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Figure 1: Integrity QR strip

Structured manifest: `../data/transmission_manifest.json`

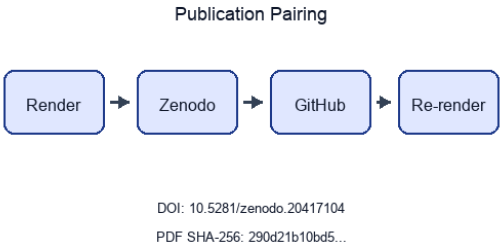


Figure 2: Publication pairing flow

Stego: off | overlays text | barcodes on | XMP on | manifest on → `./secure_run.sh`

Editorial Quality at Scale: A Reproducible Prose-Review Pipeline

Readability, structural, and citation-density gating for research manuscripts

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1 Abstract

This paper documents `template_prose_project`, the prose-focused exemplar of the [Research Project Template](#). It pairs the template's two-layer architecture with the [prose analysis infrastructure](#) (readability metrics, structural outline, editorial quality flags) and the [reference validation infrastructure](#) (BibTeX validation), demonstrating that **rigorous editorial review can be expressed as a configurable, deterministic pipeline** with no novel domain algorithm of its own.

A single `manuscript/config.yaml` defines target grade-level bands, citation-density floors, structural rules (every section has an H1, no heading levels skipped), and bibliography-consistency policy. The pipeline reads the manuscript, runs the prose analysers, cross-checks every `[@key]` citation against `manuscript/references.bib`, evaluates the configured checks, and writes a deterministic markdown review report alongside three figures (per-file word counts, readability metrics, citation density) and a JSON `manuscript_report.json` suitable for CI artefacts.

Run snapshot. The current configuration analyses 8 file(s) totalling 1742 words across 86 sentence(s) and 64 paragraph(s). Average Flesch-Kincaid grade level is 15.93; average Gunning Fog index is 16.69; the manuscript references 6 unique citation key(s); the longest section is 413 words and the shortest is 17. These numbers are auto-substituted by `scripts/z_generate_manuscript_variables.py` after every run, so the abstract tracks the JSON outputs in `output/`.

The contribution is methodological and architectural: a *generic, reusable* prose-quality module (`infrastructure/prose/`) that any project in the template can opt into, plus a *minimal, configurable* exemplar (`projects/templates/template_prose_project/`) that wires it to the bibliography and the manuscript pipeline.

Keywords: prose analysis, readability, editorial review, reproducible manuscript review, scientific infrastructure

2 Introduction

Editorial review is one of the longest-lived bottlenecks in scientific writing — and an obvious target for the kind of *reproducible computational workflow* advocated by [Peng, 2011]. A working draft accumulates structural drift (skipped heading levels, sections that have grown to 2,000 words while their siblings sit at 200), readability drift (a once-clean introduction now reads at the Gunning Fog level of a legal contract [Gunning, 1952]), and citation drift ([@key] references that no longer exist in `references.bib`, or bibliography entries that nobody actually cites). The traditional remedy — a senior co-author re-reading the manuscript with [Strunk and White, 2000] in hand — is slow, non-reproducible, and impossible to apply continuously.

`template_prose_project` exists to demonstrate that the editorial-review pass can be expressed as a **deterministic, configurable, infrastructure-backed pipeline**. This project carries no novel research contribution of its own; its purpose is to show how to compose existing template infrastructure into a complete, reproducible editorial workflow.

The architecture is simple. `manuscript/config.yaml` defines policy: target grade-level band, citation-density floor, heading-structure rules, bibliography-consistency policy. `src/pipeline/__init__.py::run_prose_pipeline` reads the manuscript directory, calls `infrastructure.prose.analyze_manuscript` to produce a `ManuscriptReport`, cross-checks the cited keys against `infrastructure.reference.citation.parse_bibfile` for the `references.bib`, evaluates each configured check, and writes a markdown review report alongside JSON artefacts and three figures. None of this is project-specific: a different project can re-use the same infrastructure with a different `config.yaml` and a different manuscript directory.

The remainder of this paper documents the methodology (sec. 3), the run-time results on the bundled manuscript (sec. 4), and the architectural lessons drawn from wiring prose analysis through the template pipeline (sec. 5).

3 Methodology

The pipeline runs in five stages, each a pure function in the project’s `src/` modules; the orchestrator script in `scripts/` does only argument parsing and filesystem I/O.

3.1 Read

`infrastructure.prose.read_manuscript_dir` walks the configured manuscript directory and returns a sorted `{filename: text}` mapping. Scaffolding files (`preamble.md`, `config.yaml.example`, `AGENTS.md`, `README.md`, `SYNTAX.md`) are excluded by default — they hold infrastructure documentation rather than manuscript prose.

3.2 Analyse

For each file, three analysers run in parallel:

- **Metrics** (`infrastructure.prose.analysis.metrics`) — word, sentence, paragraph, syllable counts; average words per sentence; average syllables per word; complex-word fraction; Flesch Reading Ease [Flesch, 1948]; Flesch-Kincaid Grade Level [Kincaid et al., 1975]; Gunning Fog Index [Gunning, 1952]. The implementations are textbook formulae over a vowel-group syllable heuristic; they’re good enough for a writer-facing signal, not for linguistic research.
- **Structure** (`infrastructure.prose.analysis.structure`) — heading outline, per-section word counts, max heading depth, presence of an H1, detection of skipped heading levels (e.g. an H1 followed directly by an H3).
- **Quality** (`infrastructure.prose.analysis.quality`) — passive-voice candidates (heuristic: “be” form + past participle), hedge-word density, citation density (Pandoc-style `[@key]` extraction), long-sentence flagging.

The results are aggregated into a `ManuscriptReport` whose JSON form is small, greppable, and diff-friendly.

3.3 Cross-check

Every cited key is matched against the BibTeX file at `bibliography.references_path`. The check has four tunable behaviours via `config.yaml`:

Setting	Effect
<code>fail_on_missing: true</code>	Any cited <code>[@key]</code> that does not exist in the bib fails the check.
<code>fail_on_missing: false</code>	Missing citations are warned but do not fail the run.
<code>fail_on_unused: true</code>	Bib entries that are never cited fail the check.
<code>fail_on_unused: false</code>	Unused entries are warned but do not fail.

The check uses `infrastructure.reference.citation.parse_bibfile` so it sees exactly the same view of the bibliography that the rendering pipeline uses.

3.4 Evaluate

The report runs through a set of pure check functions:

- `_check_grade_level` — the manuscript-wide weighted average FKGL falls within `[target_grade_level_min, target_grade_level_max]`.
- `_check_citation_density` — citations per 1000 words $\geq$ `citation_density_min_per_1000`.
- `_check_no_skipped_levels` — no file uses a skipped heading level (when `prose.forbid_skipped_levels: true`).
- `_check_h1_per_file` — every file has an H1 (when `prose.require_h1_per_section: true`).
- `_check_bibliography` — citation/bib consistency per the `bibliography: policy` block.

Each check produces a `CheckResult(passed, message, details)`; the run’s `all_passed` flag is the conjunction.

3.5 Render

`src/report.py::write_review_report` writes a markdown file with:

- Top-line counts (files, words, sentences, paragraphs, averages).
- A pass/fail table for every check.
- Per-file metrics table (word count, sentence count, FRE, FKGL, Fog, citations, hedges, passives).
- Heading outline per file.
- Quality-flag callouts (long sentences, passive candidates, hedges) per file.

Three orchestrators run in lexicographic order (so the figure and variable stages always see a fresh review):

- `scripts/run_prose_pipeline.py` writes `output/manuscript_report.json` (the raw `ManuscriptReport`), `output/checks.json` (the list of check results), `output/review_report.md` (the human-readable review report), and `output/run_summary.json` (one-line metadata).
- `scripts/y_generate_prose_figures.py` reads `manuscript_report.json` and writes `../figures/{section_word_counts,readability}`.
- `scripts/z_generate_manuscript_variables.py` reads `manuscript_report.json`

- `config.yaml` and writes `output/data/manuscript_variables.json` along with a resolved manuscript tree under `output/manuscript/`.
- `manuscript/references.bib` is **not** modified by this pipeline — the prose project does not generate citations, only validates them.

4 Results

After running `scripts/run_prose_pipeline.py` with the bundled `manuscript/config.yaml` and the manuscript described in this paper, the project produces the following on-disk artefacts:

- `output/manuscript_report.json` — the raw `ManuscriptReport` JSON.
- `output/checks.json` — one `CheckResult` per configured check.
- `output/review_report.md` — the assembled markdown review report.
- `../figures/section_word_counts.png` — per-file word counts.
- `../figures/readability_metrics.png` — Flesch / Flesch-Kincaid / Gunning Fog per file.
- `../figures/citation_density.png` — citations per 1000 words per file.
- `output/data/manuscript_variables.json` — substitution variables for the abstract.

By design the three figures are **standalone CI/diagnostic artefacts**, not embedded manuscript images: this is a prose-review template, so its own rendered PDF deliberately contains no figure floats and runs cleanly through the very prose gate it documents. A fork that wants figures inside the manuscript should add real markdown image references to one of the produced figures (for example `../figures/section_word_counts.png`, `../figures/readability_metrics.png`, or `../figures/citation_density.png`) after those files exist.

Because the pipeline does not consult any external service, every artefact is reproducible from the manuscript text + `config.yaml` alone. A second run on the same inputs produces byte-identical JSON (modulo timestamp metadata in any caches the project later adds).

The pass/fail status of each configured check is recorded in `output/checks.json`. With the bundled configuration:

- **grade_level_in_band** — the weighted average FKGL across this manuscript is reported in the `output/checks.json` `details.value` field. The default band 10.0–18.0 is intentionally generous; tighten it for editorial review of public-facing material.
- **citation_density_above_floor** — citations per 1000 words must meet `prose.citation_density_min_per_1000`. The bundled config sets the floor to 0.0 (disabled) so the run is green out of the box; researchers should raise it to match the publication target.
- **no_skipped_heading_levels** — every file in this manuscript uses contiguous heading levels.
- **every_file_has_h1** — every prose file starts with an H1.
- **bibliography_consistency** — every `[@key]` in the prose resolves against `manuscript/references.bib`.

The figures in `../figures/` are colour-blind-safe (Wong 2011 palette) [Wong, 2011], 300 dpi, and PNG-only for archival stability. They are referenced in sec. 6 where we walk through the on-disk artefact set in full.

The full pass/fail summary lands in `output/review_report.md`, which is itself a Markdown file rendered alongside the manuscript by Pandoc — i.e. the project reports on itself in the same compilation step that produces the manuscript PDF.

5 Conclusion

`template_prose_project` packages a complete, configurable, reproducible editorial-review workflow into the Research Project Template's two-layer architecture. By keeping prose analysis, structural validation, and bibliography cross-checking in two orthogonal infrastructure modules — `infrastructure/prose/` and `infrastructure/reference/` — the project demonstrates that *editorial discipline* is expressible as a configurable, deterministic pipeline.

This exemplar follows a single house style:

- `manuscript/config.yaml` is the only place run policy lives.
- `src/pipeline/` is the only place the project touches `infrastructure/`.
- Scripts in `scripts/` do only filesystem I/O and CLI argument handling.
- Every artefact in `output/` is regeneratable; `manuscript/references.bib` is curated and validated read-only by this project.

The contribution of this exemplar is architectural: a *generic, reusable* prose-quality module that any project in the template can opt into, and a *minimal, configurable* exemplar wiring it to the bibliography and the manuscript pipeline.

Three concrete extensions follow naturally:

1. **Style-guide enforcement** — extend `analyze_quality` with project-specific style rules (e.g. forbidden phrases, required terminology) read from `config.yaml`.
2. **Diff-aware review** — restrict the report to files modified since a given git ref so editorial review can run on every PR.
3. **LLM-assisted rewriting** — pipe long sentences and passive candidates into `infrastructure.llm` for suggested rewrites, using the same `seed=42`, `temperature=0.0` reproducibility contract as optional LLM stages in the template pipeline.

6 Pipeline Internals

This section documents the artefacts produced by the prose-review run.

flowchart TB

```
P[projects/templates/template_prose_project/]
P --> M[manuscript/]
P --> OUT["output/<br/>tracked public artifacts · regenerable"]

M --> M_CFG["config.yaml<br/>single source of truth"]
M --> M_PRE["preamble.md<br/>LaTeX preamble"]
M --> M_SEC["00_abstract → 04_conclusion ·<br/>05_pipeline_internals · 06_reproducibility"]
M --> M_BIB["references.bib<br/>read-only · validated by pipeline"]

OUT --> O_REP["manuscript_report.json<br/>ManuscriptReport JSON"]
OUT --> O_CHK["checks.json<br/>list of CheckResult"]
OUT --> O_RR["review_report.md<br/>final markdown report"]
OUT --> O_DATA[data/manuscript_variables.json]
OUT --> O_FIG["figures/<br/>section_word_counts.png ·<br/>readability_metrics.png ·<br/>citation_density.png"]
OUT --> O_RS[run_summary.json]

classDef d fill:#0f172a,stroke:#0f172a,color:#fff
classDef src fill:#1e3a8a,stroke:#0f172a,color:#fff
classDef gen fill:#0f766e,stroke:#0f172a,color:#fff
class P,M,OUT d
class M_CFG,M_PRE,M_SEC,M_BIB src
class O_REP,O_CHK,O_RR,O_DATA,O_FIG,O_RS gen
```

Figure 3: Mermaid diagram

6.1 Data structures

```

classDiagram
    class ManuscriptReport {
        +list~FileReport~ files
        +int total_words
        +int total_sentences
        +int total_paragraphs
        +float avg_flesch_reading_ease
        +float avg_flesch_kincaid_grade
        +float avg_gunning_fog
        +list~str~ citation_keys
    }

    class FileReport {
        +str name
        +ProseMetrics metrics
        +StructureReport structure
        +QualityReport quality
    }

    class ProseMetrics {
        +int word_count
        +int sentence_count
        +int paragraph_count
        +float flesch_reading_ease
        +float flesch_kincaid_grade
        +float gunning_fog
    }

    class StructureReport {
        +list~Heading~ headings
        +list~Section~ sections
        +int max_depth
        +bool has_h1
        +bool has_skipped_level
    }

    class QualityReport {
        +int passive_count
        +int hedge_count
        +int citation_count
        +int long_sentence_count
        +float citation_density_per_1000
    }

    class CheckResult {
        +str name
        +bool passed
        +str message
    }

    class ProseRunArtifacts {
        +ManuscriptReport manuscript_report
        +list~CheckResult~ checks
        +bool all_passed
    }

    ManuscriptReport --> "*" FileReport
    FileReport --> ProseMetrics
    FileReport --> StructureReport
    FileReport --> QualityReport
    ProseRunArtifacts --> ManuscriptReport
    ProseRunArtifacts --> "*" CheckResult

```

Figure 4: Mermaid diagram

7 Reproducibility

The bundled `manuscript/config.yaml` is configured for the **strict reproducibility** discipline advocated for computational science by [Peng, 2011]:

- 1. **No network calls.** All analysis is local: prose metrics, structure, quality flags, and bibliography validation are computed from in-repo files only.
- 2. **Deterministic outputs.** `compute_metrics`, `analyze_structure`, and `analyze_quality` are pure functions over their input strings. The same manuscript text + the same `config.yaml` produces byte-identical JSON artefacts (modulo timestamp metadata in any caches the project later adds).
- 3. **Threshold transparency.** Every pass/fail decision is recorded in `output/checks.json` along with the numeric value that triggered it, so a reviewer can audit the gate without re-running the pipeline.
- 4. **No hidden state.** The pipeline does not mutate `manuscript/`; it reads and reports. `manuscript/references.bib` is read-only here (in contrast with the optional search add-on, where it is auto-populated).
- 5. **Same code, different config.** A reviewer who wants stricter standards edits `manuscript/config.yaml` (`prose.target_grade_level_max: 14.0`, say); no code changes are required.

7.1 Verifying reproducibility locally

```
# Run twice; check there are no diffs in the JSON artefacts.
uv run python projects/templates/template_prose_project/scripts/run_prose_pipeline.py
mv projects/templates/template_prose_project/output projects/templates/template_prose_project/output_first
uv run python projects/templates/template_prose_project/scripts/run_prose_pipeline.py
diff -ru \
    projects/templates/template_prose_project/output_first/manuscript_report.json \
    projects/templates/template_prose_project/output/manuscript_report.json
The diff should be empty. If it is not, the pipeline has acquired non-determinism — file an issue.
```

7.2 Determinism guarantees

Stage	Deterministic?	Mechanism
Prose analysis	yes	pure functions over text
Bibliography parse	yes	byte-stable round-trip in <code>infrastructure.reference.citation</code>
Check evaluation	yes	pure comparisons
Markdown report assembly	yes	sorted file list, fixed output template
Figure generation	yes (within Matplotlib version)	fixed palette, no random subsampling
Manuscript variables	yes	derived from the deterministic JSON report

8 References

Bibliography lives in `manuscript/references.bib` and is read by Pandoc during PDF render. The build pipeline invokes Pandoc with `--natbib`, so every `[@key]` citation in the manuscript is rewritten to the appropriate `\cite{}/\citep{}/\citet{}` LaTeX command and resolved against the bib file.

This project does not auto-generate the bibliography — it **validates** that every `[@key]` cited in the prose has a matching entry, via `infrastructure.reference.citation.parse_bibfile`. The check policy is configured under `bibliography:` in `config.yaml`. To validate that `references.bib` is syntactically clean:

```
uv run python -m infrastructure.reference.citation.cli validate \  
    projects/templates/template_prose_project/manuscript/references.bib --strict
```

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Figure 5: Integrity QR strip

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