EXPERIMENT REPORT

The AI Engineering Experiment

A Technical Deep Dive into Agentic Software Development

AUTHOR	METHOD	LLM MODEL
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Executive Summary: The 1000€ Bet

Can a single engineer, leveraging an agentic AI system, replicate the output of a full development team in a fraction of the time? The constraints were strict.

10	20	65k	470
DAYS DURATION	TOTAL WORK HOURS	TOTAL LINES OUTPUT	GIT COMMITS

✓ **Result: Production-ready software, not a prototype.**

The Enemy: "Vibe Coding"

The Definition

Vibe coding is the standard interaction mode with current LLMs:

- ✗ **Non-deterministic:** Different results every time.
- ✗ **Non-repeatable:** Cannot be automated or scaled.
- ✗ **Unmaintainable:** "Spaghetti code" that works only once.

The Goal

Move from stochastic generation to deterministic engineering.

We need a repeatable process where the code is a side-effect of a structured thought process.

The Hypothesis

🧪Scientific Method

If we treat AI as an **agent** rather than a **chatbot**, we can enforce:

- Strict architectural patterns
- Test-Driven Development (TDD)
- Documentation-first methodology

⚖️Control Theory

By implementing a **Supervisor-Worker** model:

- High-level logic is separated from implementation details.
- Context drift is minimized by scoping tasks.
- Validation loops catch hallucinations early.

Methodology: The "Triangle of Truth"

Code is NOT the Documentation

The core failing of most AI projects is relying on the code to be the single source of truth. We inverted this.

`1. Documentation`

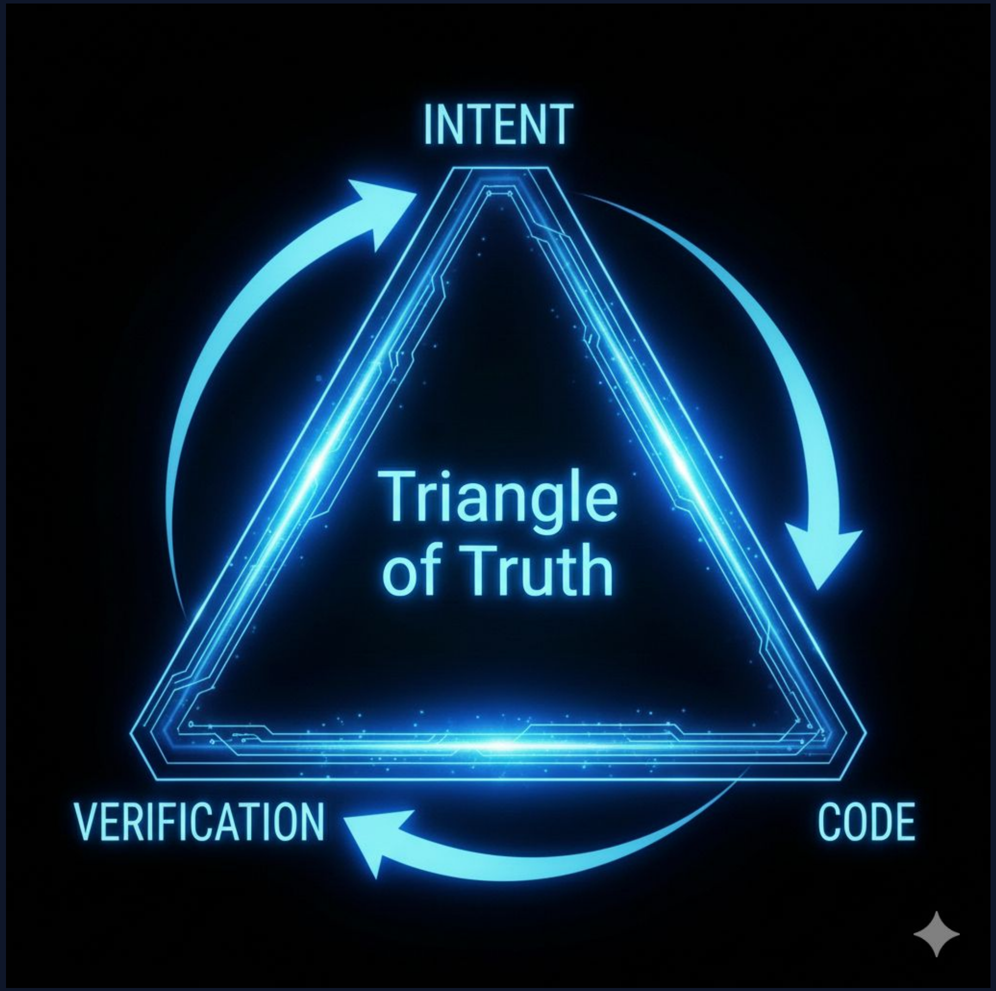
The "Why" and "What". The intent must exist before the code.

`2. Validation`

Tests define the boundary conditions of success.

`3. Structure`

Architecture and patterns allow for the necessary abstraction.



The Orchestrator: OpenCode

Why OpenCode? In an ecosystem of proprietary "Magic Boxes" (Cursor, GitHub Copilot), OpenCode offers strict control:

Model Agnostic
Swap between OpenAI, Anthropic, or Local LLMs without changing the toolchain.

No Vendor Lock-in
Open Source community driven. The process defines the success, not the tool.

Agentic Control
Allows defining custom "Tools", "Skills" and “Agents” that the AI can execute autonomously.

The Agents

OpenCode is process agnostic. Bring-You-Own-Agent is the core philosophy

The Agents to model the process being used in this experiment
had to be developed first.
They have been developed within a few hours using the only two
build-in agents of OpenCode (plan and build).

Phase 1: The Planning Chain

We do not start coding. We start thinking. A chain of specialized agents transforms abstract ideas into concrete tasks.

Idea Agent

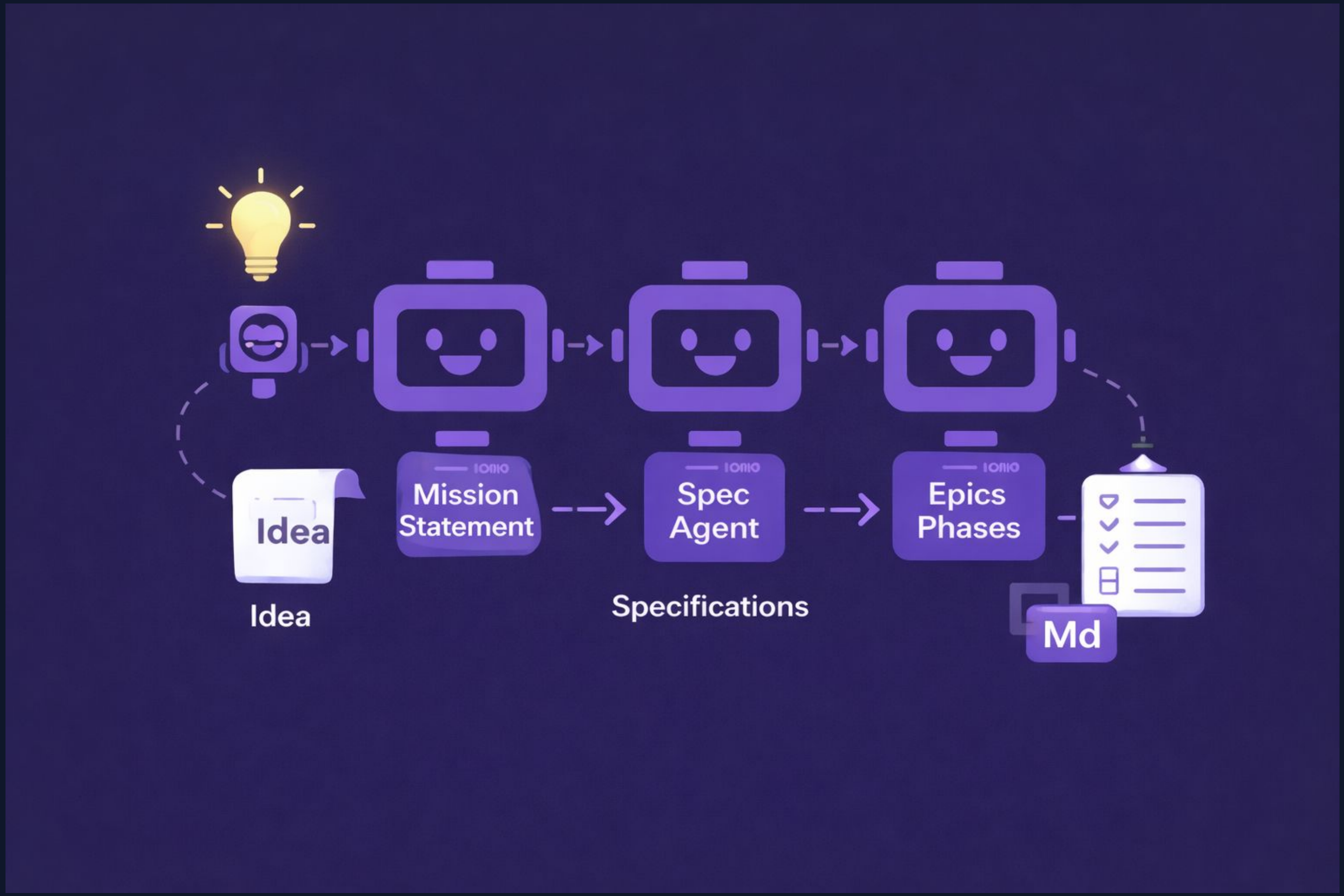
Input: Rough notes.
Output: **Mission Statement**.

Spec Agent

Input: Mission Statement.
Output: **Technical Specifications**.

Epic Agent

Input: Specs.
Output: **Epics & Phases (Markdown)**.



Deep Dive: The Specification Agent

Why it matters

LLMs are notoriously bad at implicit constraints. The Spec Agent forces **Acceptance Criteria** to be explicit.

Instead of "Make it fast", the spec becomes:

```
- Must render 1000 rows in < 100ms
- Must support offline mode
- Must pass WCAG 2.1 AA
```

Artifact Generation

All output is saved to the **thoughts/** directory.

thoughts/shared/mission.md
thoughts/shared/specs.md
thoughts/shared/epics/*.md

* This creates a permanent context memory for future agents.

Phase 2: The Implementation Loop

A recursive cycle executed for each Phase of an Epic.

Research
Find libraries, patterns & existing code.

Plan
Create step-by-step implementation plan.

Implement
Execute plan via sub-agents.

Validate
Run tests & static analysis.

Agent Hierarchy: The Manager Layer

The "Managers" hold the high-level context and delegate actual work. They do not write code directly.

The Planner

Takes an Epic + Research inputs. Outputs a detailed, step-by-step plan.md.

Implementation Controller

Reads the plan. Instantiates "Task Executor" sub-agents for each step. Monitors progress.

QA Planner

Analyzes output from QA agents. Creates a "fix-it" plan for the Controller.

Agent Hierarchy: The Worker Layer

The Researcher

Specialized in information retrieval. It does NOT hallucinate code; it finds facts.

- Scouts internet for library documentation.
- Identifies patterns in existing project codebase.
- Finds root causes for test failures.

QA Agents

Language-specific quality assurance. They act as the "Bad Cop".

- Run linters and static analysis.
- Execute test suites.
- Check for "Code Smells" and structural weakness.

Sub-Agents: The Specialists

Task Executor

The "Hands". Edits files, runs shell commands. Extremely short lifespan.

Codebase Locator

The "Cartographer". Maps file structures to find relevant context.

Codebase Analyzer

Follows data paths and execution flows to understand impact of changes.

Pattern Finder

Ensures new code matches the style of existing code.

Why separate them? To prevent Context Pollution.

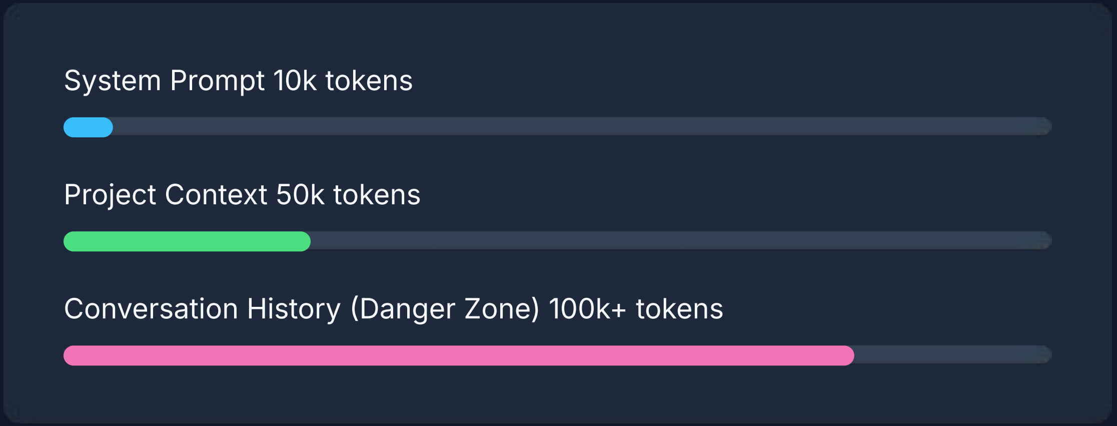
The Context Challenge

The Token Limit Reality

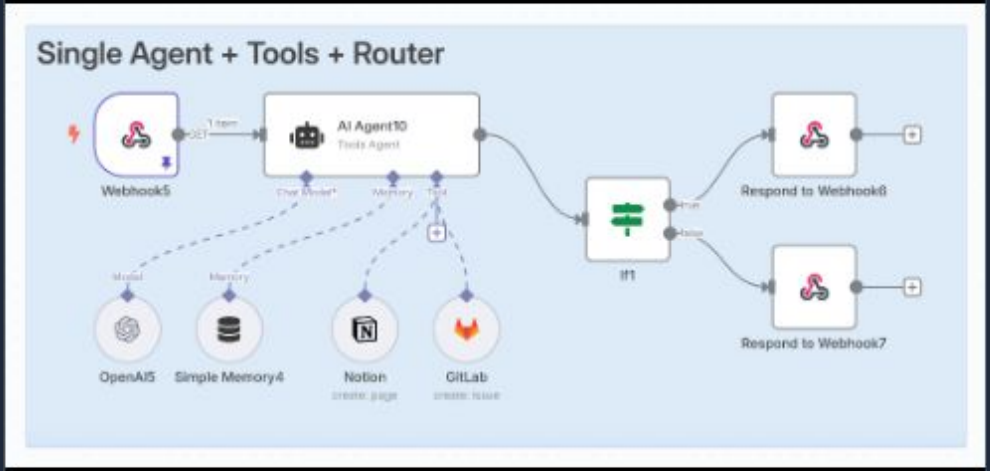
Even with Claude Sonnet 4.5's **200k context window**, usability degrades after ~40% usage.

Symptoms of Drift:

- Forgetting earlier instructions.
- Hallucinating files that don't exist.
- Lazy coding (implementing placeholders).



Strategy 1: Sub-Agent Delegation



Ephemeral Intelligence

Instead of one long conversation, we spawn ephemeral sub-agents.

1. **Primary Agent** defines a specific, isolated task.
2. **Sub-Agent** is spawned with MINIMAL context (only what's needed).
3. **Sub-Agent** performs the task (thinking, searching, coding).
4. **Sub-Agent** returns the *result* only.
5. **Sub-Agent** dies (discarding its internal thought process tokens).

Result: Primary context stays clean.

Strategy 2: State File Persistence

The 30% Reset Rule
Whenever context usage hits 30%, the session is **terminated**.

How do we not lose progress?

- We do not rely on Chat History.
- We rely on **State Files** on disk.

```
# thoughts/shared/plans/epic-1-phase-2-state.md

## Current Status
- [x] Task 1: Scaffolding created
- [x] Task 2: Database migration applied
- [ ] Task 3: API Endpoint Implementation ⟵ PAUSED HERE

## Context for Next Session
- Migration file: src/db/migrations/001.ts
- Zod schema: src/types/schema.ts
```

The AI updates this file before terminating. The new session reads it to resume.

Target Architecture: Proof of Complexity

This was not a "To-Do List" tutorial app. The target was a complex, production-grade desktop application.

Frontend

React 18 • Vite 6 • Tailwind 4 • XState

Desktop Shell

Electron (Main/Renderer Process) • IPC Security

Data Layer

SQLite • Kysely (Type-safe SQL) • Dual-client setup

Artifacts: Production Code

BUSINESS LOGIC	4,800 LOC
SHARED	415 LOC
UI	3,100 LOC

Artifacts: Testing Pyramid

Strict TDD was enforced. The agent was not allowed to mark a task complete without a passing test.

UNIT TESTS	9,050 LOC
E2E (PLAYWRIGHT)	910 LOC

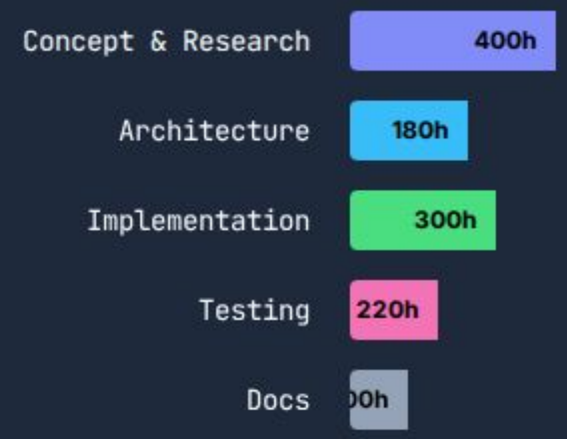
Artifacts: The "Thoughts" Directory

The hidden iceberg of the project. This folder contains the **intelligence**.

Directory	Files	Lines of Content	Purpose
thoughts/shared/plans	42	30,000	Detailed step-by-step execution guides
thoughts/shared/research	20	6,700	Knowledge gathered from web/codebase
thoughts/shared/qa	8	2,600	Bug reports and fix strategies
thoughts/shared/epics	3	1,020	High level project roadmap

⚠ **Insight:** 44,000 lines of planning vs 8,300 lines of production code. This ratio (5:1) is typical of Senior Engineering.

Human Equivalent Estimate



The 1000 Hour Estimate

Estimated by GPT-5.2 based on complexity.

- **Full-time equivalent:** 6-9 months
- **Actual Time Spent:** 20 hours
- **Efficiency Gain:** ~50x

"This project does not look like 'someone just started coding', but like clear mental models and deliberate trade-offs."

Cost Analysis

The Experiment Cost

€1,000

API COSTS (CLAUDE)

Traditional Dev Cost

€100,000+

6 MONTHS @ SENIOR RATE

Even if the API costs were 10x higher, the ROI remains orders of magnitude positive. The constraint is no longer budget, but **architectural oversight**.

Conclusion for Experts

Shift in Skillset

The role of the Senior Engineer shifts from **Syntactical Production** (typing code) to **System Orchestration** (managing agents).

Governance is King

Success depends on **Specification** and **Validation**. If you cannot describe it explicitly, the Agent cannot build it.

Image Sources

https://blog.logrocket.com/wp-content/uploads/2021/07/high-complexity-electron-app-architecture-1.png

Source: blog.logrocket.com

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