

# Knowledge Graphs & Semantic Web

## Operations with LLMs

*Build, Validate, Govern, and Use*

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## Working Draft Chapter

Version 0.1

This chapter covers operational pipelines for building and governing KGs with LLM assistance, hybrid retrieval (symbolic + vector), and evaluation aligned to the book's governance patterns.

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## 0.1 Ingestion and Mapping Pipeline

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From documents and APIs to RDF: normalize inputs, resolve entities, mint IRIs, map to SKOS/OWL terms, and validate with SHACL at each stage. Treat shapes and mappings as code with version control. ([w3c-shacl](#))

### Alignment with Evidence Record

Carry source IRIs, dates, jurisdiction codes, and content hashes into the graph so KG facts link back to the book’s Evidence Record (Chapter 3, Structured Outputs).

## 0.2 Provenance and Versioning

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Use PROV-O to record “who/what/when/how” for dataset creation, extraction runs, human curation, and publication. Align agent roles and timestamps with your audit requirements. ([w3c-provo](#))

### Minimal Provenance Pattern

- Activities for ingestion, mapping, validation; entities for inputs/outputs; agents for systems and reviewers.
- Version IRIs for datasets and vocabularies; maintain change logs.

## 0.3 LLM-Assisted Construction and Curation

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LLMs can propose entities, relations, and candidate axioms from text, tables, and schemas; they can also draft SPARQL queries and SHACL shapes. Keep humans-in-the-loop and gate changes through validation and provenance capture. Surveys highlight promise and current limits for schema-precise extraction. ([survey-llm-kg-2024](#))

### Human-in-the-Loop Gates

- Candidate triples and shapes must pass SHACL and reviewer checks before merge.
- Keep suggested vs. accepted changes separate for measurement.

## 0.4 Hybrid Retrieval: SPARQL + Text/Vector

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Combine symbolic queries (SPARQL) for precise filters (jurisdiction, effective date, identifiers) with text/vector retrieval for semantic matching. Use KGs to disambiguate entities and assemble authoritative context before LLM generation. ([w3c-sparql11-overview](#))

### Pattern

- Resolve entities via IRIs (LEI/CIK/etc.), then retrieve related filings, rulings, or contracts.
- Pass grounded snippets plus citations (Chapter 3, Structured Outputs) to the LLM.

## 0.5 Domain Examples

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**Finance.** Link LEI/CIK identifiers to disclosures and reporting taxonomies (IFRS/US GAAP) to track obligations and exposures across entities and instruments. ([gleif-lei](#); [sec-ciik](#); [ifrs-taxonomy-2024](#); [fasb-usgaap-2025](#))

**Law.** Use ELI/ECLI to connect legislation, consolidated versions, and case law across jurisdictions; publish JSON-LD for developer access. ([ecli-ejustice](#))

## 0.6 Evaluation and Operations

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Evaluate extraction precision/recall, SHACL violation rates, SPARQL endpoint performance, and user-facing outcomes (e.g., retrieval quality) alongside audit metrics. Tie quick retrieval checks to Chapter 5 (Prompt Design and Evaluation) and governance to Agents Part III.

### Operational Metrics

- SHACL violations per release; time-to-fix; coverage of required fields.
- SPARQL latency/availability; cache hit rates; change impact reports.
- Reviewer acceptance rates for LLM-suggested changes.