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AI in Real Estate: Underwriting, Valuation and Asset Management

A governed asset-evidence architecture for investment decisions and the ownership cycle

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ABSTRACT

Background. Real-estate underwriting, valuation and asset management use overlapping evidence while producing different decisions under different authority. **Objective.** This paper develops a governed AI operating model for real-estate investors and asset managers. **Approach.** The analysis reviews 25 primary standards, official rules and services, government datasets, official surveys and peer-reviewed studies available through 1 August 2026. Jurisdiction, sample and effective-date boundaries are retained. **Findings.** The proposed design creates a stable asset identity and asset evidence ledger, separates deterministic calculations from statistical and generative models, validates AVMs across time, geography and property segments, and routes material conclusions to named investment, valuation and operating authority. **Implications.** Organisations can begin with bounded assistive extraction and evidence assembly, establish a manual baseline, run shadow evaluation and enter controlled production after approved quality, service, authority and incident thresholds are met. Productivity is measured per accepted asset decision packet; attributable revenue and value remain zero until approved observed evidence supports attribution.

Highlights

- Underwriting, valuation and asset management retain separate purposes and release authority.
- A versioned asset evidence ledger connects source facts, calculations, models and decisions.
- AVM validation includes temporal, spatial, property-segment and tail-error evidence.
- Deterministic calculations remain separate from language-model narrative.
- Productivity is measured on accepted asset decision packets after human review.

JEL Classification: G11, G12, G23, G31, R21, R30, R31, C53, L86, M15, O33

Keywords: artificial intelligence, real estate underwriting, valuation, automated valuation model, asset management, geospatial data, building operations, model risk, professional judgement, GCC real estate

1. INTRODUCTION

Real-estate investment decisions combine physical assets, legal rights, local markets, contracts, capital structures and operating execution. The evidence is dispersed across title records, leases, rent rolls, transaction databases, valuation reports, building systems, budgets, invoices, market research, maps and site observations. A credible decision depends on the provenance and timing of those inputs as much as it depends on the analytical method.

Artificial intelligence can assist three connected workflows. In acquisition underwriting it can structure documents, reconcile evidence, create comparable sets, test assumptions and prepare review packets. In valuation it can support market segmentation, comparable selection, automated valuation models, sensitivity analysis and exception detection. In asset management it can classify leases and work orders, forecast operating measures, identify anomalies and prioritise human investigation. These uses share data and models. They have different purposes, standards and authority.

The International Valuation Standards effective 31 January 2025 introduced dedicated chapters on data and inputs, valuation models, and documentation and reporting [1]. RICS Valuation - Global Standards, effective from the same date, sets mandatory practices for RICS members undertaking valuation services [2]. RICS's Responsible use of artificial intelligence in surveying practice standard took effect on 9 March 2026 for RICS members and regulated firms globally [3]. The RICS standard requires governance, professional judgement, output assurance and communication that reflect the material impact of the AI system. These requirements make an important distinction: a model output can inform professional work; the responsible professional retains the duty to assess and communicate it.

Local legal and data conditions also shape deployment. Dubai Administrative Resolution No. 67 of 2020 requires valuation firms to record specified property and assignment details, retain scanned valuation records for at least five years and register completed valuations in the electronic system [4]. Dubai Land Department's official valuation service describes property categories, documentary requirements, fees and processing routes, with an instant route stated for residential units and attached villas and employee review for other application flows [5]. Saudi Arabia's Real Estate General Authority publishes transaction and rental indicators with stated sources, coverage and update frequencies; its FAQ explains that indicators are aggregated and that extreme values are excluded [6]. These official services improve the available evidence base. Their outputs retain their stated scope and are not substitutes for assignment-specific verification.

The technical evidence supports a similarly bounded conclusion. The IAAO Standard on Automated Valuation Models recommends holdout testing, ratio studies, measures of level and variability, and regular performance review [7]. Peer-reviewed research shows that spatial training choices and geographical information can materially affect results within the studied residential datasets [8,9]. Work using street-level and satellite images reported improved estimation for the studied London data, including tests on previously unseen boroughs [10]. These studies show useful design patterns. They do not establish accuracy for a different country, property type, market regime or valuation purpose.

This paper develops a governed operating model for AI across underwriting, valuation and asset management. Its central unit is the **accepted asset decision packet**: a versioned bundle of approved evidence, deterministic calculations, model outputs, assumptions, exceptions, professional review and decision authority. The packet connects the acquisition decision to the subsequent operating plan and later valuation reviews.

The proposed system has six objectives:

- create a stable identity and evidence history for every asset, parcel, unit, lease and decision;
- separate source facts, calculations, model estimates, assumptions and professional conclusions;
- preserve valuation basis, date, purpose, market segment and comparables provenance;
- test models across time, geography, property type and decision materiality;
- route every material conclusion and operational instruction to named human authority; and
- measure productivity and value per accepted asset decision packet using observed evidence.

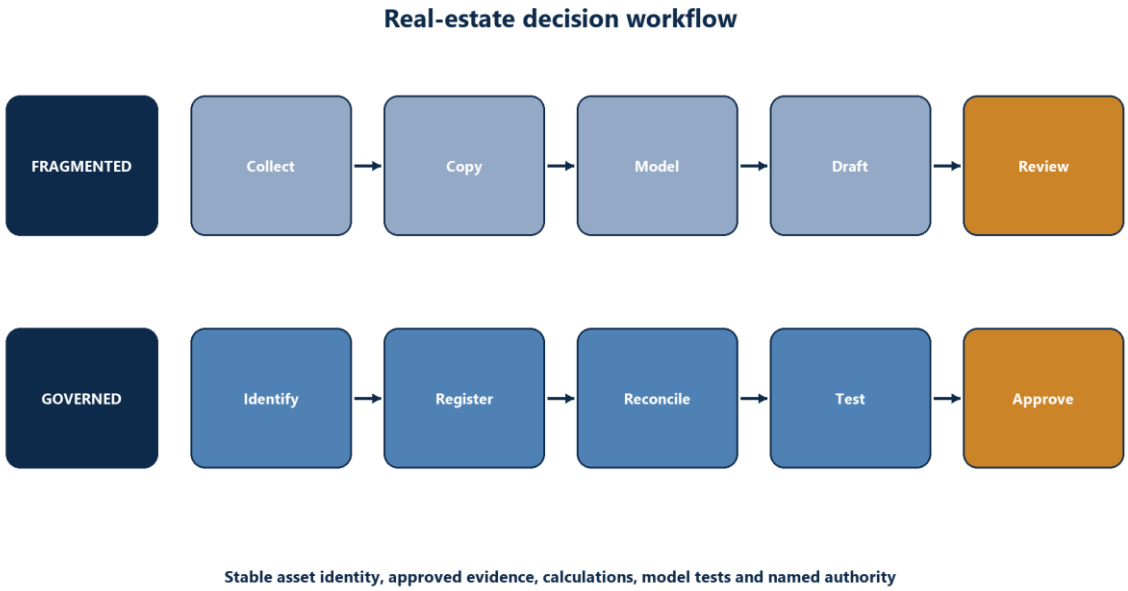

Figure 1. Real-estate decision workflow before and after governed AI assistance
Source: Matchpoint framework.

The architecture is deliberately model-independent. A statistical AVM, gradient-boosting model, computer-vision model or language model can be replaced while the source register, controls, records and authority remain intact. This design supports institutional adoption where data quality, professional responsibility and decision reproducibility matter more than a single model demonstration.

2. DEFINITIONS, SCOPE AND EVIDENCE METHOD

2.1 Definitions

Underwriting means the investment process that tests price, structure, market, physical condition, leases, operating assumptions, capital requirements, financing, risks and exit outcomes before an acquisition or commitment. Its output is a decision recommendation under stated assumptions and authority.

Valuation means the estimation of value for a defined interest, purpose, basis and valuation date under applicable professional, legal and reporting requirements. IFRS 13 defines fair value and provides a framework when another IFRS Standard requires or permits fair-value measurement [11]. IAS 40 addresses investment property and requires fair value to reflect, among other matters, current lease income and assumptions that market participants would use under current market conditions when the fair-value model is applied [12]. These accounting references apply within their reporting context.

Asset management means the controlled planning and execution of leasing, tenant, income, expense, capital, maintenance, energy, risk and reporting activities over the ownership period. ISO 55001:2024 specifies requirements for establishing, implementing, maintaining and improving an asset-management system [13]. This paper uses the standard as an organisation-level management reference; it does not claim ISO certification or prescribe a complete ISO implementation.

Automated valuation model, or AVM, means a mathematical or statistical model that estimates property value from data. AVMs range from rule-based systems and regression models to machine-learning systems. A model estimate, confidence measure and comparable set are separate outputs. An AVM estimate does not by itself establish a professional valuation conclusion.

Asset evidence ledger means the versioned record connecting approved source items, extracted facts, calculations, assumptions, model runs, reviews, exceptions and decisions to an identified asset and effective date.

Accepted asset decision packet means the governed work product approved for its stated purpose. The packet contains the question, asset identity, source manifest, data cut-off, calculations, model outputs, sensitivities, unresolved exceptions, review record and release authority.

2.2 Scope and ICPs

Primary ICP B1 is the real-estate investor, owner or operating platform. Secondary ICP A4 is the investment manager or asset manager with real-estate exposure. The design also applies to lenders, valuers and advisers where their authority and applicable requirements are separately defined.

The paper covers income-producing real estate and related residential or development examples where sources provide evidence. It does not claim that one model suits every property class. Hotels, data centres, logistics, offices, retail, multifamily, villas, land and development assets have different cash-flow drivers, physical evidence and comparable depth.

Regulatory and professional references retain their jurisdiction and membership scope. The US interagency AVM rule applies to AVMs used by mortgage originators and secondary-market issuers in specified credit decisions secured by a consumer's principal dwelling; it does not govern general commercial-real-estate underwriting in the Gulf [14]. RICS standards apply to RICS members and RICS-regulated firms as stated by RICS [2,3]. Dubai and Saudi sources are used for their stated local services, rules and datasets [4-6]. An organisation needs its own legal and professional analysis for each deployment.

2.3 Evidence method

The analysis uses primary standards, official rules and services, government datasets, official surveys and peer-reviewed research available through 1 August 2026. Each claim retains its source boundary.

Evidence class	Use in this paper	Boundary retained
Professional or international standard	Valuation, AI-governance and asset-management requirements	Membership, adoption, edition and effective date
Law, rule or official resolution	Applicable obligations and official process	Jurisdiction, transaction and entity scope
Government service or dataset	Available fields, service route and published indicators	Coverage, aggregation, update and verification limits
Official survey	Adoption, automation and governance context	Respondent-reported evidence and sample
Peer-reviewed study	Model design and reported empirical result	Dataset, geography, property type, period and model
Matchpoint framework	Architecture, controls, scorecards and operating model	Requires organisation-specific validation
Matchpoint scenario	Productivity and economic calculation structure	Unverified illustrative management assumptions

Provider marketing benchmarks are excluded as evidence of institutional productivity. No claim is made that AI increases revenue, value, accuracy or speed for a target organisation before a controlled pilot produces approved observations.

2.4 Decision stages and distinct outputs

The three stages share evidence while producing different work products.

Stage	Governing question	Controlled output	Named authority
Underwriting	Should the organisation acquire, finance or decline on stated terms?	Investment decision packet and sensitivities	Investment committee or delegated approver

Stage	Governing question	Controlled output	Named authority
Valuation	What is the value of the stated interest on the stated basis and date?	Valuation work file and professional conclusion	Qualified valuer within applicable scope
Asset management	Which approved action should be executed and monitored?	Operating plan, instruction, budget or exception	Asset manager and authorised functional owner

A model can inform more than one stage. The source cut-off, assumptions and authority must be regenerated for the new purpose. Reusing an acquisition model as a reporting valuation without reconciling the basis, date and market evidence creates an unsupported bridge between decisions.

3. WHERE AI CAN ASSIST

3.1 Acquisition underwriting

Underwriting begins with an asset identity and an investment question. The identity should resolve parcel, building, unit, ownership interest, address, coordinates, development, legal entity and seller. Every incoming document is registered against that identity. Duplicate files, superseded rent rolls and conflicting areas become visible exceptions.

Language models can extract candidate lease fields, covenants, break clauses, rent reviews, options, service charges and guarantees from documents. Optical character recognition can convert scans. Geospatial services can associate location, access, amenities and planning layers. Statistical models can segment markets and rank comparable transactions. Deterministic services should calculate rent bridges, net operating income, debt service, development cost, yields, discounted cash flow and sensitivities.

The word **candidate** is essential for extraction. A field becomes an approved fact after source location, unit, period and reviewer state are recorded. A generated summary should link each material statement to the lease page, transaction record, inspection report or calculation that supports it.

A practical underwriting workflow is:

- resolve the asset, parties, rights and proposed transaction;
- register documents and identify missing expected evidence;
- extract candidate facts with page and field provenance;
- reconcile rent roll, leases, areas, deposits and operating statements;
- build market and comparable evidence under explicit filters;
- calculate the base case, downside cases and financing cases deterministically;
- identify exceptions, conflicts and unsupported assumptions;
- draft the investment memorandum with claim-level evidence; and
- release the packet after named specialist and committee review.

AI is particularly useful where volume is high and the review target is well defined. A 300-page lease package can be converted into a structured exception list. The result still requires review against the source and instruction. Material legal interpretation remains with qualified counsel or another authorised professional.

3.2 Valuation and AVMs

An AVM estimates value from available relationships in data. Traditional hedonic models use property and location characteristics. Machine-learning models may capture non-linear interactions, spatial patterns and visual features. The appropriate choice depends on purpose, data, sample structure, explainability and the consequences of error.

Research by Krämer and co-authors used approximately 1.2 million German residential properties and compared four methods across spatial training levels; the study's purpose was to test how spatial scope affects valuation accuracy [8]. Lee and co-authors combined geographic representations with numeric and categorical variables for residential valuation in their studied dataset [9]. Law, Paige and Russell used street-level and satellite imagery with

conventional features to estimate London house prices and reported improvement within their experiments, including generalisation tests to unseen boroughs [10]. Poursaeed, Matera and Belongie studied real-estate photos and property metadata in a vision-based estimation framework [15].

The implication for production design is methodological. Location, time, physical attributes and imagery can carry useful signal. The reported performance belongs to each study's data and experiment. A Gulf commercial portfolio needs local transactions, leases, property taxonomy, currency, legal interests, market regimes and validation sets.

Professional valuation also includes elements that a predictive model score does not represent. The assignment specifies the client, intended use, asset or liability, interest, basis of value, valuation date, assumptions, limitations and reporting requirements. IVS 104, 105 and 106 place data, models and documentation within the valuation process [1]. RICS states that an AVM output without application of professional judgement is outside Red Book compliance; an AVM-derived output with professional judgement can form part of a written valuation under the stated requirements [2].

The system should therefore create four distinct artefacts:

- an estimated value or range from the model;
- a comparable and evidence packet supporting the estimate;
- a validation record describing the model's applicable population and current performance; and
- a professional conclusion with the valuer's judgement, adjustments and disclosure.

Conflating these artefacts hides uncertainty and responsibility.

3.3 Asset management

The acquisition model becomes useful after closing when it is converted into an operating baseline. Lease events, collections, renewals, vacancies, work orders, capital projects, utilities and valuations update the asset evidence ledger. Every operating decision can be compared with the original plan and latest approved forecast.

AI assistance can support:

- lease abstraction and event calendars;
- tenant and counterparty record reconciliation;
- budget variance classification and commentary drafting;
- work-order categorisation and duplicate detection;
- anomaly detection across energy, water, occupancy and plant data;
- forecast scenarios for occupancy, rent, expenses and capital timing;
- document retrieval for warranties, manuals and contracts; and
- preparation of portfolio-review and valuation-update packets.

ENERGY STAR Portfolio Manager provides an official example of structured building benchmarking. It enables users to track energy, water, waste and emissions and compare certain property types with relevant baselines or peers [16]. EPA also states that the public Data Explorer is based largely on data entered by account holders, with cleaning and aggregation, and that EPA does not verify most individual submissions [17]. The distinction between an operational system and verified evidence should be preserved in any asset-management architecture.

An anomaly is a prompt for investigation. It is not an approved work order, tenant communication, safety decision or capital commitment. The asset manager determines materiality; engineering, legal, finance or property-management functions approve actions within their authority.

3.4 Use-case boundary

Use case	AI-supported work	Required evidence	Human release
Lease abstraction	Candidate fields, clauses and exceptions	Exact lease page and version	Legal or lease-administration reviewer

Use case	AI-supported work	Required evidence	Human release
Comparable selection	Filter, similarity ranking and map	Transaction source, date, rights and adjustments	Analyst and valuer
AVM estimate	Model value, interval and diagnostics	Approved feature set and current validation	Valuer within assignment scope
Acquisition model	Document extraction and scenario preparation	Reconciled inputs and deterministic calculations	Deal lead and investment committee
Budget variance	Classification, trend and draft commentary	General ledger, budget and approved mapping	Asset manager and finance owner
Building anomaly	Detection and triage proposal	Meter, sensor, work-order and inspection evidence	Engineer or property manager
External report	Cited first draft and evidence map	Approved work file and disclosure	Named authorised signatory

4. THE ASSET EVIDENCE LEDGER

4.1 Stable asset identity

The first control is identity. Property data often uses inconsistent addresses, transliterations, unit labels and developer names. Legal parcels may be consolidated or subdivided. A building can contain strata units, common areas, leases and meters that follow different numbering systems.

The asset master should assign an internal immutable identifier and connect it to official and operational identifiers. It should represent relationships among parcel, building, floor, unit, lease, tenant, meter, work order, valuation, loan and legal entity. Matching logic can propose relationships; approved matches are recorded with confidence, evidence and reviewer.

4.2 Data classes and ownership

Data class	Examples	Primary owner	Required controls
Legal and title	ownership, parcel, easement, restriction	Legal or authorised registry function	official source, effective date, version and access
Physical	area, use, condition, specifications, images	Technical or property team	measurement basis, inspection date and evidence
Lease and tenant	term, rent, indexation, options, security	Asset management and legal	executed document, abstraction review and confidentiality
Market	sale, rent, yield, vacancy and development evidence	Research or valuation	source rights, date, geography and comparability
Financial	income, expense, arrears, capex and financing	Finance	ledger reconciliation, currency, period and approval
Operational	work orders, plant, meters, incidents and occupancy	Property or facilities manager	sensor quality, maintenance state and escalation
Valuation	basis, date, assumptions, model and conclusion	Valuation function	assignment, model version, comparables and sign-off
Decision	recommendation, conditions, votes and actions	Governance owner	authority, timestamp, conflicts and immutable record

Every field has an owner and a state. Suggested states are `candidate`, `verified`, `disputed`, `superseded`, `restricted` and `unavailable`. A generated value cannot silently replace a verified source value. Corrections create a new version and a link to the superseded item.

4.3 Evidence graph

The ledger is most useful when relationships remain explicit:

asset -> parcel -> unit -> lease -> tenant;

asset -> transaction -> comparable -> adjustment;

asset -> budget -> invoice -> work order -> physical component;

asset -> valuation -> model run -> input -> source;

asset -> assumption -> scenario -> decision -> approval.

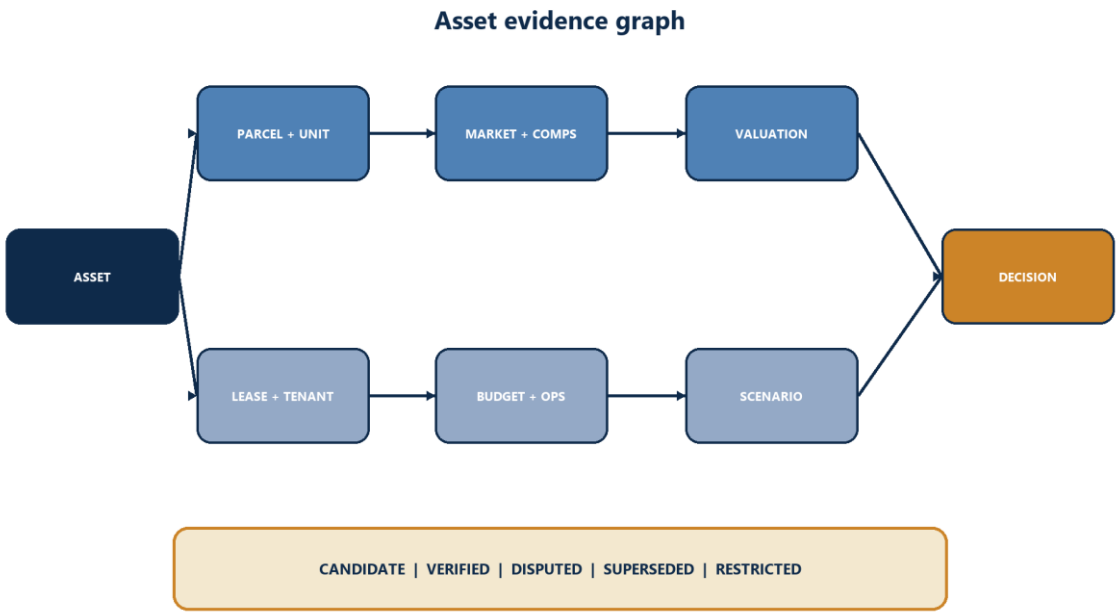

Figure 2. Asset evidence graph connecting property, contract, market, operations, valuation and decision records
Source: Matchpoint framework; local record and data references [4-6,22,23].

The graph supports impact analysis. If a rent-roll version changes, the system can identify every underwriting calculation, valuation and report that used the earlier version. If a comparable is later invalidated, its affected valuation runs can be queued for review. This is a provenance function; it does not determine whether the original decision was reasonable.

4.4 Time, units and definitions

Real-estate data is time-dependent. Market transactions have agreement and registration dates. Leases have commencement, expiry, review and break dates. financial records have service and accounting periods. Meter readings have intervals and missing observations. Valuation conclusions have a specific valuation date.

Each data item should store event time, effective time, publication time, ingestion time and review time where relevant. Currency, area, energy and rate units stay attached to values. Conversion tables and indexation series are versioned. When a model is trained, the feature availability timestamp must reflect what would have been known at the prediction date. This enables temporal holdout testing and reduces look-ahead leakage.

4.5 Official data and local context

Dubai's valuation framework provides a useful recordkeeping reference. Administrative Resolution No. 67 specifies information to record for valuations and a minimum five-year scanned-record retention period [4]. DLD's 2020 announcement stated that its smart valuation process would use AI, interconnected databases and a 15-second implementation target [18]. This is an official project statement made in 2020; it is not independent evidence of current accuracy or realised performance.

Saudi REGA's Real Estate Indicators Platform identifies official sources including the Ministry of Justice, Real Estate Registry, Ejar Network and Saudi Central Bank, with monthly or quarterly updates depending on the indicator [6]. The platform explains that indicators show averages within a selected geography and period rather than a specific property's actual price per square metre [6]. A model using those indicators must preserve the aggregation level and source update date.

5. GOVERNED TECHNICAL ARCHITECTURE

5.1 Architecture layers

The proposed architecture has seven layers.

Layer	Core services	Control objective
Experience	asset view, evidence viewer, model workbench, exceptions and approval	show evidence, assumptions and authority together
Workflow and policy	identity, purpose, materiality, permissions, states and stops	allow only authorised transitions and releases
Analytical services	underwriting calculations, AVM, forecast, anomaly and sensitivity	separate deterministic and statistical outputs
AI services	document extraction, retrieval, classification, vision and drafting	expose model, prompt, confidence and source links
Evidence and data	asset master, documents, transactions, leases, ledger and graph	preserve ownership, time, lineage and versions
Integration	registries, property systems, finance, GIS, building systems and data rooms	move approved data with observable failures
Security and observability	access, encryption, logs, model monitoring, service and incidents	protect information and make system behaviour reviewable

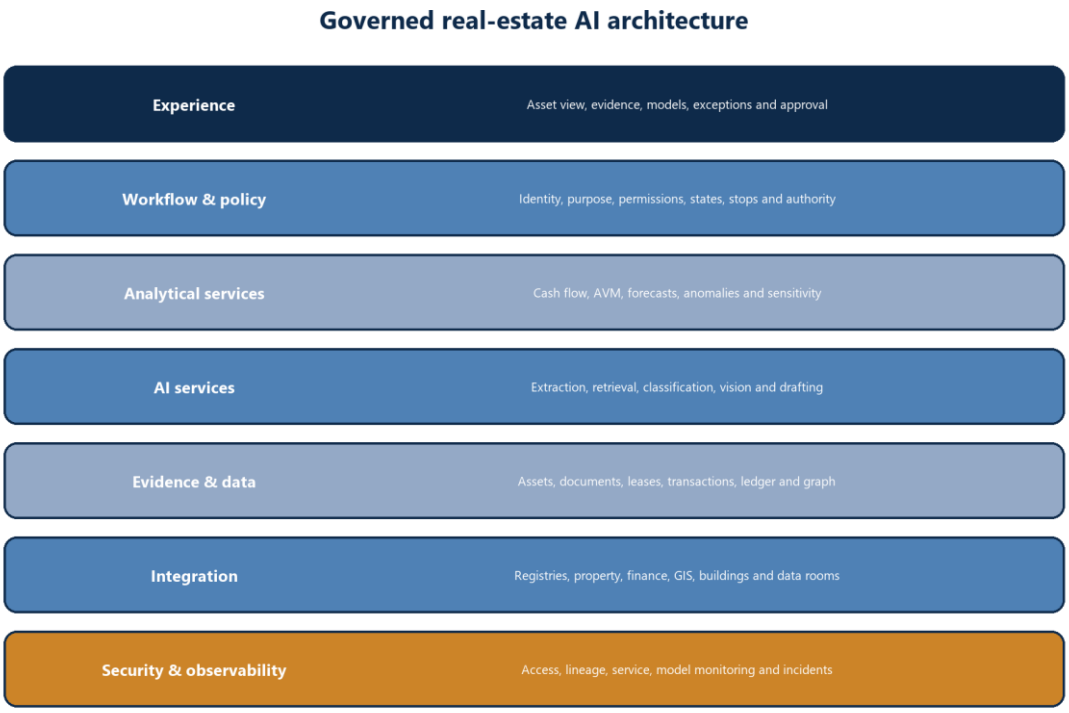

Figure 3. Governed AI architecture across experience, workflow, analytics, AI services, evidence, integration, security and observability

Source: Matchpoint architecture; standards and governance references [1-3,13,19-21].

The architecture separates systems of record from analytical copies. A lease-management system may own executed lease terms; the AI layer receives approved versions and sends candidate corrections through workflow. The model does not write directly into the legal, finance or building-control record.

5.2 Ingestion and document intelligence

Ingestion preserves original bytes, source, access rights, hash and version. Document processing identifies layout, headings, paragraphs, tables, signatures, stamps, handwritten annotations and page locations. Optical character recognition records confidence by page or region.

Lease and valuation documents require schema-aware extraction. The schema distinguishes stated rent from calculated effective rent, contractual area from measured area, option dates from expiry dates and assumptions from observations. A field-level reviewer sees the extracted value beside the exact page image.

Low-confidence items and material fields enter a review queue. Materiality is assignment-specific. A misspelt tenant trading name may be low impact; an incorrect break date or area can change the underwriting result.

5.3 Geospatial and visual features

Location is relational. Useful features can include access, parcel geometry, frontage, nearby land uses, amenity distance, transit, planning designation, hazards and development pipeline. Source date and measurement method remain attached.

Computer-vision models can extract candidate building attributes or neighbourhood representations from images. Law and co-authors demonstrate a research design that combined visual and conventional variables in London [10]. Poursaeed and co-authors used property images with metadata in their studied valuation framework [15]. Deployment requires image rights, capture date, geographic representativeness, privacy controls and local validation.

Images can become stale. A façade image predating a refurbishment, obstruction or adjacent construction can misrepresent the asset. The system should retain capture date and provenance, detect duplicates and route material visual interpretations to a reviewer.

5.4 Model and calculation services

The analytical layer contains several service types:

- deterministic calculations for cash flow, debt, tax assumptions, yields, present values and sensitivities;
- statistical AVMs for value or rent estimation;
- classification models for documents, clauses, work orders and exceptions;
- forecast models for occupancy, expenses, energy and capital timing;
- anomaly models for operating measures and data quality; and
- generative models for evidence retrieval and draft narratives.

Each service has a model card or calculation specification containing owner, intended use, excluded use, input schema, training or calibration period, validation evidence, limitations, version, approval and monitoring thresholds. A model run stores those identifiers with the inputs and output.

Calculations should be deterministic whenever the formula is defined. The record includes formula, operands, units, source references, code version and reconciliation. A language model may explain a calculation after the approved result exists. The model is not the calculation engine.

5.5 Workflow and authority

The workflow state machine can use these stages:

ingested -> extracted -> reconciled -> modelled -> challenged -> approved -> released -> monitored -> superseded.

Stops apply when a required source is absent, identity remains ambiguous, a calculation fails reconciliation, the model is outside its validated population, a material conflict is unresolved, or approval is missing. Overrides require named authority, reason, scope and expiry.

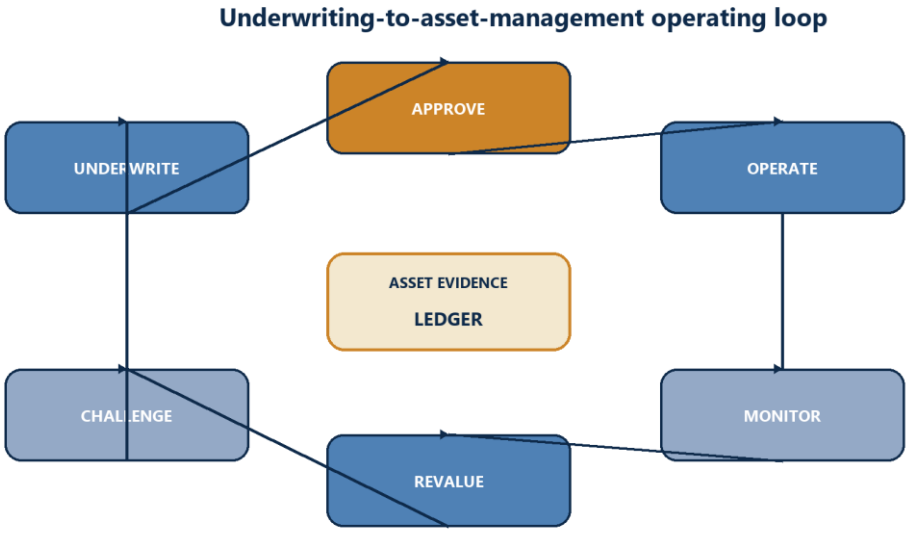

Figure 4. Underwriting-to-asset-management operating loop with controlled decisions and evidence feedback
Source: Matchpoint framework.

The investment committee releases the acquisition decision. A qualified valuer releases a valuation conclusion within applicable requirements. The asset manager releases operating instructions within delegated authority. System administrators operate infrastructure and have no implied investment, valuation or operating authority.

5.6 Security and third parties

Real-estate packets can contain personal data, tenant information, bank details, confidential contracts and commercially sensitive valuations. Retrieval filters must apply before context is assembled for a model. Data location, retention, logging, training use and subcontractors require approval.

The 2024 Bank of England and FCA survey received responses from 118 regulated firms. Respondents reported that 75% used AI, 33% of AI use cases were third-party implementations, 55% involved some automated decision-making and 2% were fully autonomous [19]. These are respondent-reported results across UK financial services. They provide context for third-party and accountability controls; they do not measure real-estate performance.

NIST AI RMF 1.0 organises voluntary AI risk-management outcomes around govern, map, measure and manage [20]. The NIST Generative AI Profile adds a cross-sector resource for risks specific to generative AI [21]. An organisation can map these functions to its model inventory, risk classification, tests, incident process and management reporting.

6. VALUATION AND MODEL VALIDATION

6.1 Applicable population

Every model needs an explicit applicable population. Dimensions include jurisdiction, city, district, property type, tenure, legal interest, age, size, price range, occupancy, development status and valuation purpose. A confidence score does not expand that population.

Sparse markets require caution. Luxury villas, development land, specialised assets and assets with unusual leases can have few true comparables. A model may produce a precise number from weak evidence. The workflow should detect low comparable count, distance from the training distribution and wide outcome dispersion, then route the case to manual analysis.

6.2 Validation design

Random train-test splits can overstate performance when nearby properties or later transactions share information with the training set. Validation should include time-based and geography-based tests aligned with the intended use. The study by Krämer and co-authors directly demonstrates that spatial training level is a substantive design choice in their German residential data [8]. Law and co-authors tested generalisation to previously unseen London boroughs in their visual-feature study [10].

The IAAO AVM standard recommends ratio studies on regular, periodic bases and use of holdout samples. It distinguishes overall quality statistics from the accuracy of an individual property estimate [7]. This distinction is important for investment work. Strong portfolio-level error statistics can coexist with a material error on one acquisition.

Validation dimension	Test	Evidence retained	Example stop condition
Temporal	rolling or forward holdout by transaction date	dates, feature availability and period errors	deterioration beyond approved threshold
Spatial	district, city or region holdout	geographic partitions and segment errors	unseen location outside approved population
Property type	separate performance by use and physical class	sample count, error and interval by class	insufficient sample for material use
Price and value	performance by value bands	median ratio, dispersion and tail errors	systematic value-related bias

Validation dimension	Test	Evidence retained	Example stop condition
Data quality	missingness, stale fields and conflicting sources	field lineage and reconciliation	material field unresolved
Stability	drift in inputs, errors and comparable coverage	monitoring series and change log	threshold breach or regime change
Fairness and compliance	relevant protected or policy groups where applicable	legal basis, test design and results	prohibited or unexplained disparity
Human acceptance	adjustment, rejection and rework by reviewers	reason-coded decisions	acceptance below approved threshold

The US interagency final rule on AVM quality-control standards specifies policies and controls designed to address confidence in estimates, protection against data manipulation, conflicts of interest, random sample testing and reviews, and compliance with applicable nondiscrimination laws [14]. The rule's scope is specified consumer mortgage decisions. Its control categories can inform broader model-governance thinking without being represented as the applicable rule for every real-estate use.

6.3 Error measures and intervals

Model evaluation should report more than one average error. Useful measures include median absolute error, median absolute percentage error, root mean squared error, bias, tail errors, coverage of prediction intervals and error by segment. Ratio studies add measures of central tendency, variability and value-related bias [7].

Prediction intervals should be empirically calibrated for the relevant segment and time. An interval is not a guarantee. It represents the model and calibration evidence under stated conditions. The professional work file records how the interval, comparable evidence and asset-specific facts affected judgement.

6.4 Comparables and adjustments

Comparable selection should be reproducible. The record includes source, rights, transaction date, property type, location, area, condition, occupancy, lease terms, price, currency and exclusions. Model similarity can rank candidates. The valuer or analyst confirms relevance and adjustments.

The system should show excluded as well as selected comparables. Exclusion reasons such as related-party transaction, incomplete registration, unusual rights, distress or stale date enable challenge. Aggregate market indicators support context; they do not prove the value of a specific asset.

6.5 Professional judgement and disclosure

RICS's AI standard requires members and regulated firms to assess material impact, maintain relevant governance and exercise professional judgement [3]. IVS 105 addresses valuation models and professional judgement within IVS compliance [1]. The work file should show:

- the model and version used;
- the applicable population and validation date;
- data and comparables included and excluded;
- model estimate, range and diagnostics;
- professional adjustments and reasons;
- unresolved limitations; and
- the named signatory and release state.

The client-facing report uses the disclosure required by the assignment and applicable framework. Technical detail can sit in the work file while material reliance and limitations remain visible in the report.

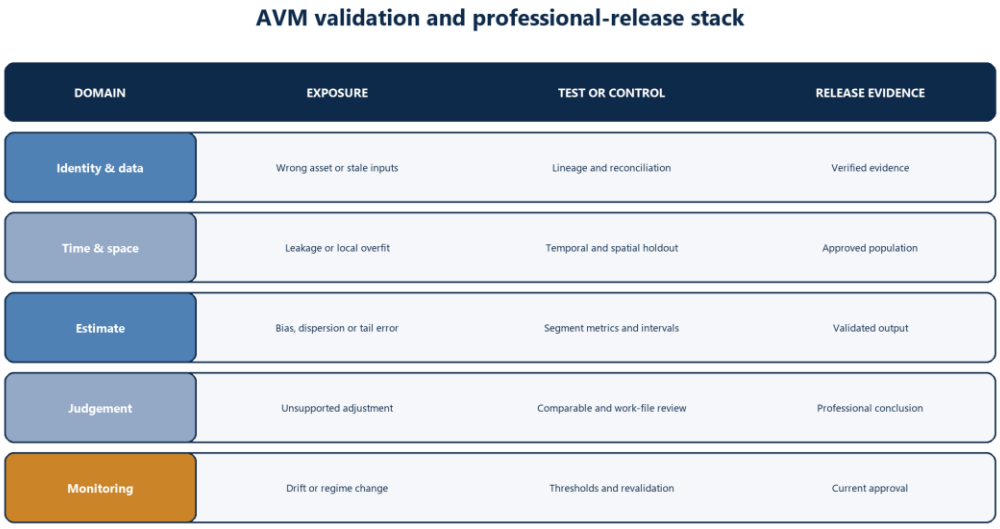

Figure 5. AVM validation stack from asset identity and data through temporal and spatial tests, professional review and monitoring
Source: Matchpoint synthesis based on [1-3,7-10,14,15,24,25].

7. GOVERNANCE, CONTROL AND ACCOUNTABILITY

7.1 Authority matrix

Decision or action	AI role	Reviewer	Final authority	Record
Accept source into evidence set	classify and flag	data owner	source owner	source approval and rights
Approve extracted lease term	propose field and citation	lease reviewer	legal or lease owner	field state and page evidence
Approve model for defined use	prepare validation results	independent validator	model-risk or governance committee	model approval and limits
Issue valuation conclusion	estimate and assemble work file	qualified valuer	authorised valuation signatory	valuation work file and report
Recommend acquisition	prepare scenarios and memorandum	deal lead and specialists	investment committee	accepted decision packet
Release operating instruction	detect, forecast or draft	functional specialist	asset manager or delegated owner	instruction, rationale and result
Publish external statement	draft with evidence map	legal, compliance and subject owner	authorised signatory	approved final and sources

Authority is attached to the decision, not the software role. A user with administrator privileges cannot release a valuation or investment decision unless separately authorised.

7.2 Risk and control map

Risk	Failure example	Control	Evidence
Identity	rent roll assigned to wrong building	stable asset IDs and reconciliation	match evidence and reviewer

Risk	Failure example	Control	Evidence
Data lineage	estimate uses superseded lease	immutable versions and effective dates	source hash and lineage graph
Extraction	break date or area is wrong	field confidence and source-page review	accepted field record
Spatial leakage	nearby observations appear in train and test	spatial holdout	partition definition and results
Temporal leakage	post-date information enters features	feature-availability timestamps	training manifest
Model drift	errors rise after market regime change	segment monitoring and revalidation	dashboard and decision log
Unsupported narrative	report claims a driver without evidence	claim-evidence review	cited statement or assumption label
Access leakage	confidential lease enters unauthorised context	pre-retrieval permissions	access decision and trace
Automation overreach	anomaly creates an unauthorised instruction	workflow state and named approval	release record
Third-party outage	model or data service is unavailable	fallback procedure and service monitoring	incident and continuity test

7.3 Records and auditability

A reproducible packet records the user, purpose, source universe, cut-off, model and prompt versions, tool calls, calculations, evidence, draft, reviewer changes, exceptions and release. Records must respect data minimisation, contractual rights and retention rules.

Dubai's five-year valuation-record requirement is one local example [4]. An organisation operating across jurisdictions should configure retention by record class and applicable obligation. The architecture should support legal hold, deletion and restricted access without breaking the integrity of approved decision records.

7.4 Change and incident management

A model update can change extraction, comparable ranking or narrative even when the question and sources remain constant. Material changes require regression tests and approval before production. The release record identifies the exact deployed version.

Incidents include material data errors, access violations, unsupported released claims, model performance breaches, unauthorised actions and unavailable critical services. The process should contain the issue, identify affected packets, notify owners, correct records, retest and document reopening criteria.

8. PRODUCTIVITY AND ECONOMICS

8.1 The correct unit of output

Documents processed, tokens generated and model calls are activity measures. The business unit is the accepted asset decision packet. Acceptance means the packet meets the approved evidence, calculation, review and authority requirements for its purpose.

The scorecard should separate:

- quality: field accuracy, calculation reconciliation, evidence coverage, exception resolution and reviewer acceptance;
- capacity: analyst hours, specialist hours, reviewer hours, cycle time and accepted packets;

- service: availability, latency, queue age and fallback use;
- cost: data, models, software, controls, review and incident response; and
- decision outcomes: forecast variance, realised operating measures and approved attribution to later value or revenue.

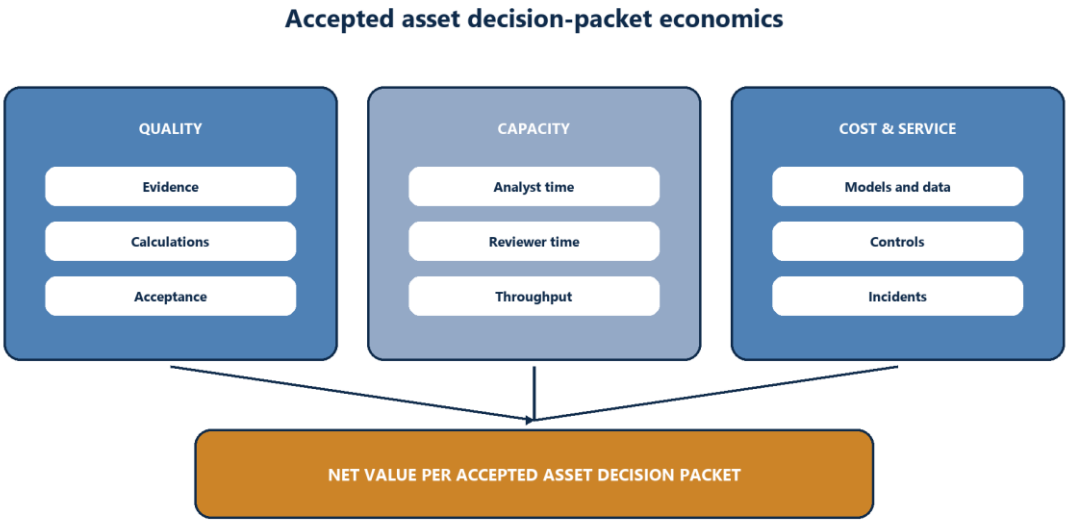

Figure 6. Productivity, quality and economics measured per accepted asset decision packet
Source: Matchpoint scenario analysis. All operating inputs require observed baseline and pilot evidence.

8.2 Baseline and pilot

The baseline should sample completed packets by property class and materiality. Measure elapsed time and active time by activity: document preparation, data reconciliation, market evidence, modelling, writing, review and rework. Record quality defects and late evidence.

The pilot should run the AI-assisted process in shadow mode against comparable work. Reviewers evaluate the output against the source and approved checklist. The pilot needs enough cases across segments to reveal tail conditions. Results stay descriptive until sample size and design support a broader conclusion.

8.3 Illustrative scenario

The following scenario demonstrates the calculation structure. Every operating input is an **unverified illustrative management assumption**. It is not a forecast or observed Matchpoint or client result.

Illustrative input	Baseline	AI-assisted	Status
Candidate packets per month	8	10	Unverified management assumption
Analyst hours per candidate packet	45	31	Unverified management assumption
Specialist and reviewer hours per candidate packet	15	17	Unverified management assumption
First-pass acceptance rate	75%	82%	Unverified management assumption
Monthly technology and control cost	USD 0 incremental	USD 18,000	Unverified management assumption

Illustrative input	Baseline	AI-assisted	Status
Fully loaded labour cost	USD 150 per hour	USD 150 per hour	Unverified management assumption

Under those assumptions:

Baseline accepted packets = 8 x 75% = 6.0 per month.

AI-assisted accepted packets = 10 x 82% = 8.2 per month.

Baseline monthly labour cost = 8 x (45 + 15) x USD 150 = USD 72,000.

AI-assisted monthly labour cost = 10 x (31 + 17) x USD 150 = USD 72,000.

AI-assisted total monthly cost = USD 72,000 + USD 18,000 = USD 90,000.

Baseline cost per accepted packet = USD 72,000 / 6.0 = USD 12,000.

AI-assisted cost per accepted packet = USD 90,000 / 8.2 = approximately USD 10,976.

Illustrative cost change per accepted packet = approximately negative 8.5%.

This result is mechanically derived from unverified assumptions. It excludes implementation cost, data remediation, incidents, change management and variation in packet materiality. The scenario provides no evidence of realised productivity, valuation accuracy, investment outcome, revenue or asset value.

8.4 Attribution to revenue and asset value

Technology can create capacity or improve information quality without creating attributable revenue. Attribution requires an observed chain from system-supported work to an approved action and financial outcome.

For acquisitions, relevant later measures may include accepted-packet throughput, bid participation, execution rate, realised versus underwritten cash flow and exit outcome. For asset management, measures may include approved lease action, arrears resolution, operating cost, capital delivery, downtime and energy intensity. Market movements, transaction selection and human decisions confound the relationship.

The governance report should therefore record attributable revenue or value as **USD 0** until finance and management approve evidence linking the intervention to the outcome. This treatment keeps a productivity claim separate from an investment-performance claim.

8.5 Scorecard

A monthly scorecard can include:

- percentage of material source fields verified;
- percentage of calculations reconciled;
- unsupported material claims per packet;
- first-pass reviewer acceptance;
- analyst and reviewer hours per accepted packet;
- cycle time and queue age;
- model error and interval coverage by segment;
- out-of-population cases and overrides;
- access, data and model incidents;
- total cost per accepted packet; and
- approved attributable revenue or value, which remains zero absent evidence.

9. ADOPTION ROADMAP

9.1 Phase 0: define authority and evidence boundary

Select one decision packet, one property class and one owner. Define purpose, materiality, expected sources, source rights, output, reviewer, authority, retention and stop conditions. Establish the manual baseline before introducing a model.

9.2 Phase 1: register assets and sources

Create stable asset identifiers. Register documents, transactions and operational systems. Define field owners, time semantics, units, versions and access. Build a labelled sample of representative and difficult cases.

9.3 Phase 2: assist extraction and retrieval

Deploy candidate lease or valuation extraction and evidence retrieval in shadow mode. Review every material field against the source. Measure precision, recall, reviewer time, correction reasons and access performance.

9.4 Phase 3: add deterministic calculations and bounded models

Move defined formulas into controlled calculation services. Validate AVMs and forecasts with temporal, spatial and segment holdouts. Approve an applicable population, limits and monitoring thresholds.

9.5 Phase 4: assemble accepted packets

Connect sources, calculations, model results, assumptions and exceptions in one review interface. Require claim-level evidence for material narrative. Run parallel manual and AI-assisted packets and compare quality, effort, service and cost.

9.6 Phase 5: controlled production

Release a bounded assistive workflow after governance approval. Maintain human authority. Monitor drift, service, incidents, overrides and reviewer acceptance. Reopen shadow mode when a threshold is breached or a material component changes.

9.7 Phase 6: extend across the ownership cycle

Connect the accepted acquisition packet to asset-management baselines and later valuation work. Expand property classes only after local data, validation and workflow evidence support the new use.

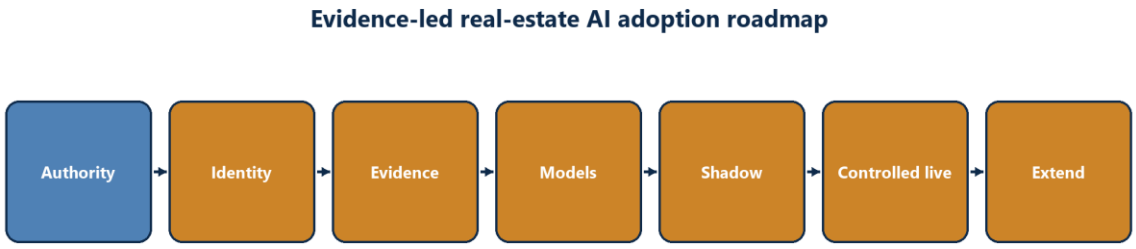

Figure 7. Adoption roadmap from authority, asset identity and source control through shadow evaluation, controlled production and ownership-cycle extension

Source: Matchpoint framework.

9.8 Minimum entry criteria

A use case enters controlled production only when:

- the purpose and excluded uses are approved;

- assets and evidence sources have accountable owners;
- material fields and calculations meet approved test thresholds;
- model applicable population and limitations are documented;
- permissions are tested before retrieval;
- named reviewers and release authority are active;
- service, fallback, monitoring and incident procedures are tested; and
- the economics are reported with assumption and attribution boundaries.

10. CONCLUSION

AI can make real-estate evidence easier to structure, retrieve, compare and monitor. Institutional value depends on the system around the model: asset identity, source rights, time and unit semantics, deterministic calculations, model validation, evidence lineage, workflow stops and named professional authority.

Underwriting, valuation and asset management should remain distinct decisions connected by a common evidence ledger. The acquisition packet supplies an approved operating baseline. Operating facts update later forecasts and valuation reviews. Each new purpose receives its own evidence cut-off, assumptions, review and release.

The accepted asset decision packet provides a measurable production unit. It supports quality and productivity analysis while preserving a clear boundary around investment outcomes and attributable value. Firms can begin with a bounded property class and assistive workflow, measure the manual baseline, validate on local cases, run in shadow mode and expand after approved evidence.

DECLARATIONS

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Data availability: No confidential client data or proprietary performance dataset was used. Public-source boundaries are stated in the paper. The productivity scenario uses unverified illustrative management assumptions.

Use of AI: AI-assisted tools supported research organisation, drafting and figure production. The author retains responsibility for review and release.

Disclaimer: This is a research paper, not investment, valuation, accounting, legal, tax, engineering, cybersecurity or regulatory advice. Organisations should obtain qualified advice and perform assignment-specific validation.

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APPENDIX A. MINIMUM ASSET DECISION PACKET

- Asset, parcel, unit, rights and legal-entity identifiers.
- Decision purpose, materiality, authority and evidence cut-off.
- Source manifest with owners, versions, dates, permissions and gaps.
- Verified physical, lease, market, financial and operating facts.
- Deterministic calculations with formulas, units and reconciliation.
- Model outputs with version, applicable population, validation and limitations.
- Comparable evidence, selection, exclusions and adjustments.
- Assumptions and scenarios labelled by owner and approval state.
- Conflicts, exceptions, missing evidence and overrides.
- Reviewer changes, specialist opinions and release decision.

APPENDIX B. MODEL INVENTORY FIELDS

- model identifier, owner, developer and vendor;
- intended and excluded uses;
- jurisdictions, property types and value bands;
- input schema, sources and data rights;
- training, calibration and validation periods;
- temporal, spatial and segment tests;
- error, bias, interval and stability measures;
- human workflow and override route;
- monitoring and revalidation thresholds;
- service dependency, fallback and incident owner; and
- approval, version, release and retirement dates.

APPENDIX C. PILOT TEST SET

The pilot test set should include ordinary and difficult cases: duplicate addresses, Arabic and English naming differences, mixed-use properties, incomplete leases, amended leases, unusual rights, development assets, sparse comparables, rapid market changes, stale imagery, missing meter data, conflicting areas, related-party transactions and assets outside the model population.
Each case contains approved evidence and expected results for identity, extraction, calculations, comparable coverage, model boundary, required exceptions and authority. Reviewers record corrections by reason. The set is versioned and rerun after material changes.

APPENDIX D. GLOSSARY

Applicable population: The jurisdictions, property classes, periods and purposes for which model use has approved validation evidence.
Asset evidence ledger: Versioned relationships among sources, facts, calculations, models, assumptions, reviews and decisions for an identified asset.
Automated valuation model: A mathematical or statistical system that estimates property value from data.
Comparable: A transaction, listing, lease or other market observation considered relevant to a subject asset under stated criteria.
Deterministic calculation: A reproducible calculation with defined formula, inputs, units and result.
Evidence cut-off: The time through which the declared source universe has been checked.
Out-of-population case: An input outside the model's approved applicable population.
Professional judgement: The accountable interpretation and decision of a suitably qualified person within their authority.
Spatial holdout: A validation set separated by geography to test performance away from training locations.
Temporal holdout: A validation set separated by time to test performance on later observations.