DEVELOPMENT OF CUSTOM INVENTORY SYSTEM FOR ASIA WOOD INTERNATIONAL CORPORATION – A SKILL-BASED PARTNERSHIP

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Approval Sheet

This design project entitled **"DEVELOPMENT OF CUSTOM INVENTORY SYSTEM FOR ASIA WOOD INTERNATIONAL CORPORATION – A SKILL – BASED PARTNERSHIP"** prepared by **Asugas, Kenneth R. , Delinia, Filjohn B. , Eulin, Ryan Bertrand B. ,Hermosura, Leigh B. , Maringal, Czer Justine D. and Polestico, Paul Justine D.** of the Computer Engineering Department, was examined and evaluated by the members of the Student Design Evaluation Panel and is hereby recommended for approval.

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SOFTWARE DESIGN PROJECT INFORMATION

2ND Semester, SY 2025-2026

<table>
<tr><td>Student/Team

Team HAMPED Devs</td><td>Kenneth R. Asugas
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Leigh B. Hermosura
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<tr><td>Project Title</td><td>Development of Custom Inventory System for Asia Wood International Corporation – A Skill-Based Partnership</td></tr>
<tr><td>Project Concentration Area</td><td>Software Development</td></tr>
<tr><td>Design Objectives</td><td>The general objective of this project is to develop a Web-Based Custom Inventory Management System for a wood-processing corporation to replace manual spreadsheet-based tracking with a centralized and automated software solution.

Specifically, it aims to:
1. Design the system architecture and database structure, including:
● A relational database schema optimized for wood product categorization (e.g., species, dimensions, and grades).
● A user-friendly web interface (UI) designed for efficient data entry and real-time stock monitoring.

2. Develop the software modules and functionalities, such as:

● An automated inventory tracking system to manage incoming and outgoing wood products.
● A secure user authentication system with role-based access for admins and warehouse staff.
● A automated report generation tool for stock levels, sales and transaction history.

3. Test and evaluate the system's accuracy and performance to ensure reliable data synchronization and integrity across the corporation’s operations.</td></tr>
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Constraints	
Constraint (Metric)	Time Constraint - The system must be deployed and completed within 4 months of the entire semester.
Constraint (Metric)	Money Constraint - The system must be developed in a cost-friendly manner while ensuring high-speed execution and low memory consumption by utilizing open-source libraries and a local database.
Constraint (Metric)	Storage Constraint - The system must maintain a minimal installation footprint, aiming for a file size that does not exceed a few megabytes, ensuring deployment across various hardware configurations.
Constraint (Metric)	Performance Constraint - The system must prioritize high-speed data processing and responsiveness with a target response time of less than one second for all database activities,ensuring consistent performance even in intense activity volume.
Constraint (Metric)	Efficiency Constraint - The system must be optimized for minimal RAM and storage utilization to achieve low hardware resource footprint by means of decreasing computational demands to decrease energy consumption and heat generation, thereby prolonging the lifespan of the client's existing hardware.
Constraint (Metric)	Design Constraint - The system must feature a digital catalog-style interface that allows users to browse and visualize products in an e-commerce-inspired layout. However, it is strictly limited to internal inventory management and informational display, therefore no mode of payment features will be included. The UI will be designed for high readability and minimalist navigation, ensuring consistency in the system's speed and efficiency.
Other constraints: These constraints do not affect each design; therefore, these were not included in selecting the best design.	
Constraint	Definition.
Corporate Compliance	The system must strictly adhere to the corporation's policies regarding data handling, inventory reporting formats, and security protocols. This ensures that all digital records and stock reports generated are valid for the company's administrative and auditing purposes.
Budgetary Limits	The development and implementation of the software must be executed within the financial resources allocated by the partnership. This includes costs related to web hosting, database maintenance, or any third-party software licenses.

Timeframe	The project must be completed, tested, and ready for deployment within the agreed-upon schedule or semester timeline. All software modules (Inventory, User Management, and Reporting) must be functional by the set deadline.
Data Integrity and Accuracy	The system must maintain a 100% accuracy rate in calculating stock levels and transactions. Any discrepancy between the physical count and the digital record must be traceable through an automated audit log.
Platform Accessibility	The inventory system must be accessible through standard web browsers (e.g., Google Chrome, Mozilla Firefox) to ensure that the corporation can use the system without the need for high-end hardware. upgrades.
Standards	
W3C (World Wide Web Consortium)	The international standard for web development (HTML, CSS, and JavaScript) to ensure cross-browser compatibility. This was used as a guide to ensure that the inventory website displays and functions correctly across different web browsers like Chrome, Firefox, and Safari.
ISQ/IEC 25010	A global quality model standard that evaluates software based on characteristics like Usability, Reliability and Security. This standard was used to design a user-friendly interface for the warehouse staff, ensuring the system is easy to navigate and minimizes input errors.
SQL/ACID Properties	A set of database standards (Atomicity, Consistency, Isolation, Durability) that guarantees reliable data transactions. These properties were applied in the database design to ensure that every stock update or sales record is accurately saved and protected from data corruption.
OWASP (Basic Security)	A standard framework for web application security to protect against common vulnerabilities and data breaches. This served as a baseline for securing the login system and protecting

	the corporation’s inventory data from unauthorized access or malicious attacks.

For single pages, use "p." For multiple pages, use "pp."
Appendices should be italicized and referred to every time it is mentioned.

Abstract

This project addresses the need for enhanced data accuracy, operational efficiency, and organized stock monitoring in a corporate wood-processing environment by designing and implementing a Web-based Inventory Management System. The system replaces traditional manual record-keeping with a digital framework that ensures real-time tracking of inventory levels and transactions. By integrating a centralized SQL database and a secure web-based interface, the system provides the corporation with a reliable tool for managing wood stocks and generating automated administrative reports. Key features include secure user authentication, dynamic stock calculation, and a comprehensive dashboard for inventory visualization. Performance evaluation demonstrates significant improvements in data integrity and a reduction in manual auditing time. The project highlights the potential of web-based solutions in streamlining corporate workflows, offering a scalable and efficient tool for modernizing inventory management systems within the timber industry.

Keywords: *Inventory Management System, Web-Based Application, Data Integrity, Corporate Compliance, Wood Industry, Stock Monitoring, Database Reliability*

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CHAPTER 1: THE PROJECT AND ITS BACKGROUND

1.1 The Problem

Asia Wood International Corporation (PH Branch) currently uses Microsoft Excel to manage its inventory. While Excel is useful for basic record-keeping, it is not designed to handle complex inventory processes. The system relies on manual data entry, which increases the risk of errors, duplicate records, and outdated information.

Using Excel makes it difficult to track inventory in real time, monitor stock movements, and ensure data accuracy. Inventory updates are not automatically reflected, which may result in incorrect stock levels, delayed reporting, and poor inventory control. Furthermore, generating reports and monitoring inventory performance require extra time and effort.

Due to these limitations, the use of Excel is no longer sufficient to support the company's inventory management needs. Therefore, there is a need to develop a custom inventory system that will provide accurate, real-time tracking and improve overall inventory management for Asia Wood International Corporation.

1.2 The Client

Asia Wood International Corporation is a business organization engaged in the wood industry, handling various inventory items such as raw materials, finished products, and operational supplies. The company's operations require accurate inventory monitoring to support daily activities and ensure smooth business processes.

As the client of this project, Asia Wood International Corporation seeks to improve its current inventory management practices. The company aims to replace its Excel-based inventory recording with a custom inventory system that is more reliable, efficient, and suitable for its operational needs. Through this system, the company expects better inventory control, improved data accuracy, and easier access to inventory information.

Table 1-1. Client and Engineering Requirements / Considerations

Client Requirements / Considerations	Engineering Requirements / Considerations
The system can provide a centralized and organized platform to replace manual, paper-based inventory tracking.	The system can utilize a **MySQL Database** to ensure data integrity, eliminate redundancy, and centralize all records.
The system can be accessed easily without needing high-end computer specifications or a stable internet connection.	The system can run on a **Localhost environment** using a C++ backend engine, ensuring high performance even on low-end hardware.

The system can allow users to input data manually but still generate professional, organized reports.	The system can process inputs via a **Web-based UI** and automate the generation of **standardized Excel/HTML reports.**
The system can show a quick overview of the current stock status for faster decision-making.	The system can visualize real-time inventory data through **Pie Graphs and Dashboards** using frontend data-binding.

1.3 The Project

To address the challenges of managing inventory at Asia Wood International Corporation, this project aims to improve the accuracy, efficiency, and accessibility of inventory operations.

The proposed Inventory System is a web-based application that enables the client to monitor the health of company inventory through a standard web browser, allowing access across multiple devices and locations.

The system is developed specifically for Asia Wood International Corporation, an international wood-working company, and is designed to track materials and finished products across multiple categories while monitoring their stock status.

1.4 Project Objectives

The general objective of this project is to design and develop a Web-based Inventory Management System that improves data accuracy, operational efficiency, and organized stock monitoring for a corporate wood-processing environment by replacing manual record-keeping with a reliable and centralized digital solution.

Specifically, the project aims to:

- Design the required hardware and system infrastructure to support a web-based inventory platform, including server and network resources for reliable system deployment.
- Develop a web-based inventory management system application with secure user authentication and role-based access control
- Develop a centralized SQL database for real-time storage, retrieval, and management of wood stock data and transaction records.
- Develop automated stock calculation and reporting features to support administrative decision-making and corporate compliance.
- Develop a dashboard interface for clear data visualization and monitoring of inventory levels and transaction history.
- Test and evaluate the device's accuracy in tracking inventory data and generating reports, ensuring data integrity and system reliability.

1.5 Scope and Delimitations

This project involves the design, development, and evaluation of a Web-based Inventory Management System for a corporate wood-processing environment. The system supports authorized corporate personnel in managing wood inventory records, including stock-in and stock-out transactions, real-time inventory monitoring, automated stock calculations, and report generation through a centralized SQL database. Secure user authentication and role-based access control are implemented to maintain data integrity and system security.

The system also includes a publicly accessible web interface that allows clients to browse the wood products offered by the corporation and view basic product information. Client access is limited strictly to product viewing and does not permit access to inventory data, stock availability, or internal management functions. The system is accessible through standard web browsers and is evaluated based on data accuracy, operational efficiency, and reliability.

The project is limited to inventory management and product information display functionalities. It does not support online ordering, payment processing, customer account creation, or order tracking features. Financial accounting, payroll systems, supplier management, and full enterprise resource planning (ERP) capabilities are excluded.

The system does not incorporate hardware-based automation such as barcode scanners, RFID systems, or IoT-enabled inventory tracking devices. Evaluation of the system is confined to functional testing, data accuracy, and efficiency improvements and does not include advanced cybersecurity testing, long-term scalability analysis, or multi-branch deployment. The application is designed specifically for managing wood products and does not extend to other industries or material categories.

1.6 Design Constraints

This section outlines the constraints that may affect the design, development, and deployment of the system.

- Time
    - Development timelines may be impacted by scheduling conflicts between the development team and the client, potentially causing delays in project completion.
- Accessibility
    - The Inventory System requires an active internet connection to function. Limited or unstable connectivity may prevent system access or result in delayed data synchronization and reduced accuracy.
- Security
    - As a web-based application, the system is inherently exposed to internet-based threats, making it more susceptible to security risks such as malware attacks and data breaches.

- Marketability
    - Unlike native applications distributed through app stores, the Inventory System relies on direct URLs or search engine access, which may reduce its discoverability among potential users.
- Performance
    - System performance may degrade as the number of concurrent users increases, potentially affecting response times and overall user experience.

Possible constraints: accessibility, aesthetics, codes, constructability, cost, ergonomics, extensibility, functionality, interoperability, legal considerations, maintainability, manufacturability, marketability, policy, regulations, schedule, standards, sustainability, or usability. (wag muna tanggalin, baka may naiisip pa kayong constraints mga pre lapag niyo lang)

Safety (Root-Mean-Squared Error)
First sentence must explain the constraint. Functionality is… .
The second sentence must explain the metric. Error rate defines … .
Third sentence explains how the metric is obtained. It is computed by 1 - accuracy.
The Fourth sentence must explain the relationship between the constraint and the metric. Followed by the conclusion. A higher error rate indicates lower functional performance … .
Conclusion. Therefore, the design with the lowest error rate is the winning design.

Other constraints: These constraints do not affect each design; therefore, these were not included in selecting the best design.

Sustainability

Public Health

Welfare

Social

Global

Cultural

1.7 Engineering Standards
The engineering standards serve as the foundation for the overall design and functionality of the project. To ensure that all specifications and requirements are carried out in compliance with these standards, the project adheres to the following guidelines:

ISO/IEC 25010 (Systems and Software Quality Model)
This standard defines quality characteristics for software systems such as usability, reliability, security, and maintainability. The system shall follow the ISO/IEC 25010 standard to ensure that the website is user-friendly, reliable, secure, and easy to maintain. This guarantees that the interface design and system functions meet acceptable software quality levels.

W3C Web Content Accessibility Guidelines (WCAG 2.1)
These guidelines provide standards for making web systems accessible to all users. The system shall adhere to WCAG 2.1 to ensure readable text, proper color contrast, and clear navigation, allowing employees of Asia Wood International Corporation to use the system effectively regardless of device or user limitations.

HTML5, CSS3, and Modern Web Standards
These standards define the structure, presentation, and behavior of modern web applications. The system shall follow HTML5 and CSS3 standards to ensure cross-browser compatibility, responsive design, and consistent performance across different devices used within the organization.

1.8 Engineering Design Process

Considering the time constraints of the software being developed and other factors, the team has decided to use the **Scrum Model** as a guide throughout the software development process. This approach ensures that each phase of the Engineering Design Process is executed efficiently, allowing for continuous feedback and refinement.

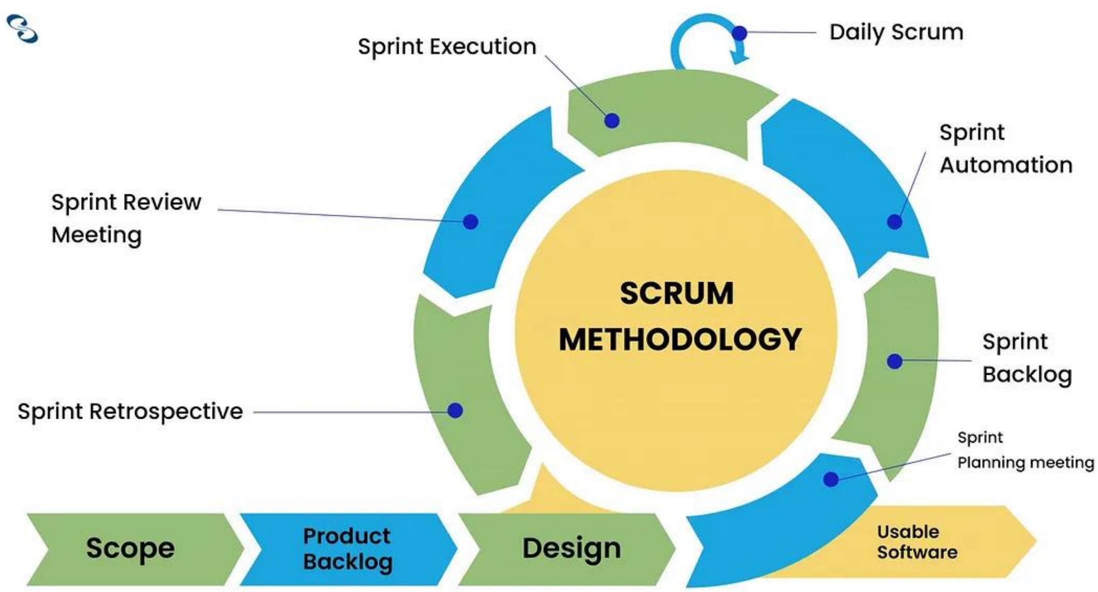

Figure The Agile Design Process (TeachEngineering, 2023)

The figure above illustrates the team's systematic approach to transforming abstract requirements into a functional system. The process is defined by the following stages:

- **Project Scope and Product Backlog:** The process begins by defining the project scope, which prioritizes a **minimalist** and **lightweight** design. All features, specifically the **Manual Data Entry** system and **MySQL Database** requirements, are documented in the Product Backlog.

- **Design and Sprint Execution:** The "loop" in the diagram represents the Sprint cycle. During this phase, the **Front-End Developer** (Figma) and **Back-End Developer** (C++/MySQL) collaborate to build the system's core components. By utilizing "Sprint Automation" in our workflow, we ensure that documentation and progress tracking remain consistent despite the tight schedule.

- **Iterative Development:** The circular motion of the framework signifies that the software development undergoes continuous refinement. Each iteration is an opportunity to review the "manual-first" logic, ensuring it remains intuitive and matches the client's expectations
.
- **Usable Software (Increment):** The ultimate goal of the cycle, as shown in the figure, is the delivery of **Usable Software**. This ensures that the final output is a high-performance, lightweight digital catalog that is ready for deployment on the client's hardware.

1.8.1 Ask: Identifying the Need and Constraints

The team began by identifying the client's primary need: a centralized system to manage inventory more effectively than manual paper-based methods. Key constraints include the requirement for the software to be **lightweight** enough to run low-end hardware and the client's preference for a **manual data management** approach initially, rather than full automation.

1.8.2 Research the Problem

We conducted research on efficient data handling and minimalist UI designs. The team studied how **MySQL** can store structured data reliably and how **C++** provides the necessary performance to keep the software "lightweight" or low-resource-intensive. We also looked into existing digital catalog systems to identify features that align with a **minimalist** philosophy.

1.8.3 Imagine: Develop Possible Solution

During the brainstorming phase, the team considered various platforms. We discussed whether to build a fully cloud-based web app or a standalone desktop application. Ultimately, we leaned toward a **Hybrid Architecture**—utilizing a **Desktop-based backend** for warehouse operations to ensure offline accessibility and a **Web-based frontend** for product viewing to provide client accessibility. This approach adheres to the client's need for a minimalist yet versatile tool.

1.8.4 Plan: Select a Promising Solution

The team officially selected a **C++ Application with a MySQL backend**, integrated with a **Web-viewing module**. This "Promising Solution" was picked because it allows for high-performance manual-entry tracking that is 100% operational within a Local Area Network (LAN), while still providing the company an online presence through a browser-accessible catalog.

1.8.5 Create: Build a Prototype

In this stage, the team is developing high-fidelity mockups in Figma and the initial database schema in MySQL. This prototype serves as the visual and structural blueprint, ensuring that the **"Manual-first" logic**—where every stock movement is precisely logged—is correctly mapped before the full coding phase begins. The prototype also includes the layout for the **Web Catalog interface** to test how product information will be displayed to external browsers.

1.8.6 Test and Evaluate the Prototype

The prototype is evaluated based on its usability and adherence to the "lightweight" constraint. We test the system flow to ensure that manual data entry is straightforward,the web-based catalog displays information accurately across browsers, and that there is no unnecessary "bloat" in the software that could slow down the client's PC.

1.8.7 Improve: Redesign as Needed

Based on internal reviews and the Project Manager's feedback, the team refines the design.This iterative step is crucial for addressing any logic gaps in the manual tracking system, ensuring that the final output is a polished, minimalist, and highly efficient software.

CHAPTER 2: SOFTWARE DESIGN

This chapter discusses the architecture, methodologies, and principles involved in the design and development of the software. It provides a detailed description of the software's structural design, the engineering principles applied, and the specific requirements necessary for the system to operate effectively. Furthermore, this chapter presents a comparison with existing products and outlines the various constraints considered throughout the software development cycle to ensure the final output meets the client's standards for efficiency and reliability.

2.1 Description of the Design Solution

2.1.1 General Description

This section provides a high-level overview of the proposed **Custom Inventory Management System**. The design solution is specifically engineered to modernize the client's current **Excel-based workflow** by introducing a centralized and more reliable digital environment. The system is a **Web-Integrated application** that operates primarily on a **Localhost server for internal inventory management**, ensuring that core operations remain functional across the company's local area network (LAN) without the need for an active internet connection. However, the system also features a **web-catalog module** for external accessibility.

To fulfill the requirement for a lightweight yet high-performance tool, the system utilizes **C++** for its core backend logic. This ensures **near-instantaneous** data processing and minimal system resource consumption, even on modest hardware. For data storage, a **MySQL database** is implemented to provide professional-grade data integrity and security, addressing the inherent limitations and risks of manual spreadsheets. Overall, the design focuses on a minimalist, user-friendly interface for warehouse personnel, while providing robust reporting capabilities—including **dynamically generated HTML charts** and **Excel-compatible data reports**—to facilitate efficient management audits and decision-making.

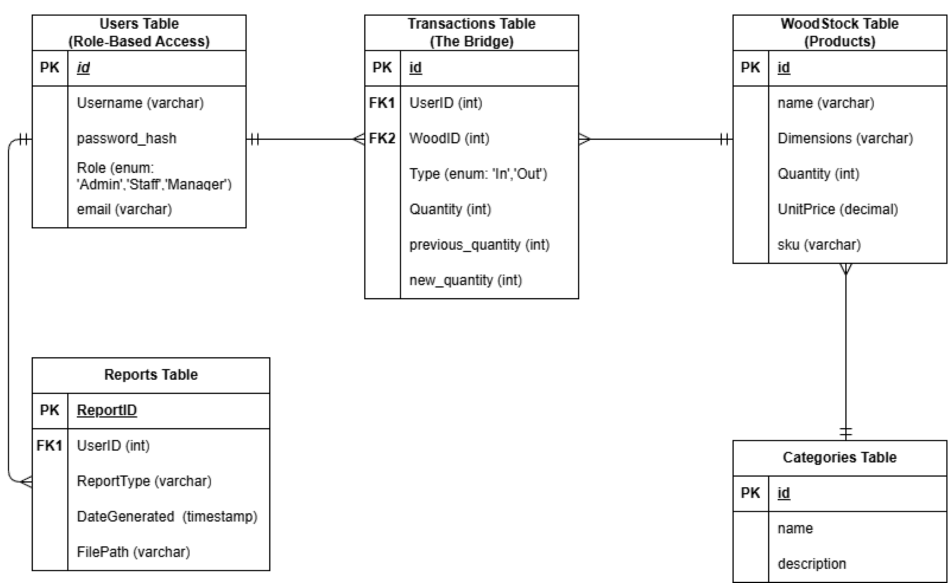

Figure 1: Entity Relationship Diagram of the AWIC System.

The diagram illustrates the logical data structure, showing the relationships between user roles, categorized inventory tracking (WoodStock), detailed audit trails (Transactions), and the automated reporting module.

The system utilizes a relational database management system (MySQL) to ensure data integrity and structured storage of inventory records. Figure 1 illustrates the Entity Relationship Diagram (ERD) of the AWIC Inventory System, which is composed of five (5) core entities:

- **Users Tables:** This table manages the **Role-Based Access Control (RBAC)** of the system. It distinguishes between 'Admin' and 'Staff' roles to ensure that sensitive functions, such as report generation and data deletion, are restricted to authorized personnel only.

- **WoodStock Table:** Serving as the central repository of the company's assets, this table stores detailed information about the wood inventory, including species, physical dimensions, current quality, and unit pricing.

- **Categories Table:** This table organizes the inventory into logical groups (e.g., Timber, Plywood, specialized wood types). This allows for easier filtering and more organized report generation, ensuring that the database remains scalable as more product types are added.

- **Transactions Table:** This acts as the Audit Trail of the system. Every manual entry (Stock In or Stock Out) is recorded here, linking the specific user who performed the action to the specific wood item affected. It records the **previous_quantity** and **new_quantity** for every action, providing 100% accountability for every change in stock levels.

- **Reports Table:** This table tracks the history of generated Excel/HTML reports. It logs which user extracted data and when, providing the AWIC management with a clear timeline of corporate compliance and inventory audits.

2.1.2 Engineering Principles Involved

This section outlines the fundamental software engineering principles and methodologies applied in the development of the AWIC Inventory Management System to ensure reliability, scalability, and system integrity.

1. Modular Design Principles (Separation of Concerns)

Explanation: In software engineering, modularity involves breaking down a complex system into smaller, manageable, and independent modules. This project applies this principle by separating the Data Layer (MySQL), the Logic Layer (C++ Backend), and the **Presentation Layer (User Interface)**. This ensures that the system can support both the **Management Application** and the **Web Catalog** independently, Allowing the system to become easier to debug, maintain, and update without affecting the entire architecture. This ensures that the AWIC system remains robust even as data complexity grows.

2. Database Normalization

Explanation: Database normalization is an engineering process used to organize a relational database to reduce data redundancy and improve data integrity. Following the principles taught in formal database studies, the system's ERD is designed to reach the **Third Normal Form (3NF)**. This ensures that every piece of wood inventory data is stored logically, preventing anomalies during "Stock In" or "Stock Out" transactions and ensuring that automated reports are always accurate for the client.

3. User-Centered Design (UCD)

Explanation: This principle focuses on creating a system that prioritizes the end-user's needs and constraints. Since the AWIC staff requires a "lightweight" and "manual-input friendly" interface, the engineering of the web dashboard focuses on **Usability and Efficiency**. The design reduces cognitive load by providing clear data visualizations (Pie Charts) and a simplified navigation flow, which directly supports the project's objective of enhancing administrative decision-making.

4. KISS (Keep It Simple, Stupid)

Explanation: This principle highlights the importance of simplicity in both system design and user interface. For the **AWIC Inventory System**, the development focuses on a straightforward workflow–avoiding convoluted navigation that could confuse the staff. By keeping the database schema and the C++ backend logic simple, the system becomes easier to maintain and less prone to "bloatware" issues. Complexity is avoided to ensure that the primary goal–inventory tracking–is achieved with maximum clarity.

5. DRY (Don't Repeat Yourself)

Explanation: The DRY Principle is applied to eliminate redundancy within the system's code and data processes. In the context of the project, functions such as "Stock Update" or "User Authentication" are centralized and reused across different modules. Instead of writing separate codes for every transaction, a modular approach is used to call existing functions. This not only reduces the margin for error but also ensures that updates to the logic are applied consistently throughout the software.

6. YAGNI (You Aren't Gonna Need It)

Explanation: This principle prevents over-engineering by focusing only on the features currently required by the client, AWIC. While it is tempting to add advanced features like "AI-based forecasting" or "automated cloud backup", the team adheres to what is essential for the current scope: reliable manual input, real-time stock monitoring, and Excel report generation. This ensures that the system remains lightweight and delivers immediate value without unnecessary technical overhead.

2.1.3 Prior Art Analysis

This section evaluates existing inventory management solutions and compares them with the proposed AWIC Inventory system. While various commercial systems exist, most are designed for general retail (e-commerce) and include unnecessary complexities such as payment gateways and public-facing storefronts which do not align with the client's private operational requirements.

A. Description of Prior Arts

- **Prior Art A: Generic E-commerce/POS Systems (e.g., Shopee, Lazada)** - These are comprehensive platforms designed for global retail. While feature-rich, they often require high subscription costs and include public "Add to Cart" and "Payment Gateway" modules that are irrelevant to a private wood manufacturing warehouse.

- **Prior Art B: Manual Spreadsheet Tracking (MS Excel/Google Sheets)** - The current method used by many small-to-medium enterprises. It is highly flexible but prone to human error, lack role-based security, and does not have a structured database to prevent data redundancy.

- **Prior Art C: Professional ERP & Inventory Software (e.g., Zoho Inventory, ECOUNT ERP)** These are high-end. cloud-based enterprise solutions. While they provide structured data management, they operate on a **Subscription Model,** which are generally not for free due to additional features that AWIC does not need, such as VAT automated filing, international shipping, and multi-currency support. Furthermore, they require constant internet connectivity to function.

- **The Proposed PROJECT: AWIC Inventory System** - A bespoke, lightweight C++ and MySQL- based application. It focuses on internal stock movements (In/Out) with automated reporting, specifically designed for wood species and dimensions, without the overhead of commercial retail features.

Table 1: Prior Art Analysis Matrix

Design	Features					
	Bespoke Wood Species Tracking	**Role-Based Access Control (RBAC)**	**Automated Excel Report Generation**	**Offline/ Local LAN Operation**	**Zero Subscription / License Cost**	**Exclusion of Public Payment Gateways**
Prior Art A	X	/	/	X	X	X
Prior Art B	/	X	X	/	/	/
Prior Art C	X	/	/	X	X	X
PROJECT	/	/	/	/	/	/

Narrative Discussion of the Matrix:

1. **Specialization: Prior Arts A and C** fail to provide bespoke tracking for wood species and dimensions (Thickness, Width, Length), which is the core requirement for AWIC. While **Prior Art B** (Manual) is flexible enough to record these, it lacks the automation and security of a database system.

2. **Economic Sustainability:** One of the most critical factors is the **Zero Subscription Cost.** While professional systems like **Prior Art C** offer high functionality, they require a recurring monthly fee (e.g., ₱2,800) which adds long-term financial pressure. The **PROJECT** offers enterprise-level features without the recurring overhead.

3. **Privacy and Security:** By strictly adhering to the **Exclusion of Public Payment Gateways**, the **PROJECT** reduces the attack surface for cybersecurity threats. Unlike **Prior Art A**, which is open to the public, the AWIC system is a “Closed-Loop” environment, ensuring that inventory data is never exposed to external commercial risks.

4. **Operational Resilience:** The system is designed for **Offline/Local LAN Operation**. This ensures that the staff can continue logging stocks and generating reports even during internet outages–a major weakness found in the cloud-dependent architectures of **Prior Arts A and C.**

2.2 General System Architecture

This section details the practical implementation of the engineering concepts and architectural elements of the AWIC Inventory System. It describes the integration of hardware components and software environments to create a cohesive, high-performance inventory management solution.

2.2.1 Hardware Elements

The hardware architecture is designed for **On-Premise Deployment**, ensuring that AWIC maintains full ownership of its data without recurring cloud costs.

- **Central Database Host (The Server):** A designated workstation within the AWIC office that serves as the central repository. It hosts the MySQL Server Instance.

- **Networking Infrastructure (Hybrid LAN/WLAN):** The system operates via a local router. The "Host PC" is connected via Ethernet for stability, while staff laptops or tablets access the web-interface via protected Wi-Fi.

- **Client Devices (Staff Laptops):** The system is optimized to run on standard Windows 10 laptops commonly used by the staff, allowing them to access the management interface via a standard web browser.

- **Engineering Justification:** To meet **Money Constraints**, the system is designed to run on existing office hardware (at least an Intel Core i3 with 8GB RAM), eliminating the need for expensive dedicated server racks.

2.2.2 Software Elements

A. Embedded Software

- **Not Applicable (N/A):** The current system architecture is designed as a standalone enterprise application running on general-purpose computing hardware (Laptops/Desktops).

- **Reasoning:** Since the project focuses on high-level inventory logic and database management via the **Drogon Framework** and **C++**, it does not require low-level embedded firmware or specialized hardware controllers.

B. Application Software

This section outlines the software stack and development tools utilized to build the system's logic, database, and user interface.

- **Programming Language (Backend): C++** serves as the core language for the system's backend logic, chosen for its high-performance capabilities and efficient memory management on Windows-based machines.

- **Web Framework (Drogon):** The system utilizes the **Drogon Framework**, a high-performance C++ HTTP framework. It manages the routing of data, handles HTTP requests from the client browsers, and serves as the bridge between the C++ logic and the user interface.

- **Database Management System (MySQL): MySQL 8.4** is used for persistent data storage. The database is structured following **Third Normal Form (3NF)** to ensure data integrity and eliminate redundancy in wood species and transaction records.

- **Frontend Interface:** The interface is developed using **HTML5 and CSS3**. This allows the staff to interact with the system through any standard web browser (e.g., Google Chrome, Microsoft Edge) installed on their **Windows 10/11** laptops.

- **Development & Prototyping Tools: Figma** was used for the initial UI/UX prototyping, while the database schema was designed using **draw.io** to map out the entity relationships.

C. Key Algorithms Used (Optional)

- **Stock Reconciliation Logic:** The C++ backend automates the calculation of stock levels during every "Stock In" or "Stock Out" action. It follows the formula:

  $$NewQuantity = PreviousQuantity \pm TransactionAmount$$

  This ensures that the **WoodStock Table** always reflects the real-time physical count in the warehouse.

- **Role-Based Access Control (RBAC):** The system implements an algorithm that validates the **Role** (Admin, Staff, or Manager) stored in the **Users Table** before granting access to sensitive modules such as report generation or data deletion.

2.2.2 System Algorithm

2.2.3 Data, Datasets, and Processing

a. Datasets
This section describes the data you used, including data sets that you have acquired from external sources, data you have generated, and data you (may have scraped or mined).
Include in your discussion the detailed PROCESS on how you acquired your data.

b. Data Processing Scheme and Algorithms
This section talks about the processing (including pre and post).
Show the raw dataset, the dataset after pre-processing, and the final dataset.
Include the pre-processing steps on the data.
Discuss also where these processes are applied in your design.

Note: If your alternative designs are focused on algorithms (ML/DL technologies), then you should not mention them here. Alternatively, if your designs do not involve ML/DL but they are used in the SOFTWARE DESIGN, then this is where they have to be mentioned.

c. Other Data Utilized in the Design

This section talks about data that are not necessarily used in the data analytics part, (i.e. Database of patient names, constants used in calibration, etc.)
Including mock data.

2.3 Design Alternatives

2.3.1 Rationale for Design Alternatives

Discuss here why THESE are the design alternatives you used. Why are these critical for the design? Why do these design alternatives matter?

Note: This is similar to the previous "Discussion of Alternative Designs," make sure to keep the content of this section concise. No need to discuss the designs in great detail here as long as you follow the guide questions above. Each design has a section for your extensive discussions.

2.3.1 Design Alternative 1:

A. Engineering Principles of Alternative

Contains discussions (with references) of the technologies, principles, and concepts utilized (i.e. Machine Learning, Convolution, Kinematics, etc).

Note: This repeats for all 3 designs. It must not mention the principles mentioned above but instead those specific to the design alternative.

B. Architecture of Design Alternative

Discuss how key components, sub-systems, algorithms, of this design alternative are implemented.

C. Constraints

Constraint A

Constraint B

Constraint C

Constraint D

Constraint E

iv. Evaluation Results (if model)

2.3.2 Design Alternative B

i. Engineering Principles of Alternative

ii. Architecture of Design Alternative

iii. Evaluation of Constraints

Constraint A

Constraint B

Constraint C

2.3.3 Design Alternative C

i. Engineering Principles of Alternative

ii. Architecture of Design Alternative

iii. Constraints

Constraint A

Constraint B

Constraint C

2.4 Standards Involved in the Design

This section presents the standards followed by the design, including their references. Matrix may be used to show how standards are used in each specific design.

Table xx Summary of Standards Involved in the Alternatives

<table>
<tr><th rowspan="2">Standard</th><th rowspan="2">Brief Description</th><th colspan="3">DESIGNS</th></tr>
<tr><th>DESIGN A</th><th>DESIGN B</th><th>DESIGN C</th></tr>
<tr><td>IEC 60950</td><td>Product Safety Standard for electronic and computing products.</td><td colspan="3">Used in enclosure, power supply leakage, ESD, wiring, and connectors.</td></tr>
<tr><td>Philippine National Standards for Drinking Water (PNSDW)</td><td>Standards for drinking-water quality, water sampling and examination and evaluation.</td><td colspan="3">Used in conditional statements to determine if water is drinkable.</td></tr>
<tr><td>IEEE 1309-2013</td><td>Standard for Calibration of Electromagnetic Field Sensors and Probes</td><td>NA</td><td>NA</td><td>Calibration of sensor used in detecting heavy metals.</td></tr>
<tr><td>IEEE 1858-2016</td><td>IEEE Standard for Camera Phone Image Quality</td><td>Reference for image processing camera.</td><td>NA</td><td>NA</td></tr>
</table>

Explain this table and end with a summary.

CHAPTER 3: DESIGN TRADEOFFS

3.1 Summary of Constraints

Explain table xx below in this paragraph.

Table xx Summary of Design Constraints

Designs	Constraints				
	Constraint A (Metric)	Constraint B (Metric)	Constraint C (Metric)	Constraint D (Metric)	Constraint E (Metric)
Design A					
Design B					
Design C					

Synthesize for the next section.

3.2 Trade-offs

Table xx Preference and Importance of Constraints

Constraints	Preference	Importance (raw)	% Importance

Explain the use of Pareto Multi-Criteria Decision Making (MCDM).

$$Minimization = 9 \times \left(\frac{Max\ Value - Raw\ Value}{Max\ Value - Min\ Value}\right) + 1$$ Equation No. xx

$$Maximization = 9 \times \left(\frac{Raw\ Value - Min\ Value}{Max\ Value - Min\ Value}\right) + 1$$ Equation No. xx

3.2.1 Tradeoff 1: Constraint A (Metric)

3.2.1.1 Design 1: Normalization of Constraint A (Metric)
<Introduce>

Table xx Evaluation of Three Design Alternatives based on Constraint A

Design	Constraint (Metric)

<Analyze>

3.2.1.2 Design 2: Normalization of Constraint A (Metric)

Table xx Evaluation of Three Design Alternatives based on Constraint B

Design	Constraint (Metric)

3.2.1.3 Design 3: Normalization of Constraint A (Metric)

Table xx Evaluation of Three Design Alternatives based on Constraint C

Design	Constraint (Metric)

3.2.2 Tradeoff 2: Constraint B (Metric)

3.2.2.1 Design 1: Normalization of Constraint B (Metric)
3.2.2.2 Design 2: Normalization of Constraint B (Metric)
3.2.2.3 Design 3: Normalization of Constraint B (Metric)

3.2.3 Tradeoff 3: Constraint C (Metric)

3.2.3.1 Design 1: Normalization of Constraint C (Metric)
3.2.3.2 Design 2: Normalization of Constraint C (Metric)
3.2.3.3 Design 3: Normalization of Constraint C (Metric)

3.2.4 Tradeoff 4: Constraint D (Metric)

3.2.4.1 Design 1: Normalization of Constraint D (Metric)
3.2.4.2 Design 2: Normalization of Constraint D (Metric)
3.2.4.3 Design 3: Normalization of Constraint D (Metric)

3.2.5 Tradeoff 5: Constraint E (Metric)

3.2.5.1 Design 1: Normalization of Constraint E (Metric)
3.2.5.2 Design 2: Normalization of Constraint E (Metric)
3.2.5.3 Design 3: Normalization of Constraint E (Metric)

3.3 Summary of the Normalized Values of the Three Designs

Designs	**Constraints**				
	Constraint A (metric)	**Constraint B (metric)**	**Constraint C (metric)**	**Constraint D (metric)**	**Constraint E (metric)**
Design A					
Design B					
Design C					

3.4 Designers Raw Ranking for the Three Designs

Table xx Designers Raw Ranking for the Three Designs

Decision Criteria	**Criterion's Importance**		**Ability to Satisfy Criterion**		
	Scale (0-10)	**Percentage (%)**	**Design A**	**Design B**	**Design C**

3.5 Sensitivity Analysis

3.6 Influence of the Design Tradeoffs in the Final Design

CHAPTER 4: FINAL DESIGN

4.1 Final Design
4.1.1 Software Application
4.1.2 Hardware Design
4.2 Test Procedures and Evaluation
4.2.1 Test Procedures
4.2.2 Test Evaluation
4.3 Test and Evaluation Results
4.3.1 Test Results
4.3.2 Evaluation Results
4.4 Conclusion
4.5 Impact of the Design
4.5.1 Societal
Target UN SDG.
4.5.2 Ethical
In compliance with known ethical codes/standards
4.5.3 Legal
National / Intl Laws
4.6 Sustainability Plan

CHAPTER 5: BUSINESS PLAN AND MODEL

REFERENCES

Note: This must be done using APA format. Check the guide for more details: https://www.scribbr.com/apa-style/apa-seventh-edition-changes/

Covey, S. R. (2013). *The 7 habits of highly effective people: Powerful lessons in personal change*. Simon & Schuster.

APPENDICES

Include standards preview, certification from experts/clients, code snippets, patent reports, and other long and detailed documents here. Format is as follows below:

APPENDIX A: TITLE OF THE SECTION

<figure>

Note: No figure number. Standards must be followed with a paragraph explaining its contents and purpose.