



Patterns and Anti-Patterns

Best Practices for Requirements Traceability with RTMX

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Introduction

This guide defines recommended patterns and anti-patterns for working with RTMX. Following these patterns ensures requirements remain traceable, verifiable, and trustworthy.

Whether you're a developer integrating RTMX into your workflow, a team lead establishing processes, or an AI agent working in an RTMX-enabled project, these patterns will help you get the most value from requirements traceability.

CANONICAL SOURCE

This whitepaper expands on the patterns defined in `docs/patterns.md` in the RTMX repository. That file serves as the single source of truth and is designed for insertion into project CLAUDE.md files.

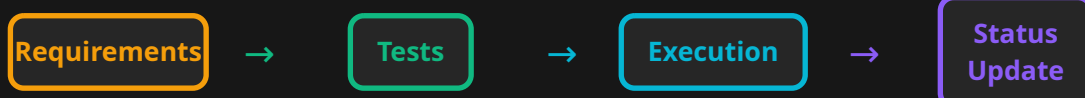
Core Principle: Closed-Loop Verification

RTMX is built on a fundamental principle:

Requirement status must be derived from evidence, not opinion.

This is **closed-loop verification**: tests determine status, and status flows back to inform what needs work.

CLOSED-LOOP VERIFICATION



↻ Status flows back to inform requirements

Status reflects reality. Tests are the arbiter of truth.

Why Closed-Loop Matters

When status is derived from tests:

- **Releases are trustworthy** — 100% complete means all tests pass
- **Regressions are detected** — Failed tests automatically downgrade status
- **AI agents can't lie** — They can't claim completion without passing tests
- **Progress is auditable** — Git history shows exactly what changed and when

Verification Patterns

Pattern: Automated Status Updates

PATTERN

Use `rtmx verify --update` to derive status from test results

ANTI-PATTERN

Manually editing the `status` field in `rtm_database.csv`

The `verify` command is the core of RTMX:

```
bash

# In CI/CD pipeline
rtmx verify --update

# Local development (preview first)
rtmx verify --dry-run
rtmx verify --update
```

How It Works

1. Runs all tests with `@pytest.mark.req()` markers

2. Maps test outcomes to requirements
3. Updates status based on pass/fail results

| Test Result | Status Transition |
|----------------------|---------------------------------|
| All pass | → COMPLETE |
| Some pass, none fail | → PARTIAL |
| Any fail | COMPLETE → PARTIAL (regression) |
| No tests | Status unchanged |

KEY INSIGHT

Status reflects what the code **actually does**, not what someone **hopes** it does.

Anti-Pattern: Manual Status Edits

NEVER DO THIS

Manually editing the `status` field breaks the verification loop and makes the RTM untrustworthy.

Symptoms of this anti-pattern:

- Status says COMPLETE but tests fail
- No test coverage for “complete” requirements
- Status changes without corresponding code changes
- Requirements marked complete before implementation

Why it's harmful: Manual status updates transform the RTM from a verification record into a wish list. When you can't trust status, you can't trust release readiness.

Pattern: Test-Linked Requirements

Every requirement should have at least one test with `@pytest.mark.req()`:

```
python

@pytest.mark.req("REQ-AUTH-001")
@pytest.mark.scope_unit
```

```
@pytest.mark.technique_nominal
@pytest.mark.env_simulation
def test_user_can_login():
    """Verify REQ-AUTH-001: User can log in."""
    user = create_test_user()
    result = login(user.email, user.password)
    assert result.success
    assert result.session_token is not None
```

Sync test metadata to the RTM:

```
bash
rtmx from-tests --update
```

This populates `test_module` and `test_function` columns, creating **bidirectional traceability**.

Anti-Pattern: Orphan Tests

PATTERN

Add `@pytest.mark.req()` to every test

ANTI-PATTERN

Write tests without requirement markers

Detection:

```
bash
rtmx from-tests --missing # Shows unlinked tests
```

Orphan tests provide no evidence for requirement completion. They may test important functionality, but that functionality isn't tracked.

Development Workflow Patterns

Pattern: Spec-First Development

Write the requirement specification **before** writing code:

| Step | Action |
|------|---------------------------------------|
| 1 | Define requirement in RTM database |
| 2 | Create specification file |
| 3 | Write acceptance criteria |
| 4 | Write failing tests |
| 5 | Implement to pass tests |
| 6 | Run <code>rtmx verify --update</code> |

Anti-Pattern: Code-First, Spec-Never

PATTERN

Define requirement → Write spec →
Write test → Implement → Verify

ANTI-PATTERN

Write code → Maybe write tests →
Never create requirement

Features without requirements can't be verified, prioritized, or traced. When asked "what does the system do?", the answer becomes "read the code."

Pattern: Phase Gates in CI

Block releases until phase requirements are verified:

```
yaml
# .github/workflows/release.yml
- name: Verify Phase Requirements
  run: |
    rtmx verify --update
    rtmx status --json | jq -e '.phases["1"].complete == true'
```

Anti-Pattern: Phase as Suggestion

DON'T SKIP PHASE GATES

Releasing with incomplete phases means shipping unverified functionality. Phases exist to ensure quality gates, not as optional guidance.

Agent Integration Patterns

Pattern: Agent as Implementer, RTMX as Verifier

AGENT WORKFLOW

- 1 Read specification** docs/requirements/CATEGORY/REQ-XXX.md
- 2 Write tests** `@pytest.mark.req("REQ-XXX")`
- 3 Implement code** Pass the tests
- 4 Run verification** `rtmx verify -update`
- 5 Commit changes** Status already updated by verification

The key insight: agents **implement**, RTMX **verifies**. Agents never determine status—tests do.

Anti-Pattern: Agent Status Claims

PATTERN

```
subprocess.run(["rtmx", "verify", "--update"])
```

Evidence-based status from tests

ANTI-PATTERN

```
db.update("REQ-XXX", status=Status.COMPLETE)
```

Opinion-based status claim

Agent opinions about completion are unreliable. Tests may not exist, may fail, or may not cover the requirement. Only `rtmx verify` provides evidence-based status.

Pattern: RTM as Development Contract

Agents should read the RTM to understand what to build:

```
bash

# Discover next task
rtmx backlog --phase 2 --limit 1

# Read specification
cat docs/requirements/CATEGORY/REQ-XXX.md

# Check dependencies
rtmx deps --req REQ-XXX

# Implement, then verify
rtmx verify --update
```

The RTM provides:

- **What to build** — requirement text
- **How to verify** — linked tests
- **What's blocking** — dependencies
- **Priority order** — phase, priority

Anti-Pattern: Ignoring Dependencies

WARNING

Implementing requirements before their dependencies are complete often requires rework. Check `blockedBy` fields before starting work.

CI/CD Patterns

Pattern: Verify on Every PR

```
yaml
# .github/workflows/ci.yml
jobs:
  verify:
    runs-on: ubuntu-latest
    steps:
      - uses: actions/checkout@v4
      - name: Install RTMX
        run: pip install rtmx
      - name: Verify Requirements
        run: rtmx verify --update
      - name: Check for Regressions
        run: |
          git diff --exit-code docs/rtm_database.csv || \
            echo "::warning::RTM status changed"
```

Pattern: RTM Diff in PRs

Show requirement status changes in pull requests:

```
yaml
- name: RTM Diff
  run: |
    git fetch origin main
    rtmx diff origin/main HEAD --format markdown >> $GITHUB_STEP_SUMMARY
```

This surfaces new requirements, completions, and regressions.

Quick Reference

Commands

| Command | Purpose | When |
|---------|---------|------|
|---------|---------|------|

| | | |
|---------------------------------------|--------------------------|----------------------|
| <code>rtmx verify --dry-run</code> | Preview status changes | Before updating |
| <code>rtmx verify --update</code> | Update status from tests | After implementation |
| <code>rtmx from-tests --update</code> | Sync test metadata | After adding tests |
| <code>rtmx health</code> | Validate RTM integrity | Before releases |

Status Sources

| Source | Trustworthy? | Notes |
|-----------------------------------|--------------|------------------------|
| <code>rtmx verify --update</code> | Yes | Evidence-based |
| Manual CSV edit | No | Opinion-based |
| Agent claim | No | Unverified |
| CI pipeline | Yes | Automated verification |

Verification Checklist

Before claiming a requirement is complete:

- Test exists with `@pytest.mark.req("REQ-XXX")`
- Test passes locally
- `rtmx verify --update` shows COMPLETE
- CI pipeline passes
- Specification acceptance criteria met

Summary

| Do This (Pattern) | Not This (Anti-Pattern) |
|--|-------------------------|
| <code>rtmx verify --update</code> | Manual status edits |
| <code>@pytest.mark.req()</code> on all tests | Orphan tests |

| | |
|---------------------------------|-------------------------|
| Spec-first development | Code-first, spec-never |
| Phase gates in CI | Phase as suggestion |
| Agent implements, RTMX verifies | Agent claims completion |
| Respect dependencies | Ignore blockedBy |

REMEMBER

The RTM is a **verification record**, not a wish list.
Status must be **earned** through passing tests, not **claimed** through manual edits.

For more information, visit rtmx.ai
Questions? Contact dev@rtmx.ai