements for the competence of testing and calibration laboratories — has become the de facto international benchmark[20]. The standard prescribes management arrangements, technical requirements, validated procedures, equipment calibration regimes and documented quality control. Compliance is verified through periodic external audit by accreditation bodies which themselves operate under transnational mutual recognition arrangements.

Three features of the accreditation paradigm warrant specific attention. First, accreditation operates upstream of the courtroom: it ensures that methodologies are validated and laboratories competent before any specific case arises. The court is then relieved of the impractical task of evaluating methodological reliability from scratch in every case. Second, accreditation produces evidence of compliance — audit reports, proficiency-test results, quality manuals — that is usable in court and that supports rather than supplants judicial gatekeeping. Third, accreditation creates incentives for continuous methodological improvement, because non-conformance findings must be addressed if the laboratory is to retain its accreditation status. ENFSI's Best Practice Manuals operate as the methodological

[18]Risinger D.M., Saks M.J., Thompson W.C., Rosenthal R. The Daubert/Kumho implications of observer effects in forensic science: hidden problems of expectation and suggestion // California Law Review. 2002. Vol. 90. P. 1–56.

[19]Robertson B., Vignaux G.A., Berger C.E.H. Interpreting Evidence: Evaluating Forensic Science in the Courtroom. 2nd ed. Chichester: Wiley, 2016. P. 67–73.

complement to accreditation, providing technical guidance that translates the abstract requirements of ISO/IEC 17025 into discipline-specific protocols[21].

From a doctrinal perspective, accreditation reframes the institutional problem of forensic reliability. Where the Daubert paradigm assigns reliability assessment to courts in individual cases, the accreditation paradigm distributes the responsibility across professional regulators, accreditation bodies and laboratories themselves, with courts performing residual gatekeeping. The two paradigms are complementary rather than competing: accreditation supplies the empirical foundation that admissibility doctrine purports to assume.

For transition jurisdictions, this has a practical consequence. A jurisdiction that adopts ISO/IEC 17025 as a mandatory standard for state and non-state forensic providers acquires, at relatively low cost, an internationally recognisable infrastructure of methodological reliability. The cost of accreditation is non-trivial in financial terms, but it is modest compared with the alternative of building from scratch the doctrinal jurisprudence and institutional capacity that mature jurisdictions have developed over decades. Aligning domestic forensic practice with international standards is therefore both an evidentiary improvement and a comparative advantage.

The Republic of Uzbekistan offers a useful case study of a transition jurisdiction at an active reform threshold. The 2010 Law on Forensic Examination established a unified statutory framework, codifying the principles of legality, independence, objectivity, scientific rigour and procedural equality[22]. The 2021 Concept for the Development of Forensic Expert Activity through 2025, adopted by Presidential Decree, set out a strategic agenda including digitalisation, methodological harmonisation and the development of non-state forensic providers[23].

Yet several structural features of the existing framework warrant doctrinal reconsideration in light of the comparative analysis advanced above. First, expert independence is articulated in declaratory terms but operationalised only weakly. The statute does not specify a distinct offence for attempts to influence expert findings, nor does it establish robust procedural protections against administrative pressure during the conduct of a particular examination. Translating the three layers of independence into concrete statutory provisions — institutional, procedural and methodological — would substantially strengthen the regime.

Second, the asymmetry between state and non-state forensic providers is structural rather than merely transitional. Non-state experts operate under a separate regulatory regime with limited integration into the unified national infrastructure. A coherent reform agenda would establish a single accreditation framework applicable to both state and non-state providers, with conclusions of equivalent procedural weight subject to the same evidentiary

[21]ENFSI Quality and Competence Committee. Best Practice Manual for the Forensic Examination of Digital Technology. Wiesbaden: European Network of Forensic Science Institutes, 2015–2023. P. 5–9.

[22]Republic of Uzbekistan. Law No. ZRU-249 of 1 June 2010 on Forensic Examination. Articles 3, 7, 17.

[23]Decree of the President of the Republic of Uzbekistan No. UP-6256 of 5 July 2021 on Measures to Improve the Forensic Expert System. Annex: Concept for 2021–2025.

scrutiny. This convergence is consistent with the networked European archetype and would facilitate eventual integration with regional and international networks such as AFSN.

Third, the digital dimension of forensic activity is significantly under-regulated. The current statutory text reflects the technological assumptions of its drafting period and does not adequately address electronic evidence, digital forensics, biometric analysis or algorithmic methods. A modernised statute should explicitly recognise digital forensic examination as a distinct discipline, establish protocols for the handling of electronic evidence, and create a legal foundation for the responsible integration of artificial intelligence into examination workflows.

Fourth, time-limit provisions for the conduct of examinations should be tightened in a manner that protects both procedural efficiency and methodological thoroughness. A general thirty-day limit, extendable in complex cases by reasoned procedural decision, would balance these competing demands while reducing the opportunities for administrative drift that arise under indeterminate timeframes.

Fifth, the statute should anchor methodological validity in international standards by formally recognising ISO/IEC 17025 as the framework for laboratory competence and by mandating progressive accreditation of state and non-state laboratories. Recognition of best practice manuals issued by recognised international networks would bring methodological harmonisation within reach without requiring the development of equivalent domestic infrastructure from scratch.

These five reform vectors are mutually reinforcing rather than alternative. Institutional independence without methodological accreditation produces a centralised but unreliable system; accreditation without independence produces reliable methodology under administrative control; both without digital readiness produce a system unfit for contemporary criminal and economic disputes. A serious modernisation agenda must operate across all five vectors simultaneously.

Forensic expert activity is best understood not as a procedural step nor as a scientific enterprise wearing procedural clothing, but as a sui generis legal institution whose epistemic authority rests on the simultaneous satisfaction of institutional, procedural and methodological conditions. The doctrinal frameworks elaborated in mature jurisdictions — Daubert in the United States, ISO/IEC 17025 and ENFSI in Europe, the judge-centred model in Germany, the centralised state model in Scandinavia and Russia — offer complementary rather than competing answers to a common problem: how to ensure that specialised knowledge produced in support of adjudication is both reliable and contestable.

For transition jurisdictions, the principal doctrinal lesson is that declaratory norms are not sufficient. Independence must be operationalised across three distinct layers, accreditation must be embedded as an upstream guarantee of methodological validity, and digital readiness must be built into the statutory framework rather than retrofitted later. The reform path traced in this article is at once a doctrinal proposition and a practical agenda. It treats forensic expert activity with the seriousness its evidentiary function demands — neither minimising it as a technical adjunct to investigation nor inflating it into an autonomous scientific enclave indifferent to procedural constraints.

Future research might profitably investigate three lines of inquiry: the empirical effectiveness of the various institutional configurations in suppressing observer bias and methodological drift; the doctrinal implications of artificial intelligence and machine-learning techniques for the traditional concept of expert authorship; and the comparative legal architecture necessary to integrate non-state forensic providers into a unified evidentiary framework without compromising methodological rigour. Each line of inquiry promises to refine the framework offered here. The framework itself, however, is offered as an analytical foundation upon which subsequent doctrinal and institutional work can build

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