

AI-Powered Change Documentation & Approval Agent

Date: November 20, 2025

Platform: Self-Hosted n8n (Docker on Windows)

Author: Yashwanth

1. Executive Summary

This project involves the design and deployment of an automated system to streamline scope change management in construction and architecture projects. The system utilizes **n8n** (a workflow automation tool) to intercept change requests, retrieve project data, and generate formal approval documentation. This report details the successful establishment of the local hosting environment, the database architecture, and the secure integration with Google Cloud Platform services.

2. Problem Statement

In the Architecture, Engineering, and Construction (AEC) industry, scope changes are frequently communicated verbally or via informal messaging platforms. This lack of formal documentation leads to:

- **Financial Discrepancies:** Unrecorded costs for material and labor.
- **Timeline Conflicts:** Unapproved extensions to project deadlines.
- **Payment Disputes:** Lack of signed evidence for completed variations.

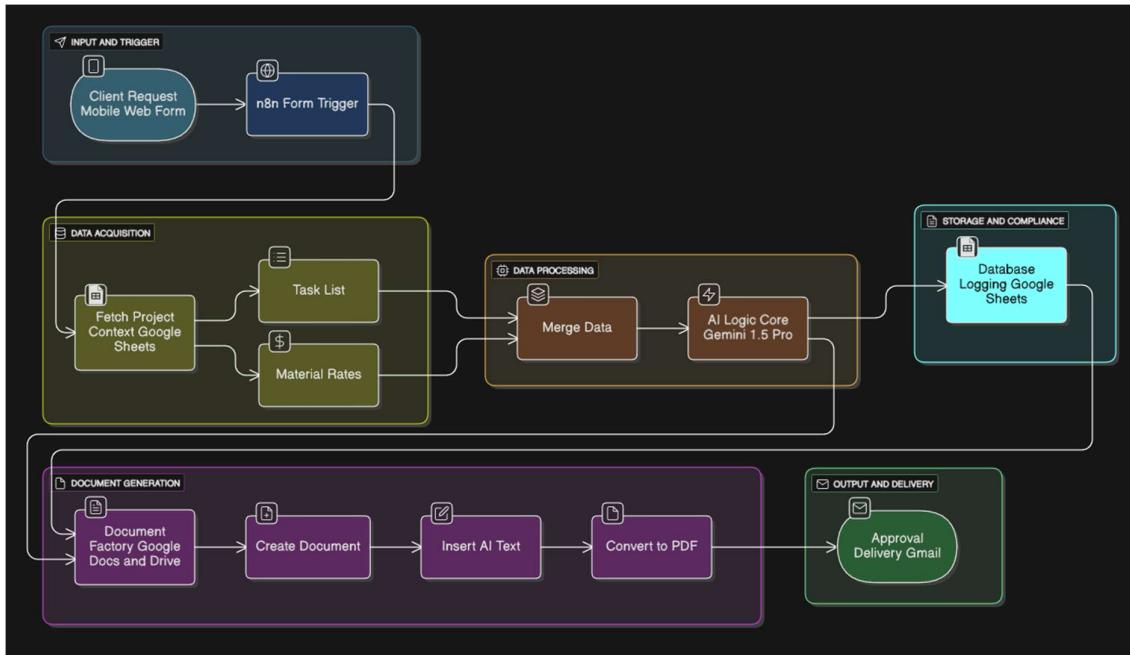
The objective is to automate the creation of "Change Orders" to ensure all modifications are financially quantified, documented, and approved before execution.

3. Technical Architecture

The system is hosted locally to ensure data privacy and control, utilizing a containerized architecture for stability.

- **Host Machine:** ASUS TUF A14 (AMD Ryzen Processor).
- **Virtualization Layer:** Windows Subsystem for Linux 2 (WSL2).
- **Containerization:** Docker Desktop for Windows.
- **Automation Engine:** n8n (Enterprise-grade workflow automation).
- **Database:** Google Sheets (Structured data storage).

- **Authentication:** Google Cloud IAM (Service Account with JSON Key).



4. Implementation Methodology

4.1. Environment Configuration

To avoid version conflicts and dependency issues common with standard Node.js installations, a containerized approach was selected.

1. **BIOS Configuration:** Virtualization (SVM Mode) was enabled in the host machine's BIOS to support the Linux subsystem.
2. **WSL2 Deployment:** The Windows Subsystem for Linux (Version 2) was installed to provide a native Linux kernel for Docker execution.
3. **Network Configuration:** Initial connectivity issues regarding DNS resolution within the container were resolved by resetting the WSL network stack and forcing a factory reset of the Docker network bridge.
4. **Docker Deployment:** The n8n instance was deployed using the following persistent configuration:
 - **Port Mapping:** 5678:5678 (Localhost access).
 - **Volume Mounting:** A dedicated Docker volume (n8n_data) was created to ensure workflow and credential data persists across system reboots.
 - **Restart Policy:** Configured to unless-stopped to ensure high availability.

4.2. Database Architecture

A structured database was created in Google Sheets to serve as the "Ground Truth" for the automation agent. The schema consists of three distinct datasets:

1. **Project_Tasks:** Contains baseline data including Task ID, Description, Original Cost, and Duration.
2. **Rates:** Acts as a lookup table for unit costs (e.g., cost per window, cost per sq. meter of tile) and delay impacts.
3. **Change_Logs:** A designated output register where the AI will record generated change orders and approval statuses.

4.3. Cloud Integration & Security

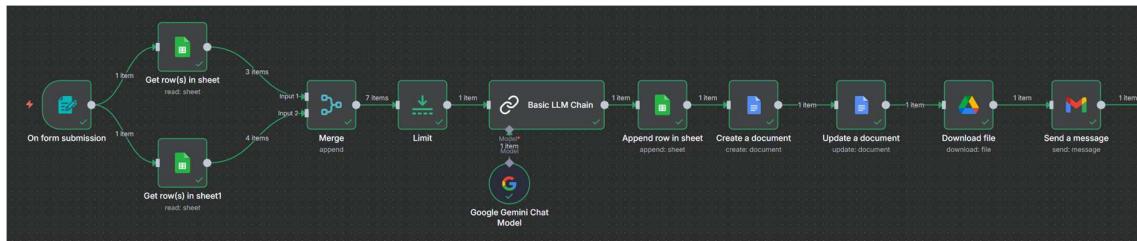
To allow the local n8n instance to interact with the cloud database securely without manual user login, a Server-to-Server authentication method was implemented.

1. **Google Cloud Project:** A dedicated project (n8n-construction-agent) was established in the Google Cloud Console.
2. **API Enablement:** The Google Sheets API was enabled for this project.
3. **Service Account Creation:** An Identity and Access Management (IAM) Service Account (n8n-bot) was created to act as a "Robot Identity."
4. **Key Generation:** A secure JSON private key was generated for this Service Account.
5. **Access Control:** The specific Google Sheet was shared with the Service Account's email address with "Editor" privileges, adhering to the Principle of Least Privilege (the robot only has access to this specific file, not the entire Google Drive).

5. Current System Status

The backend infrastructure is fully operational.

- **Connectivity:** The local Docker container successfully establishes outbound connections to the internet (verified via HTTP request probes).
- **Authentication:** n8n is successfully authenticated with Google Cloud using the Service Account credentials.
- **Data Retrieval:** The workflow is currently configured to read the Project_Tasks and Rates datasets programmatically. Tests confirm that data is being correctly fetched and parsed into JSON format within the automation environment.



6. Conclusion and Next Steps

The foundational infrastructure for the AI Change Documentation Agent is complete. The environment is stable, secure, and connected to the necessary data sources.

Immediate Next Steps:

1. **Data Merging:** Combine the "Task" data with "Rates" data to create a unified context.
2. **AI Integration:** Connect the workflow to the Large Language Model (LLM) to generate the natural language documentation.
3. **Output Generation:** Configure the system to write the final Change Order back to the database.