India Pharma M&A: Knowledge Graphs for Patent, Trial and Licensing Diligence

An evidence-gated framework linking molecules, patents, trials, licences, counterparties and probability-adjusted transaction value

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Abstract

Pharmaceutical M&A diligence is difficult because value and risk sit across documents and systems that use inconsistent identifiers. A molecule can have several development codes, salts, formulations, brand names, patent families, trial registrations, sponsors, licensees, manufacturers and territorial rights. A conventional data room can contain every document and still conceal the relationships that determine exclusivity, development feasibility, freedom to operate, milestone obligations and probability-adjusted value.

This paper develops an evidence-gated knowledge-graph framework for India pharmaceutical M&A. The graph connects molecules, targets, indications, patents, inventors, applicants, ownership events, clinical trials, investigators, sponsors, regulatory permissions, licences, counterparties, territories, fields of use, royalties, milestones, manufacturing sites and adverse events. It preserves the document, passage, date, jurisdiction and reviewer supporting every material edge. Artificial intelligence can assist extraction, entity resolution, contradiction detection and query prioritisation. Qualified legal, scientific, regulatory, financial and transaction professionals remain accountable for conclusions.

An illustrative acquisition considers a hypothetical Indian specialty-pharma company with three development programmes, twenty-four patent families, fourteen registered studies and six material licence arrangements. The case tests patent-family concentration, trial dependency, change-of-control consent, territorial overlap, milestone leakage and probability-adjusted value under central and adverse assumptions. All numerical assumptions are hypothetical and are used to demonstrate the framework. They are not observed company data, a valuation opinion, investment recommendation or transaction commitment.

The analysis finds that graph completeness is less important than evidential reliability and decision relevance. A buyer should begin with the investment thesis, define the rights perimeter, reconcile identifiers, validate provenance, test graph queries against manual diligence and connect verified findings to valuation, transaction protections and the ownership plan. The graph should expose uncertainty and abstain where evidence is missing. It should never convert a weak source into a confident fact.

JEL Classification: C88, G34, I11, L65, O32, O34

Keywords: India pharma M&A, pharmaceutical knowledge graph, patent diligence, clinical trials, licensing, intellectual property, probability-adjusted valuation, pharmaceutical transactions, entity resolution, deal diligence

1. Define the investment thesis

State the decisions, users, workflows, economic outcomes, ownership horizon and valuation purpose.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an approved pharma-graph thesis. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when technical novelty is mistaken for investable enterprise value. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for define the investment thesis should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

2. Set the asset perimeter

Separate molecules, patents, trials, licences, regulatory records, counterparties, manufacturing rights, graph logic and reviewers.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an asset-perimeter map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when one diligence label conceals assets with different rights, lives and economics. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for set the asset perimeter should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

3. Distinguish controlled vocabulary, rights-and-evidence schema and graph

Define controlled vocabularies, semantic rules, entities, relationships and inference requirements.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a semantic-layer classification. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when buyers treat every connected dataset as a proprietary rights-and-evidence schema. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for distinguish controlled vocabulary, rights-and-evidence schema and graph should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

4. Map the knowledge lifecycle

Trace capture, cleaning, entity resolution, modelling, validation, publishing, use, feedback, change and retirement.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a lifecycle and cost map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when valuation ignores the continuing work required to keep knowledge current. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

The decision pack for map the knowledge lifecycle should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

5. Verify rights and control

Test ownership, licences, consents, contractual rights, portability and restrictions for every data and model component.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a rights and control register. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the target cannot transfer or continue using a material knowledge asset. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for verify rights and control should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

6. Measure source-corpus quality

Score authority, coverage, uniqueness, freshness, consistency, lineage, permissions and replacement difficulty.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a source-quality scorecard. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when volume is used as a proxy for useful or defensible knowledge. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for measure source-corpus quality should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

7. Test entity resolution

Measure precision, recall, duplication, identity drift and exception handling across high-value entities.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an entity-resolution benchmark. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when false merges and missed links contaminate diligence retrieval and analytics silently. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for test entity resolution should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

8. Govern rights-and-evidence schema design

Assign domain ownership, definitions, modelling rules, approvals, versioning and deprecation.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an rights-and-evidence schema governance model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the rights-and-evidence layer becomes an undocumented expert artefact. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

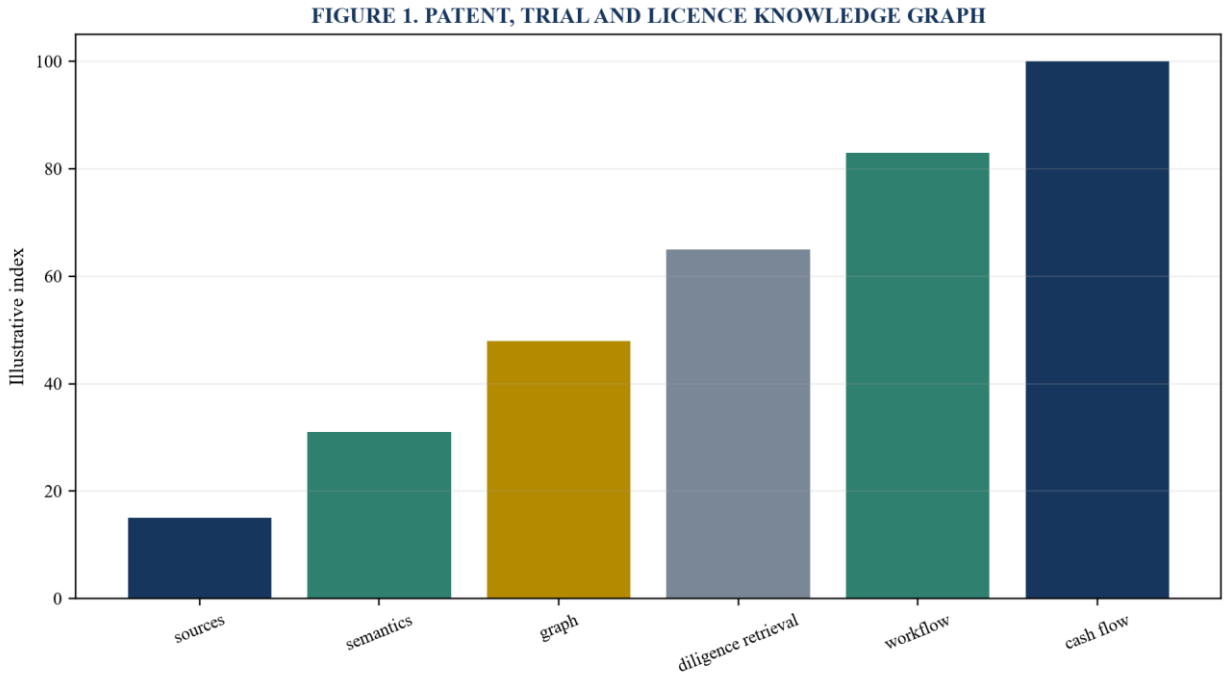
The decision pack for govern rights-and-evidence schema design should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

Table 1. Pharmaceutical diligence asset layers

Layer	Value driver	Required evidence
source data	rights, uniqueness and quality	corpus audit
semantic model	definitions and relationships	governed rights-and-evidence schema
diligence retrieval system	decision-relevant performance	controlled benchmark
workflow	adoption and economic outcome	cohort evidence

Illustrative controls require use-, consequence-, jurisdiction-, firm- and period-specific approval.

Figure 1. Patent, trial and licence knowledge graph



Values are illustrative indices and require replacement with approved validation evidence.

9. Test standards interoperability

Map RDF, OWL, SKOS, SHACL, SPARQL, JSON-LD and target schemas to portability requirements.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an interoperability assessment. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when proprietary structures create avoidable integration and exit risk. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for test standards interoperability should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

10. Preserve provenance and lineage

Connect assertions to source, transformation, confidence, owner, version and effective date.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a knowledge-provenance graph. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the graph cannot explain why a relationship or conclusion exists. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for preserve provenance and lineage should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

11. Benchmark graph-assisted retrieval

Compare graph-assisted diligence retrieval with vector, keyword and hybrid baselines on the same query set.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a controlled baseline study. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when graph-assisted retrieval is credited for gains caused by better data preparation or prompting. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for benchmark against conventional rag should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

12. Build a decision-relevant query portfolio

Sample global, local, multihop, temporal, comparative, exception and sparse-evidence questions.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a representative query suite. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when evaluation uses easy demonstration queries that do not represent paid workflows. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

The decision pack for build a decision-relevant query portfolio should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

13. Test global and local diligence retrieval

Measure whether community summaries and entity neighbourhoods improve corpus-level and fact-level discovery.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a diligence retrieval-mode benchmark. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when global summaries obscure specific evidence or local diligence retrieval misses system-wide patterns. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for test global and local diligence retrieval should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

14. Measure diligence retrieval performance

Track coverage, relevance, ranking, latency, cost, stability and failure by query class.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a segmented diligence retrieval scorecard. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when one aggregate score conceals weak performance in material workflows. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for measure diligence retrieval performance should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

15. Test answer quality and evidence

Measure correctness, completeness, citation support, contradiction, abstention and reproducibility.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an answer-quality evaluation. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when plausible prose increases while decision quality remains unchanged. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for test answer quality and evidence should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

16. Prove workflow outcomes

Compare time, rework, error, decision cycle, conversion, loss avoidance and user adoption against a baseline.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a workflow outcome bridge. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when graph use is presented as value without an observed operating outcome. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

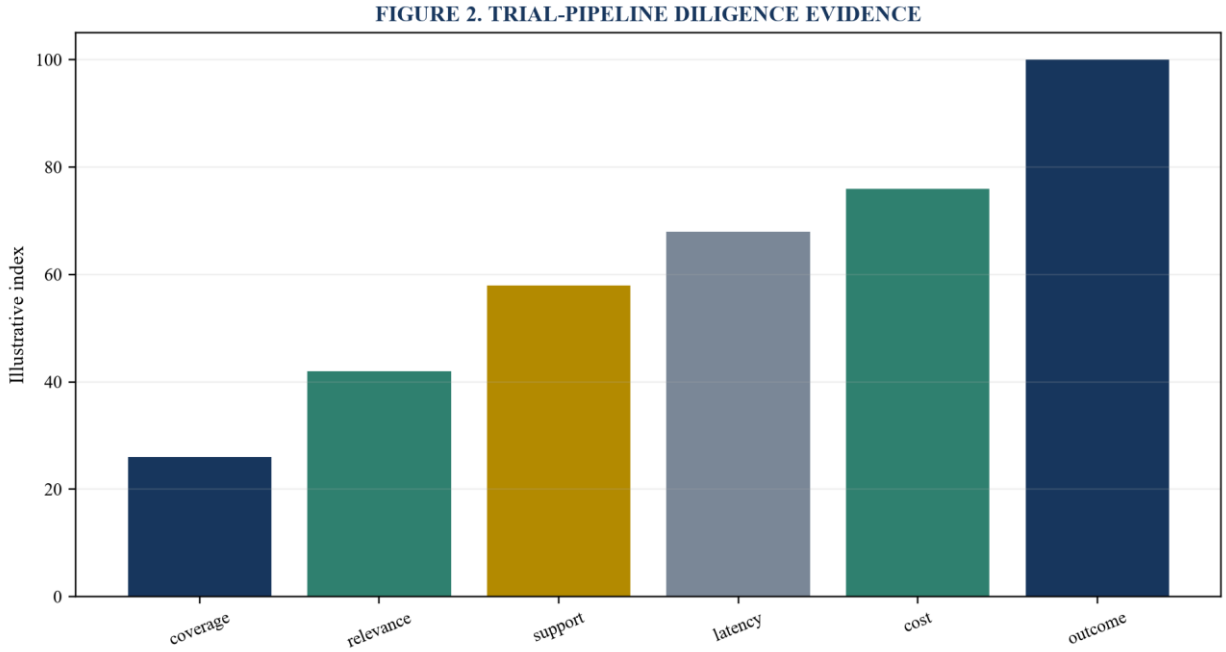
The decision pack for prove workflow outcomes should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

Table 2. Entity-resolution and diligence-query benchmark

Dimension	Test	Decision evidence
coverage	global and local query suite	baseline delta
correctness	supported answers and conflicts	error distribution
economics	latency, compute and review	cost per outcome
stability	updates, drift and repeatability	variance by segment

Illustrative controls require use-, consequence-, jurisdiction-, firm- and period-specific approval.

Figure 2. Trial-pipeline diligence evidence



Values are illustrative indices and require replacement with approved validation evidence.

17. Map economic value pools

Separate revenue, retention, pricing, cost, risk, capital, speed, reuse and option value.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an economic value map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when benefits overlap and are counted more than once. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for map economic value pools should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

18. Evidence revenue effects

Test whether knowledge improves recommendation, cross-sell, win rate, price, retention or market access.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a revenue attribution model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when revenue uplift relies on management aspiration rather than cohorts or experiments. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for evidence revenue effects should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

19. Evidence cost and productivity effects

Measure avoided search, duplication, manual reconciliation, rework, escalation and onboarding cost.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a net productivity model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when gross time savings ignore review, maintenance and exception labour. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for evidence cost and productivity effects should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

20. Value risk reduction

Quantify avoided errors, leakage, regulatory breaches, contractual failures and operational concentration.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a risk-adjusted benefit model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when remote loss scenarios are capitalised without probability or control evidence. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

The decision pack for value risk reduction should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

21. Test switching costs

Measure data migration, rights-and-evidence schema dependence, workflow redesign, integrations, retraining and contractual friction.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a switching-cost evidence pack. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when technical inconvenience is labelled durable target lock-in. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for test switching costs should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

22. Test data and learning effects

Measure whether use creates unique corrections, relationships, feedback and performance improvement.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a learning-effect assessment. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when scale is assumed to create a network effect without cross-user benefit. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for test data and learning effects should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

23. Measure complementarities

Identify value created only with proprietary data, domain experts, distribution, workflow software and deal-team integration.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a complementary-assets map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the knowledge layer is valued independently from assets required to realise benefits. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for measure complementarities should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

24. Prove adoption and change

Track active expert use, decision penetration, override, trust, training and process redesign.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an adoption-quality dashboard. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when licence counts conceal shallow adoption and parallel manual work. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

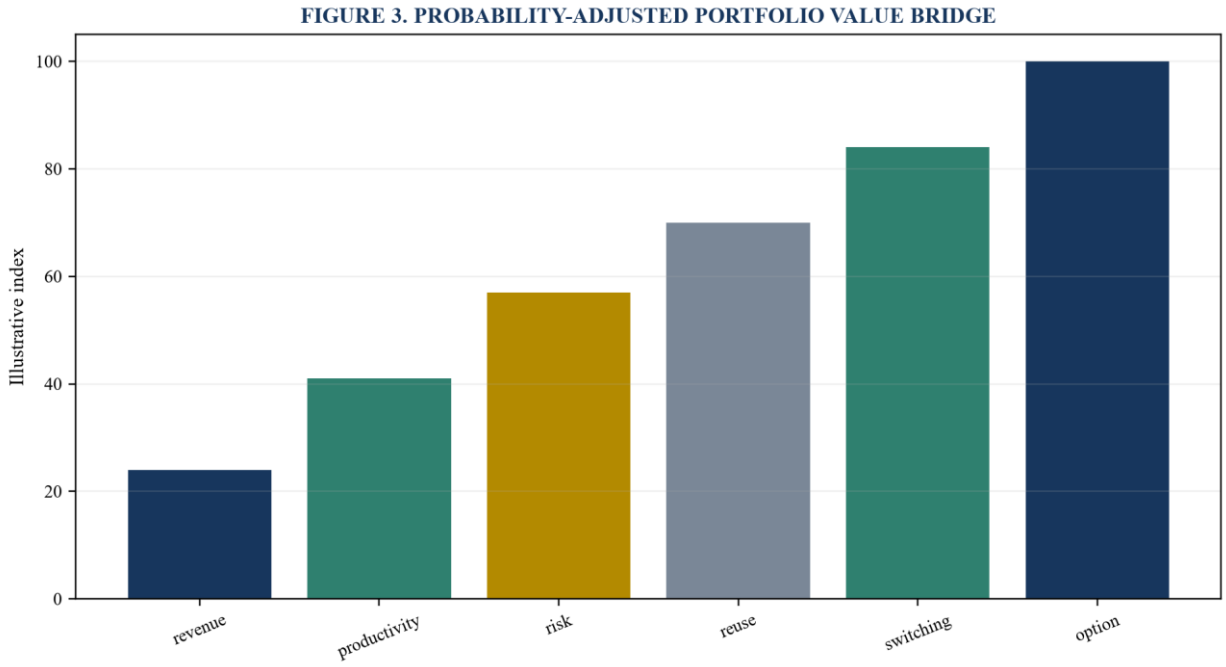
The decision pack for prove adoption and change should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

Table 3. Probability-adjusted transaction value bridge

Value pool	Measure	Deduction
revenue	cohort conversion and retention	other growth drivers
productivity	net cycle-time reduction	review and upkeep
risk	probability-weighted avoided loss	control cost
option value	new workflow or market access	execution investment

Illustrative controls require use-, consequence-, jurisdiction-, firm- and period-specific approval.

Figure 3. Probability-adjusted portfolio value bridge



Values are illustrative indices and require replacement with approved validation evidence.

25. Model maintenance burden

Forecast curation, schema change, source refresh, reconciliation, validation and domain-expert cost.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a maintenance cost model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when replacement cost is capitalised while recurring upkeep is omitted. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for model maintenance burden should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

26. Control model and vendor dependence

Map LLM, embedding, graph database, cloud, tooling and specialist dependencies with substitution tests.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a dependency and portability register. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when economics depend on a vendor whose pricing or product path can change. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for control model and vendor dependence should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

27. Protect security and privacy

Assess permissions, tenant boundaries, sensitive relationships, inference risk, logging and deletion.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a knowledge-security control map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the graph amplifies access by connecting facts that were previously separated. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for protect security and privacy should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

28. Verify intellectual property

Test copyright, database rights, trade secrets, patents, open-source obligations and employee or contractor assignments.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an IP and freedom-to-operate record. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when valuable structure cannot be defended or transferred. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

The decision pack for verify intellectual property should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

29. Quantify technical debt

Measure undocumented schemas, brittle pipelines, stale entities, manual fixes, unsupported code and key-person dependence.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a technical-debt estimate. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when a polished interface masks costly remediation behind the graph. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for quantify technical debt should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

30. Test scalability and resilience

Benchmark ingestion, updates, traversal, diligence retrieval, isolation, recovery and cost under production loads.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a production-scale benchmark. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when prototype performance is extrapolated to enterprise scale. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for test scalability and resilience should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

31. Build unit economics

Link query and workflow volume to compute, storage, graph operations, curation, support and gross margin.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a pharma-graph unit model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when usage growth reduces contribution because diligence retrieval and maintenance costs are unpriced. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for build unit economics should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

32. Separate accounting from economic value

Assess recognition under applicable accounting standards while preserving unrecognised economic assets and expenditure.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an accounting-to-economics bridge. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when book value is used as a ceiling or proxy for transaction value. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

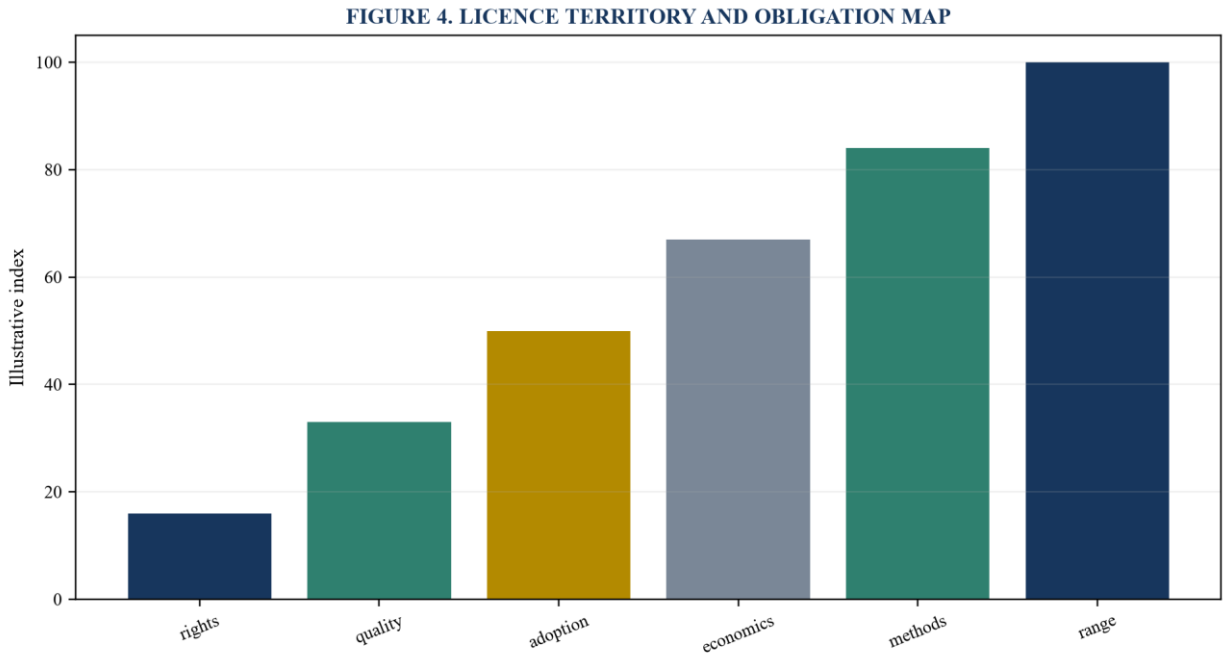
The decision pack for separate accounting from economic value should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

Table 4. Licence and exclusivity exposure matrix

Method	Best evidence	Primary limitation
income	incremental attributable cash flow	allocation and forecast risk
market	comparable rights and economics	scarce comparability
cost	replicable service potential	ignores unique earnings
relief or excess earnings	defensible rights and cash flows	assumption sensitivity

Illustrative controls require use-, consequence-, jurisdiction-, firm- and period-specific approval.

Figure 4. Licence territory and obligation map



Values are illustrative indices and require replacement with approved validation evidence.

33. Select valuation approaches

Choose income, market and cost methods by asset control, cash-flow evidence, comparability, lifecycle and purpose.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a valuation-method decision tree. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when one fashionable multiple substitutes for triangulation. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for select valuation approaches should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

34. Build the income approach

Forecast incremental cash flows, adoption, decay, maintenance, tax, contributory assets, risk and terminal assumptions.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an incremental cash-flow model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when all graph growth is attributed to the knowledge layer. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for build the income approach should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

35. Build the cost approach

Estimate reproduction or replacement cost, obsolescence, opportunity time and developer profit.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a replacement-cost model. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when historic spend is mistaken for current service potential. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for build the cost approach should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

36. Build the market approach

Normalise comparable companies and transactions for data rights, workflow depth, growth, margin, concentration and maturity.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a comparable-evidence matrix. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when generic software multiples are applied to dissimilar knowledge assets. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

The decision pack for build the market approach should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

37. Run scenarios and sensitivity

Test adoption, quality uplift, maintenance, model cost, rights loss, key-person exit and technology substitution.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a valuation sensitivity map. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when a single base case hides the variables that actually determine value. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Pharmaceutical diligence value arises when structured domain meaning changes a paid workflow, cash flow, risk or strategic option. Architecture alone does not establish economic value.

The decision pack for run scenarios and sensitivity should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

38. Design technical and commercial diligence

Verify architecture, benchmarks, rights, targets, economics, security, people and roadmap through evidence.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an evidence-gated diligence plan. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when management demonstrations substitute for reproducible diligence. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

The diligence system combines separable and complementary assets. Rights, data, semantic models, software, domain expertise, distribution and deal-team integration should be evaluated distinctly before value is allocated.

The decision pack for design technical and commercial diligence should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

39. Plan integration and value capture

Define rights-and-evidence schema ownership, source migration, product integration, expert retention, target continuity and synergy tracking.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is a 100-day value-capture plan. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when the buyer damages the tacit and technical system that created value. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Graph-assisted diligence retrieval should be benchmarked against credible vector, keyword and hybrid baselines. Incremental quality, latency, cost and workflow outcomes require reproducible evidence.

The decision pack for plan integration and value capture should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

40. Close through investment gates

Require asset control, benchmarked outcomes, defensible economics, valuation triangulation, risks and accountable value capture.

The controlled record includes scope; authority; source; passage; fact; calculation; reviewer; decision. The immediate deliverable is an evidence-gated investment decision. Preserve jurisdiction, effective date, version, transformation, reviewer, approval and unresolved exceptions.

The principal failure occurs when a sophisticated pharmaceutical knowledge graph is mistaken for a valuable enterprise graph. Reviewers should reconstruct the evidence path, test consequence under adverse conditions and identify who may approve or withhold the recommendation.

Valuation should triangulate income, market and cost evidence while testing adoption, decay, maintenance, dependency, transferability, obsolescence and value-capture execution.

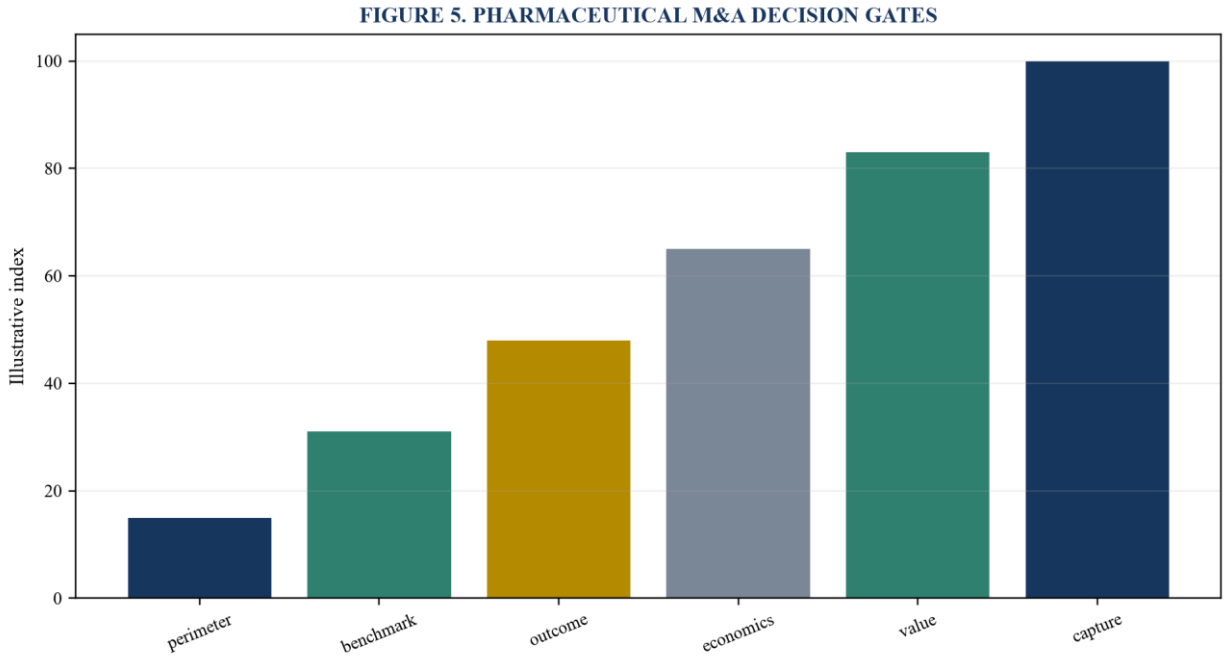
The decision pack for close through investment gates should show the prior view, correction, consequence at stake, alternatives, owner, due date, next evidence gate and observed outcome. Exceptions require closure evidence and an explicit effect on diligence retrieval, citation, abstention, review or release.

Table 5. Pharmaceutical M&A diligence gates

Gate	Primary work	Completion evidence
asset	rights, quality and governance	controlled perimeter
performance	diligence retrieval and workflow benchmark	incremental outcome
economics	unit model and valuation	triangulated range
execution	integration and value capture	accountable plan

Illustrative controls require use-, consequence-, jurisdiction-, firm- and period-specific approval.

Figure 5. Pharmaceutical M&A decision gates



Values are illustrative indices and require replacement with approved validation evidence.

Frequently asked questions

What distinguishes a valuable pharmaceutical knowledge graph in M&A diligence?

A graph becomes economically valuable when controlled rights, governed semantics, superior diligence retrieval and sustained adoption improve paid workflows, cash flows, risk or strategic options. Technical structure alone is insufficient.

How should graph-assisted retrieval be benchmarked?

Use the same representative query portfolio, corpus, model and evaluation rules across graph-assisted, vector, keyword and hybrid baselines. Measure coverage, correctness, citation support, latency, cost, stability and workflow outcome.

Do taxonomies and ontologies create switching costs?

They may create migration and workflow dependence when deeply integrated and difficult to reproduce. Durable switching costs require evidence of asset-specific structure, retraining, integrations, rights and economic friction.

Can proprietary data be valued separately?

Only after defining the asset, control, rights, transferability, useful life and complementary assets. Target data, patents, licences, relationships, semantic models and software may have distinct economics and valuation methods.

Which valuation method is most appropriate?

The method depends on cash-flow attribution, comparability, replaceability, rights, lifecycle and purpose. Income, market and cost evidence should usually be triangulated with explicit assumptions and sensitivities.

How should maintenance affect value?

Forecast source refresh, entity resolution, rights-and-evidence schema governance, validation, domain-expert work and graph operations. Maintenance supports benefits and reduces net cash flow; it also influences useful life and obsolescence risk.

What should M&A diligence verify?

Verify rights, corpus quality, semantic governance, diligence retrieval benchmarks, workflow outcomes, targets, unit economics, security, technology dependencies, key people and the value-capture plan through reproducible evidence.

When is the investment case complete?

Completion requires a controlled asset perimeter, benchmarked incremental performance, evidenced workflow outcomes, sustainable unit economics, valuation triangulation, tested risks and an accountable integration and value-capture plan.

References

[1] Central Drugs Standard Control Organisation. New Drugs and Clinical Trials Rules, 2019. https://cdsco.gov.in/opencms/resources/UploadCDSCOWeb/2022/new_DC_rules/New%20Drugs%20and%20Clinical%20Trials%20Rules%2C%202019.pdf

[2] Central Drugs Standard Control Organisation. Investigational New Drugs. https://www.cdsco.gov.in/opencms/opencms/en/Drugs/Investigational-New-Drugs-/

[3] Central Drugs Standard Control Organisation. New Drugs circulars and amendments. https://www.cdsco.gov.in/opencms/opencms/en/Acts-and-rules/New-Drugs/

[4] Clinical Trials Registry India. Trial Registry. https://www.ctri.nic.in/Clinicaltrials/

[5] Clinical Trials Registry India. Frequently Asked Questions. https://www.ctri.nic.in/Clinicaltrials/faq.php

[6] World Health Organization. International Clinical Trials Registry Platform. https://www.who.int/clinical-trials-registry-platform

[7] World Health Organization. Trial Registration Data Set. https://www.who.int/clinical-trials-registry-platform/network/who-data-set

[8] World Intellectual Property Organization. PATENTSCOPE. https://patentscope.wipo.int/

[9] World Intellectual Property Organization. Handbook on Patent Analytics. https://www.wipo.int/publications/en/details.jsp?id=4466

[10] World Intellectual Property Organization. Patent Landscape Reports. https://www.wipo.int/patentscope/en/programs/patent_landscapes/

[11] Indian Patent Office. Intellectual Property India. https://ipindia.gov.in/

[12] Indian Patent Office. Manual of Patent Office Practice and Procedure. https://ipindia.gov.in/writereaddata/Portal/Images/pdf/Manual_for_Patent_Office_Practice_and_Procedure_.pdf

[13] Department for Promotion of Industry and Internal Trade. Patents Act 1970. https://ipindia.gov.in/writereaddata/Portal/IPOAct/1_31_1_patent-act-1970-11march2015.pdf

[14] Securities and Exchange Board of India. Substantial Acquisition of Shares and Takeovers Regulations. https://www.sebi.gov.in/legal/regulations/sep-2011/sebi-substantial-acquisition-of-shares-and-takeovers-regulations-2011-last-amended-on-december-6-2021-_54305.html

[15] Securities and Exchange Board of India. Takeover disclosure formats. https://www.sebi.gov.in/filings/takeovers/nov-2011/formats-for-reports-disclosures-as-per-sebi-sast-regulations-2011_21699.html

[16] Competition Commission of India. Combination Regulations. https://www.cci.gov.in/combination/legal-framwork/regulations

[17] Competition Commission of India. Combination filing guidance. https://www.cci.gov.in/combination/filing-a-notice/guidance-notes

[18] International Council for Harmonisation. Good Clinical Practice E6. https://www.ich.org/page/efficacy-guidelines

[19] International Council for Harmonisation. Common Technical Document. https://www.ich.org/page/ctd

[20] United States Food and Drug Administration. Orange Book. https://www.accessdata.fda.gov/scripts/cder/ob/

[21] United States Food and Drug Administration. Drugs@FDA. https://www.accessdata.fda.gov/scripts/cder/daf/

[22] European Medicines Agency. Clinical Trials Information System. https://www.ema.europa.eu/en/human-regulatory-overview/research-development/clinical-trials-human-medicines/clinical-trials-information-system

[23] European Patent Office. Espacenet. https://worldwide.espacenet.com/

[24] National Institute of Standards and Technology. Artificial Intelligence Risk Management Framework 1.0. https://www.nist.gov/itl/ai-risk-management-framework

[25] World Health Organization. Ethics and Governance of Artificial Intelligence for Health. https://www.who.int/publications/i/item/9789240029200

[26] OECD. Due Diligence Guidance for Responsible Business Conduct. https://www.oecd.org/investment/due-diligence-guidance-for-responsible-business-conduct.htm

[27] Ministry of Corporate Affairs India. Companies Act 2013. https://www.mca.gov.in/content/mca/global/en/acts-rules/ebooks/acts.html

[28] Department of Pharmaceuticals India. Uniform Code for Pharmaceutical Marketing Practices 2024. https://pharmaceuticals.gov.in/policy/uniform-code-pharmaceutical-marketing-practices-ucpmp-2024

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Chennakeshav (CK) is a corporate finance and investment banking executive with 25+ years of global experience in deal origination, structuring and execution across M&A, growth capital and corporate strategy. He has led value-creation mandates for founders, corporates and funds — bridging the boardroom view to hands-on execution and closure.

His career spans Morgan Stanley, HSBC, Lloyds Banking Group, EWEC, ADQ portfolio companies and Emirates Growth Fund, across TMT, real estate, fintech, deeptech, cleantech, infrastructure and energy. He has partnered with C-suite leaders, private equity and venture funds, sovereign wealth funds and family offices to finance complex fund raises and scale-up ventures, and has led M&A due diligence, post-merger integration and business-transformation initiatives to create value.

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