Al Champions Bootcamp Agent-based Analyser for Technical and Regulatory Requirements Checks

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Adapted From **Data Literacy ePrimer – Module 5**





Agent-based Analyser for Technical and Regulatory Requirements Checks

prepared by PONG Woon Wei, Senior Manager, BCA (Lead)

Problem Statement: The Problem



The construction industry still relies heavily on manual checks to verify design intent and technical drawings against building specifications and regulatory requirements (e.g., BCA, SCDF, etc.).

Stakeholders with diverse backgrounds and expertise often struggle to navigate the complex tools and requirements needed for these checks.

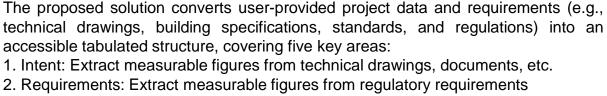
With hundreds of projects initiated annually, these inefficiencies compound, leading to time-consuming processes and impacting manpower allocation.

The key question is:

How can we simplify and automate repetitive checks, reduce noncompliance risks, and improve workflows to ease the work burden on project stakeholders?

https://launchpad.gov.sg/ideathon/8adea89f-b8bd-4015-b9b8-4ed956b7a60a/ideas/58549471-d222-41a5-aef4-ba2cd0d837d5

Proposed Solution



- 3. Checks: Compare design intent against requirements for non-compliances.
- 4. Recommend: Provide suggestions based on the most stringent requirements.
- 5. Validate: Cross-check online data for common practices and requirements.

This enables non-technical stakeholders to easily analyze and ensure project conformance. The system automates data processing and validation using Python packages, Google Gemini LLM models as AI agents assigned to tasks like extracting, parsing, comparing user-provided information, and cross-reference design intent with regulatory requirements, generate reports, validate using available online data resources, and respond to natural language queries to recommend the most stringent design criteria.

A Proof of Concept (PoC) will demonstrate the solution's feasibility using a common component, such as windows and/or doors, scalable to other components.

https://launchpad.gov.sg/ideathon/8adea89f-b8bd-4015-b9b8-4ed956b7a60a/ideas/58549471-d222-41a5-aef4-ba2cd0d837d5

Impact

This solution will streamline repetitive checks, reduce reliance on complex tools and manual processes, and mitigate non-compliance risks for project stakeholders.



With over 12,000 projects' submissions expected annually, automating design and regulatory compliance checks will significantly enhance efficiency and accuracy for regulatory bodies and industry practitioners.

Stakeholders & Users

Industry practitioners, including Qualified Persons (QPs), main contractors, suppliers, specialists, and public agency officers, will benefit from automated analysis, checks, and increased productivity in ensuring design requirements and regulatory compliance.



Available Data and Samples



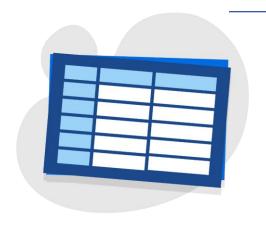
The project is using publicly available regulatory requirements, such as BCA approved documents and the SCDF Fire Code 2023, specifically focusing on Chapter 4 fire safety requirements for access openings.

These standards are essential for ensuring compliance needs for all building projects.

To better scope down the workload, the project is using a window schedule, captured as jpeg and used as practical data samples.

These sources provide a foundation for testing the automated parsing and compliance-checking capabilities of the system, helping users validate their building designs against recognized regulatory requirements efficiently.

Data Classification



Officially (Open) / non-sensitive

Lines Of Inquiry

Hypotheses and Assumptions

- **1. Al Feasibility**: The current Al models trained is able to extract, parse, clean and structure the data from PDF and image files.
- **2. Compliance Automation**: With multi-Al agents' engagement, the process can be effectively streamlined on data processing for non-compliances checks.

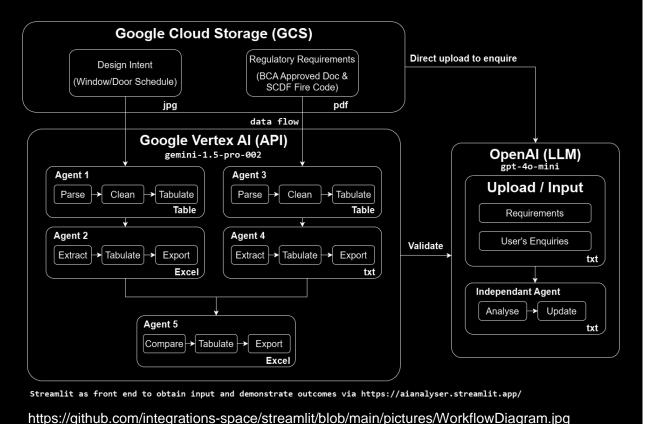
Validation Approach

- 1. **Testing & Comparison**: Using a third party Al Agent of different model to compare Al-extracted data and recommendations, and having manual checks for accuracy.
- 2. User Study & Scalability: Through completed AI Hackathons with trade association chambers, and key vendors e.g. SIA/YAL and Google TrailBlazer programme, we have gained better understanding of the users' problem statements and needs for potential AI Agentic workflow and automated solutions to be scaled.

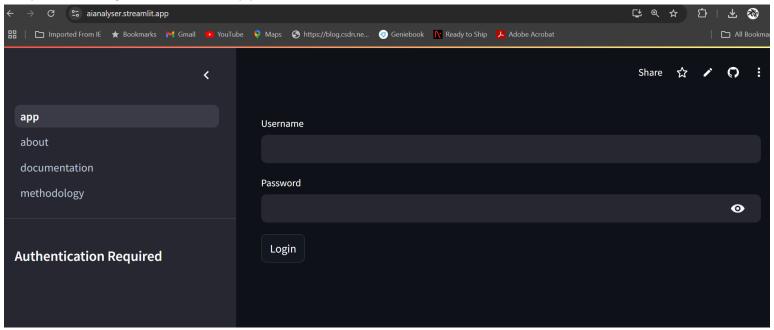


Methodology (Workflow Diagram)





https://aianalyser.streamlit.app/



Username: ants Password: abc2024

https://aianalyser.streamlit.app/

Agent-based Analyser for Technical and Regulatory Requirements Checks

Design Intent - Parse, Calculate & Tabulate

Click the button to allow:

- 1. Al Agent 1 to parse the provided window schedule drawing (in jpeg), and calculate the maximum room area using the predefined 10% ventilation requirement.
- 2. Al Agent 2 to clean, tabulate and save as Excel output for the next Al Agent to check.

Run Design Intent Parsing Script

https://aianalyser.streamlit.app/

Requirements - Parse & Compare

Click the button to allow:

- 1. Agent 3 to analyze compliance-related requirements with the provided PDF documents from Google Cloud Storage.
- 2. Agent 4 to extract and summarize key information from regulatory documents, providing structured analysis on specific requirements.

Run Requirements Parsing Script

https://aianalyser.streamlit.app/

Output - Checks and Recommend

Click the button to allow:

- Agent 5 to use the provided window schedule as design requirements to check against regulatory requirements and provide recommendations for compliance.
- 2. BCA Approved Doc & SCDF Chapter 4 are provided as default requirements for the checks and recommendations.

Run Compliance Check Script

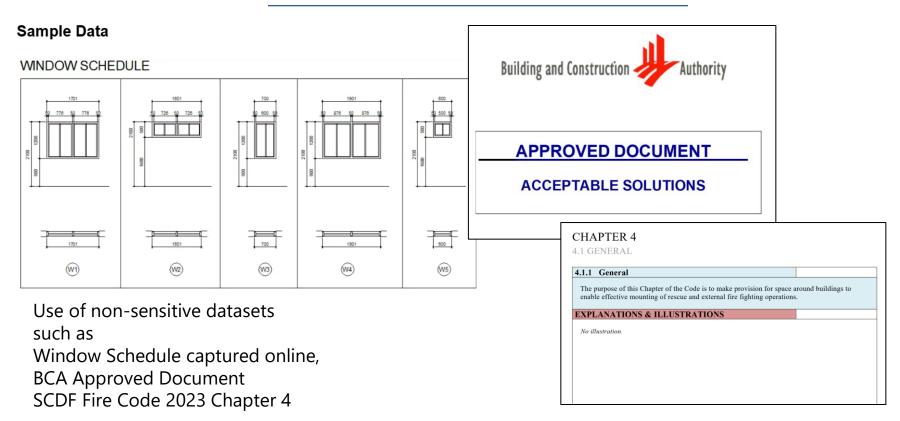
https://aianalyser.streamlit.app/

Validation - explore the use of GPT-4o-Mini Text File Parsing for topic-focused requirements

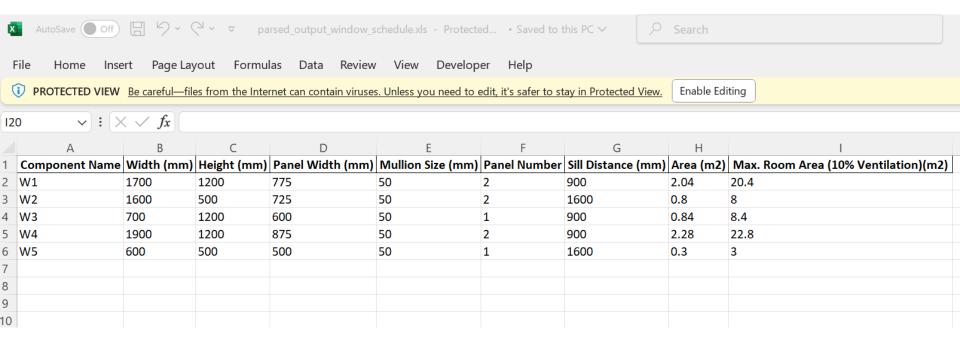
Click the link below to open the GPT-4o-Mini application for text file parsing in a new tab.

Open GPT-4o-Mini Text File Parser

Sample Data: Intent & Requirements (jpg & pdf)

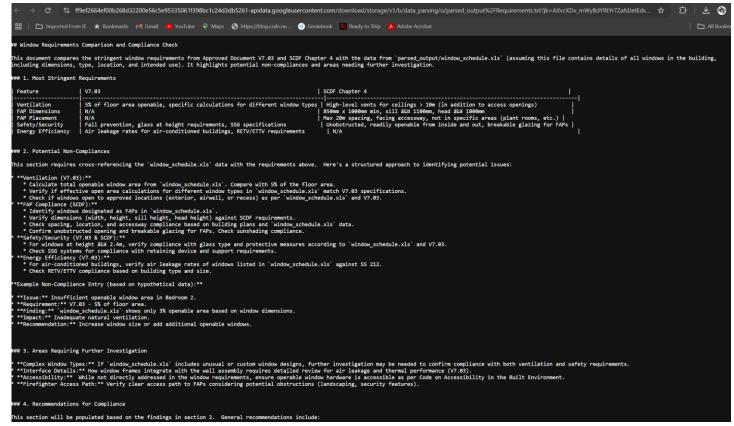


Output: Tabulated Measurable Data (xls)



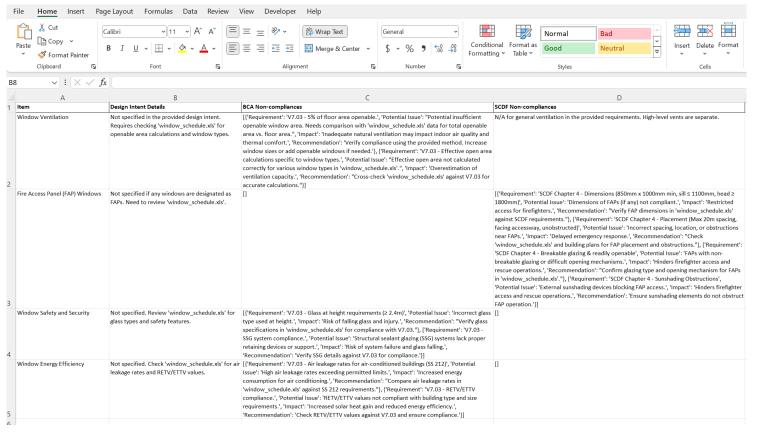
https://storage.cloud.google.com/data_parsing/parsed_output/window_schedule.xls

Output: Parsed Requirements (txt)



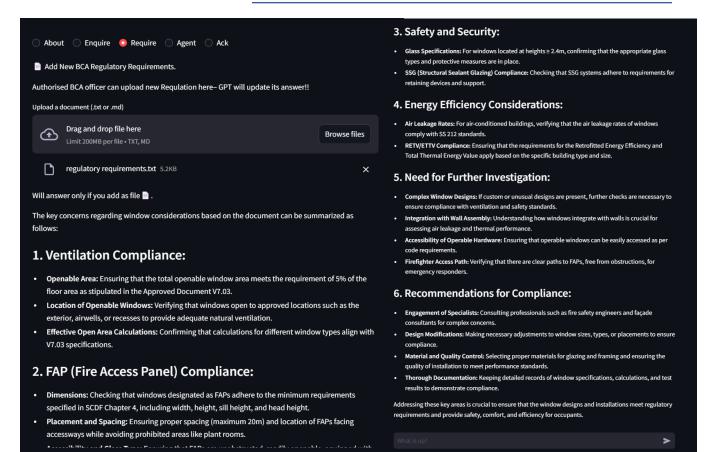
https://storage.cloud. google.com/data_par sing/parsed_output/R equirements.txt

Output: Highlighted non-compliances concerns (xls)



https://storage.cloud. google.com/data_par sing/parsed_output/c heck_1.xlsx

Output: Validations (Independent Agent)



https://bcaproject.streamlit.app/

Outcome: Proof of Concept for Al Agentic Workflow

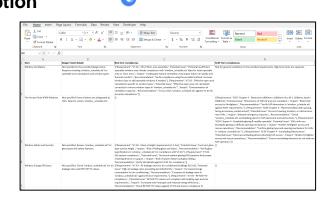








Use of Al Agents as Analysers to Automate the Processing of Design Intent and Requirements into Clean, Structured, and Verified Datasets for Project Stakeholders' Easy Understanding and Consumption



Building and Construction

Learning Points (from Obstacles)



Functionality & User Experience:

- Use different AI models to replace functional building tasks (Limited know-how)
- Adopt a "learning while doing" approach due to time constraints (Limited time)

Technical Implementation:

- Utilize AI and programming to accelerate software learning (Difficult tools)
- Apply prompt engineering techniques to achieve effective outcomes, addressing Al hallucination risks (Al hallucination)

Innovation:

- Implement AI-driven workflows to streamline programming processes (Complex workflow)
- Automate practical processes with an interactive LLM approach (Manual processes)

Documentation:

- Prioritize documentation for learning and relearning, tackling short memory limitations (Short memory)
- Promote information sharing to support teamwork and avoid isolated work (Workin-silos)

