# NanoBot Platform – 2025 Post-Mortem Report

## Project Overview

Objective: Build a modular mobile robotics platform capable of stereo vision, visual odometry, and SLAM using heterogeneous compute (Raspberry Pi 5 + Jetson Orin Nano).

Outcome: Core architecture validated. Multiple systemic integration failures were identified. Most failures were related to timing, driver compatibility, and system coupling rather than application code.

## What Went Right

• Split-compute architecture successfully isolated real-time motor control from high-level perception workloads.
• Motor controller and servo offloading proved reliable.
• Low-level debugging (drivers, pipelines, timing) enabled accurate fault identification.

## What Went Wrong

Driver Fragility: Kernel and JetPack mismatches caused WiFi and camera failures.
Camera Pipeline Coupling: Monolithic GStreamer pipelines caused system-wide crashes.
Timing Assumptions: IMU and camera synchronization errors invalidated VO/SLAM outputs.
Premature Daemonization: systemd services masked root causes during development.
Documentation Lag: Repeated rediscovery of known issues increased development time.

## Root Cause Analysis

The primary root cause was unchallenged assumptions regarding driver availability, timestamp validity, and module isolation. Failures were emergent across system boundaries rather than localized to single components.

## Corrective Actions for Rebuild

• Establish timing ownership and verify synchronization electrically.
• Isolate failure domains into separate processes.
• Select hardware only with verified in-tree driver support.
• Promote code through staged deployment (CLI → script → service).
• Treat documentation as a mandatory deliverable.

## Final Assessment

The project was not a failure. It successfully exposed the real failure modes of robotics systems: drivers, timing, and integration edges. The primary value delivered was the development of

systems-level debugging and architectural judgment.