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Tea Estate Management System

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1. Background

Sri Lanka, a pioneer in tea exporting, is home to numerous plantation companies that distribute tea globally. Among these, Bio Tea Factory, situated in Haputale, stands out as one of the nation's premier tea suppliers. As the first certified organic tea manufacturer in Sri Lanka, Bio Tea Factory has established a significant presence in the international market. Its diverse product range, including organic black and green tea, is exported to over 80 countries across five continents, both in bulk and packaged forms.[1]

Operating from a single factory outlet, Bio Tea Factory employs around 500 dedicated workers and manages approximately 900 hectares of tea plantations. Despite advancements in machinery over the years, the factory's management processes remain largely manual. Critical tasks such as record-keeping, sales tracking, and inventory management are still performed without the aid of modern automated systems.

The process at Bio Tea Factory begins with tea leaves being plucked from various fields by assigned employees. These harvested leaves are transported to the factory, classified, and processed into powdered tea, which is then stored in the inventory. The inventory also includes fertilizers supplied by various vendors. All records, including employee assignments, tea quantities, classification details, inventory levels, and sales transactions, are managed manually. The end products are sold through auctions. This manual approach leads to inefficiencies, inaccuracies, and increased potential for errors, highlighting the need for an automated system to improve productivity and data management.

Bio Tea Factory's mission is to cultivate a truly sustainable tea industry that benefits people and to become the leading tea exporter in Sri Lanka. Given current industry trends and the scale of their operations, there is significant potential for improvement and efficiency gains through the adoption of advanced software solutions and computerized systems. Transitioning to digital solutions could enhance data accuracy, streamline processes, and facilitate better decision-making. This shift would ultimately boost the overall productivity and competitiveness of Bio Tea Factory in the global export market.

2. Problems

The existing factory management at Bio Tea Factory faces several significant challenges due to outdated and manual processes. These problems hinder efficiency, accuracy, and productivity, making it difficult for the factory to compete effectively in the global market. Below are some of the major issues that our software web application aims to address:

1. Manual Database Management:

- **Current Process:** Data is stored manually in physical records or basic digital formats, making it difficult to retrieve, filter, and search for old data. The storage is often insufficient, and the manual nature of data management complicates analysis and decision-making.
- **Problem:** The manual database is inefficient and error-prone. It is challenging to measure and record the quantity of tea leaves harvested daily over many years. This lack of accurate data hampers the ability to analyze trends and make informed decisions.

2. Lack of Integrated Systems:

- **Current Process:** Different systems and departments within the factory are physically separated and lack direct connections. To send files or data, an additional person is required to physically transfer the documents, which complicates communication and increases resource usage.
- **Problem:** This disjointed communication method slows down processes, increases the likelihood of data loss or errors, and requires additional personnel to handle document transfer, reducing overall efficiency and Lack of real time access.

3. Manual Salary and Payment Management:

- **Current Process:** Salary management, payment processing, and order management are not automated. These tasks rely on traditional methods and require auditors or personnel to maintain account information.
- **Problem:** This manual approach increases labor costs and is time-consuming. It also increases the risk of human error, which can lead to financial discrepancies and inefficiencies in managing payments and orders.

4. Inefficient Inventory Monitoring:

- **Current Process:** Monitoring inventory requires manual checking of stock levels. For example, to determine the amount of fuel remaining in storage, someone must physically check the inventory.
- **Problem:** This manual inventory monitoring consumes a significant amount of time and labor. Constant physical checks are required to maintain accurate inventory levels, leading to inefficiencies and potential stock-outs or overstock situations.

5. **Lack of Predictive Maintenance:**

- **Current Process:** Maintenance of machinery and equipment is performed reactively, often only after a failure has occurred. Maintenance records are kept manually.
- **Problem:** This reactive approach to maintenance can lead to unexpected downtime, higher repair costs, and reduced equipment lifespan. Manual record-keeping makes it difficult to track maintenance history and predict future maintenance needs.

6. **Limited Customer Relationship Management (CRM):**

- **Current Process:** Customer interactions and sales follow-ups are managed manually, with little to no centralized system for tracking customer data and preferences.
- **Problem:** This limits the ability to build strong customer relationships, track sales performance, and personalize customer service. It also hinders effective marketing and sales strategies.

7. **Inadequate Reporting and Analytics:**

- **Current Process:** Reports are generated manually, often using spreadsheets and basic tools, which can be time-consuming and prone to errors.
- **Problem:** Manual reporting limits the ability to quickly generate accurate reports and analyze data for strategic decision-making. This can affect the company's ability to respond to market trends and operational challenges in a timely manner.

8. **Inconsistent Supply Chain Management:**

- **Current Process:** The management of suppliers and supply chains is conducted manually, including tracking orders, deliveries, and supplier performance.
- **Problem:** This can lead to delays in supply, inaccuracies in inventory levels, and difficulties in maintaining strong supplier relationships. Inconsistent supply chain management can disrupt production schedules and increase operational costs.

3. Motivation

By addressing these key areas with advanced software solutions, Bio Tea Factory will transform its operations, making them more efficient, accurate, and responsive to market demands. The integration of automated systems will reduce labor costs and errors, ensure consistent product quality, and streamline inventory management. Enhanced communication and collaboration across departments will improve workflows, while optimized harvest management and predictive maintenance will increase yield and reduce downtime. Strengthening customer relationships through a centralized CRM system and utilizing accurate reporting for strategic decision-making will further enhance overall business intelligence. Streamlined supply chain management and real-time data access will boost operational efficiency. This digital transformation will position Bio Tea Factory as a leader in the tea industry, improving its competitiveness and ability to achieve its mission of creating a sustainable tea industry and becoming the leading tea exporter in Sri Lanka.

The Proposed Solutions:

- **Automated Database Management:** Centralized digital database for accurate data recording, easy access, and comprehensive analysis.
- **Integrated Systems with Real-Time Communication:** Connecting all departments digitally for efficient data sharing and communication.
- **Automated Salary and Payment Management:** Digital payroll and order management systems to reduce labor costs and errors.
- **Automated Inventory Monitoring:** Real-time inventory tracking with automated alerts.
- **Predictive Maintenance System:** Automated maintenance scheduling and tracking to prevent downtime and reduce costs.
- **Advanced CRM System:** Centralized customer data for improved relationship management and personalized service.
- **Enhanced Reporting and Analytics:** Automated report generation for quick, accurate data analysis.
- **Streamlined Supply Chain Management:** Digital tracking of orders, deliveries, and supplier performance

4. Aims

Our objective is to develop a comprehensive digital software solution that automates all functionalities involved in the management of tea estates. This all-in-one solution is designed to be applicable to any tea estate in Sri Lanka. The software aims to streamline operations across various management sectors, including maintenance, transportation, harvesting, supply, and inventory management.

Additionally, we will introduce an online auction platform to modernize the Sri Lankan tea market, promoting competitiveness and enhancing the country's standing as a leading tea exporter in the global market.

5. Objectives

- **Platform Development:**
 - Design and implement a fully functional web application for the Tea Estate Management System, incorporating modules for user registration, employee management, harvest management, product management, sales management, inventory tracking, and core logistics for transportation and supply management.
- **Usability Focus:**
 - Conduct user testing with tea estate managers and stakeholders, gather feedback, and incorporate at least 70% of the suggested changes into the platform's final design.
- **Cost Analysis:**
 - Create a detailed cost-benefit model comparing traditional tea estate management expenses versus projected operational costs and potential revenue using the Tea Estate Management System. Distribute this model to six prospective tea estate networks or organizations.
- **Pilot Program:**
 - Partner with a tea estate for a pilot program to onboard them with the Tea Estate Management System for real-world testing. Monitor for a period of at least three months and document outcomes such as order volume, customer satisfaction, and operational efficiency gains.

6. System Overview

The Tea Estate Management System for Bio Tea Factory aims to streamline and enhance the operational efficiency of tea estate management by automating manual processes and consolidating data into an integrated digital platform. This system addresses key challenges such as delays in accessing inventory data, inefficiencies in workforce management, and issues with data accuracy and transparency. By leveraging the MERN technology stack (MongoDB, Express.js, React.js, Node.js), the system provides comprehensive functionalities including inventory management, employee management, transport scheduling, and sales order processing. The objective is to modernize Bio Tea Factory's operations, ensuring efficient data management, improved decision-making capabilities, and compliance with industry standards, thereby supporting the factory's sustainable growth and competitiveness in the tea industry.

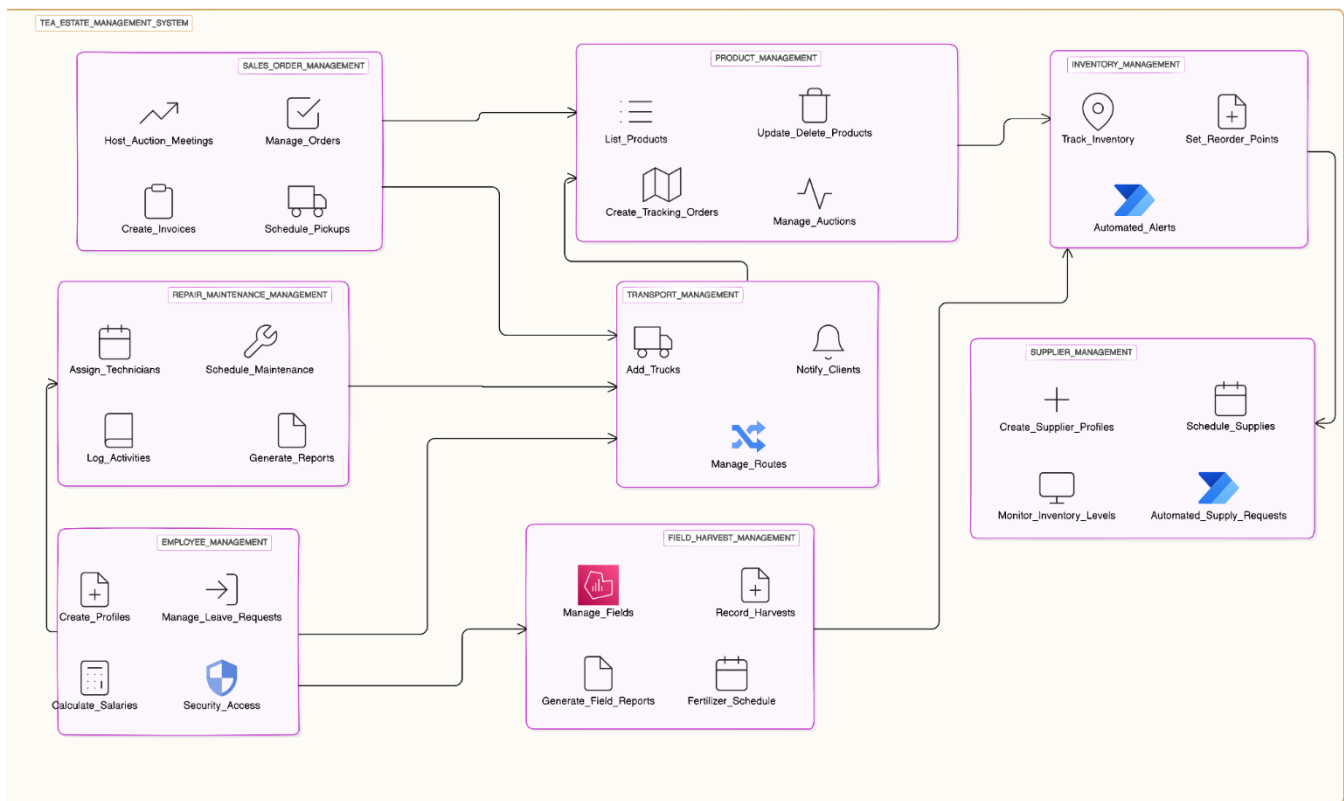


Figure 1 System Diagram

1) Employee Management System

Employee Management System, or EMS, is a powerful tool designed to significantly enhance the efficiency of our HR department. As you know, managing employee-related tasks can be overwhelming, but with the EMS, we streamline these tasks, making our processes more efficient and effective. There are four main functions of the system and they are Employee Database Management, Recruitment Management, Attendance and Leave Management and Salary Calculation.

Functional requirements

- Employee Database Management allows to maintain detailed records of employee information. It enables the HR team to manage individual employee accounts.
- Allows advanced search capabilities to quickly retrieve employee information.
- Allows to generate detailed reports on employee data, such as performance. ensures that we have accurate and accessible information at our fingertips.
- Recruitment Management this feature revolutionizes the way we handle job postings and applications. It allows for efficiently create and manage job postings including job descriptions and requirements, and tracking of applicants throughout the recruitment process
- Attendance and Leave Management, in this function the HR department can track the daily attendance of employees.
- Allows employees to request leave through an intuitive interface and enables managers to review, approve, or reject leave requests via the interface
- Salary Calculation, this function calculates monthly salaries and allowances with precision, based on each employee's designation and performance. Automating salary calculation minimizes errors and ensures that our employees are paid accurately and on time.
- This allows also the calculation of allowances and deductions according to the attendance and performance of each employee.
- Security measures ensure that all employee data is protected and access is controlled, maintaining confidentiality and data integrity.

Overall, the Employee Management System is a game-changer for our HR department. It enhances administrative efficiency by automating and streamlining critical tasks, allowing our HR professionals to focus more on strategic initiatives and employee engagement. The result is a more organized, efficient, and responsive HR function that supports the growth and success of our organization.

Non-functional requirements

- Legal Compliance & Data Privacy - Ensure the system complies with relevant labour laws and regulations concerning data privacy and employee information management.
- Data Backup - Regular backups should be conducted to prevent data loss.
- Scalability - The system should be able to scale to accommodate a growing number of employees and increased data volume.
- Redundancy & Failover - Implement redundancy and failover mechanisms to ensure continuous operation in case of hardware or software failures.
- User-Friendly Interface - The system should have an intuitive and user-friendly interface to ensure ease of use for HR staff and employees.

Technical Requirements

- Secure Access
 - Implement role-based access control for employee data.
- Automated Payroll
 - Integrate with payroll systems for automated processing.
- Compatibility
 - Utilize responsive web design techniques to ensure compatibility across both desktop and mobile devices.
- Should be able to integrate with external systems within the application.

2) Field and Harvest Management

The Field and Harvest Management System for the Tea Estate Management System is designed to streamline and optimize the management of tea fields and the harvesting process. This system automates labor assignments, tracks daily harvests, updates inventory levels, and provides detailed performance analytics, ensuring efficient and effective field and harvest operations within the tea estate. Below is an overview of its functional and non-functional requirements:

Functional Requirements

- Allows managers to create, edit, and manage records of all tea fields within the estate.
- Enables assigning and managing labor resources to specific fields based on field requirements and labor availability.
- Facilitates the reassignment of labor as needed to optimize productivity and resource allocation.
- Provides a structured interface for recording the daily quantity of tea leaves harvested.
- Ensures accurate documentation of daily harvest data to maintain up-to-date records.
- Automatically updates inventory levels in real-time as daily harvest records are entered.
- Provide Visual Representations (Graphs, Charts) of Employee and Field Performance Metrics
- Allows managers to filter and view performance data based on different criteria.
- Facilitates detailed analysis of labor performance, field productivity, and seasonal variations.
- Enables the creation of periodic and on-demand reports detailing field and harvest activities.
- Implements an alert system to notify managers when a significant number of poor or diseased leaves are detected.
- Provides recommendations for adjusting fertilizer schedules based on field conditions and harvest data.

Non-Functional Requirements

- **Availability-** Ensure the system is available for users at any time without significant downtime.
- **User Interface-** Design a simple and easy-to-use interface to enhance user experience and efficiency.
- **Information Accuracy-** Provide accurate and precise information to ensure reliable data management and decision-making.
- **Performance-** Ensure quick responses while handling large amounts of data to maintain system efficiency
- **Data Backup** - Regular backups should be conducted to prevent data loss.

Technical Requirements

- **Compatibility-** Responsive web design techniques to ensure compatibility with both desktop and mobile devices.
- **Interoperability-** Capable of integrating with external systems within the application.
- **Authentication-** Role-based access control to restrict access to features and data based on user roles.
- **Real-Time Updates-** Real-time data updates to ensure that users have the most current information.

3) Inventory Management

Functional Requirements

- Track raw tea and processed tea - The system should be capable of monitoring the quantities and locations of both raw tea leaves and processed tea products.
- Manage daily utilities and large stocks - Handle day-to-day inventory needs and manage large quantities of stock (fuel, fertilizer, other inventory)
- Set and manage reorder points - Define minimum stock levels for different items and set up automatic reorder triggers when stock falls below these levels.
- Generate automated alerts when stock level drops below minimum - Automatically notify users when stock levels drop below the predefined minimum thresholds.
- Provide graphical representations of inventory trends - Display inventory data through charts, graphs, and other visual tools to show trends over time.
- Generate automated dynamic reports - Produce reports on inventory status, usage, and trends automatically, with real-time data updates.
- Provide a search function - Allow users to search for specific items or information within the inventory system.

- Maintain a secured system - Implement security measures to protect sensitive inventory data and ensure only authorized personnel have access.
- User Roles and Permissions - Define different user roles with specific permissions and access levels.

Non-Functional Requirements

- System should be accessible any time - The system should be available 24/7, with minimal downtime.
- User interface should be intuitive and user-friendly - The interface should be intuitive and easy to use, with a clear layout and navigation.
- The system should be able to generate dynamic reports in real-time - Reports should be generated in real-time, reflecting the most current data.
- Data access control measures should be robust - Implement robust mechanisms to control and restrict data access based on user roles and permissions.
- High performance efficiency - The system should operate efficiently, with fast response times and minimal delays.
- Should be scalable - The system should be able to handle increasing amounts of data or users without a significant performance drop.
- Interoperability - The system should be able to work with other systems or software used within the organization.
- Accuracy - The system should maintain accurate and precise data throughout its operations.

Technical Requirements

- **Live Updates:** Implement real-time tracking of inventory levels with instant updates on stock changes.
- **Centralized Control:** Enable centralized management of inventory across multiple locations or warehouses.
- **Custom Reports:** Provide tools for generating custom reports and dashboards tailored to specific user needs.
- **Automated Data Validation:** Implement automated checks to validate data accuracy and consistency during input and processing.

4) Supply Management

The Supply Management System (SMS) for the Tea Estate Management System is designed to enhance the efficiency and reliability of managing suppliers and their supplies. This system automates supply requests, monitors inventory levels, and provides detailed reports, ensuring seamless supply chain operations within the tea estate. Below is an overview of its functional and non-functional requirements:

Functional Requirements

- Supplier-facing
 - Offer dashboards for suppliers to view relevant information.
 - Enable suppliers to view supply requests sent by the supplier manager.
 - Allow suppliers to enter details of supply loads they have sent
 - Provide suppliers with access to their supply history.
- Administrative Facing
 - Supplier management
 - Enable supplier managers to add and manage new suppliers and their data.
 - Classify suppliers based on the materials they supply.
 - Supply management
 - Provide supplier managers with the capability to send supply requests to suppliers.
 - Automatically dispatch supply requests to suppliers as per scheduled routes defined by the suppliers.
 - Monitor inventory levels and generate supply requests from primary suppliers when stock falls below set thresholds.
 - Facilitate the scheduling of repetitive supply orders based on supplier types.
 - Track all received supply loads from each supplier, record them in the database, and generate reports as needed.
 - Display alerts from inventory management to the supplier manager.

Non-Functional Requirements

- Scalability- The database must scale efficiently to handle growing
- Data backup- Establish regular backup to protect supplier orderings
- Performance
 - The system should handle more suppliers and ordering
 - Should be able to handle real-time notification.
- Security- Sensitive data should be encrypted

Technical Requirements

- Implement analytics to evaluate supplier performance based on delivery timeliness, quality, and reliability
- Provide alerts for non-compliance and manage corrective actions.
- Implement real-time alerts for critical inventory levels, expiring products, and potential stockouts

5) Product Management System

The online auction platform for tea estate products focuses on two main areas: product catalogue management and buyer management. These functions work together to create a seamless auction experience. Product Managers create detailed catalogues featuring descriptions, images, starting prices, and auction information. Scheduled auctions enable buyers to join video conferences for bidding, with the Order Manager selecting the highest bidder and updating the buyer's profile with the quotation. Buyers must register to access product lists and receive auction notifications. They can communicate directly with the Order Manager, track orders in real time, and access transaction history for reports. This integration ensures an efficient and user-friendly marketplace for tea estate products.

Functional Requirements

- **Buyer Registration:** Buyers can register by providing their information. This step is essential to ensure secure and personalized access to the platform.
- **Product Viewing and Searching:** Registered buyers can browse and search for tea products available for auction. The system provides detailed product information and images.
- **Auction Participation:** Buyers can join auctions listed in the auctioneer catalogue. Each auction has a fixed start time and includes product details, a starting price, and a join auction button.
- **Video Conferencing:** Upon joining an auction, buyers are directed to a video conference where the order manager oversees the bidding process.
- **Buyer Profile Features:** The buyer's profile includes personal details, auction quotations notifications, order tracking information (real-time from the transport manager), and a history feature to view past activities and generate reports.

Non-Functional Requirements

- **Usability**
 - The user interface should be intuitive and easy to navigate, with minimal training required for buyers and product managers.
 - The system should provide clear and concise error messages to guide users in case of issues.
- **Security**
 - The system must comply with industry standards for data protection and encryption.
 - User authentication should be robust, including two-factor authentication (2FA) for critical operations like bidding and profile management.
- **Scalability:**
 - The system should be scalable to accommodate a growing number of users and product catalogues.
 - It should support adding new auction events without requiring significant downtime or manual intervention.
- **Availability**
 - High uptime to ensure the platform is always accessible.

Technical Requirements

- **Video Conferencing:**
 - Integrate a reliable video conferencing service (e.g., Zoom API, WebRTC) for live auction participation.
 - Ensure low latency and high-quality video streaming during auctions.
- **Authentication and Authorization:**
 - Implement secure authentication mechanisms using OAuth 2.0 or JWT (JSON Web Tokens).
 - Define role-based access control (RBAC) to manage permissions for different user types (e.g., buyers, product managers, order managers).
- **Notification System:**
 - Set up a notification service (e.g., Firebase Cloud Messaging, AWS SNS) to send real-time alerts and updates to users.
 - Ensure notifications are reliable and delivered promptly.

6) Sales and Order management system

Another crucial procedure in our Tea Estate Management System is the Sales and Order Management function. This function is designed to streamline and optimize sales, order, and inventory management processes. This system must meet the needs of various stakeholders, including the Sales Manager, Buyer, Inventory Manager, and Purchase Manager, providing each with tools and functionalities to enhance the efficiency and effectiveness of this system.

Functional Requirements:

- Allows managers to create, edit, and manage records of auction meetings, orders, and sales summaries.
- Enables scheduling and updating auction meetings with buyers, including updating meeting links.
- Facilitates the acceptance or decline of orders after auctions.
- Provides the ability to delete canceled orders from the invoice.
- Ensures orders are feasible and manageable.
- Allows the creation and viewing of invoices by both the sales manager and buyers.
- Ensures invoices are generated as soon as orders are accepted.
- Assign pickups for accepted orders to the Transport Manager to ensure smooth delivery.
- Automatically updates inventory levels in real-time as orders are processed
- Provides visual representations graphs, charts of sales data, including sales items, prices, and customer details.
- Allows managers to filter and view sales performance data based on different criteria.

Non - Functional Requirements:

- **Database:**
 - Use a robust relational database to store orders, sales data, and other relevant information.
- **Scalability:**
 - Ability to handle an increasing number of orders, users, and inventory items without performance issues.
- **Availability**
 - Ensure the system is available for users at any time without significant downtime
- **Response Time:**
 - Quick response time for generating reports and visualizing sales data to maintain system efficiency.

Technical Requirements:

- **Communication Platforms for Auctions:**
 - Integrate communication platforms for conducting auction meetings.
- **Web-Based Application:**
 - Accessible through standard web browsers to ensure wide accessibility.
- **Data Export and Import:**
 - Provide functionality for exporting and importing data in common formats (e.g., CSV, Excel) for reporting and integration purposes.
- **Real-Time Synchronization:**
 - Ensure real-time synchronization of data across different modules (e.g., sales, inventory).

7) Transport Management

The Transport Management System (TMS) for the Tea Estate Management System is designed to streamline and optimize the transportation operations within a tea estate. This comprehensive system ensures efficient vehicle and route management, effective handling of supply loads, and detailed record-keeping and reporting. Below is an overview of its functional and non-functional requirements

Functional requirements

- **Vehicle Management**
 - Allow transport managers to manage all vehicles in the estate by adding, editing, removing, and assigning drivers.
 - View Vehicles' current status and upcoming maintenance
 - Request and receive the fuel from inventory and fill each vehicle.
- **Route Management**
 - Enable transport managers to handle and organize routes by adding and removing Routes.
 - Facilitate the scheduling of transport routes.
- **System Automate Function**
 - Automatically allocate vehicles to each scheduled route and notify drivers of their daily assignments.
 - Track the order queue and automatically schedule a pickup when the order volume is sufficient for a truck.
 - Notify the order owner about the pickup time, vehicle, and driver details when an order is assigned to a vehicle.

- Record and Report management
 - Should be able to view the record of vehicles' use of fuel
 - Should be able to view the Vehicles' transportation records separately as delivery transportation, supply transportation and employee transportation
 - Should be able to generate the reports on each search
- Allow transport managers to view daily scheduled routes and manually override or change them, with the system notifying the endpoints of these changes.

Non-Functional Requirements

- Performance
 - high response time
 - should support concurrent users
 - Emergency handling capabilities
- Availability
 - Should be available anytime
- Reliability
- Back-up and Recovery
 - In case of data loss, latest data should be able to recovered quickly
- Real time analytics
 - The notifications should be real time

Technical Requirements

- Predictive Maintenance
 - Implement predictive maintenance using data analytics to anticipate vehicle issues before they occur.
- Live Tracking for Customers
 - Provide notifications for delays and changes in delivery schedule.
- Load Optimization Algorithms
 - Use optimization algorithms to maximize vehicle load efficiency and minimize empty runs.

8) Maintenance and Repairs Management

The Maintenance and Repairs Management System for the Tea Estate Management System is designed to streamline and optimize the maintenance and repair tasks for machinery and vehicles within the tea estate. This system automates task assignments, tracks progress, and maintains detailed records, ensuring efficient and effective maintenance operations. Below is an overview of its functional and non-functional requirements:

Functional Requirements

- View and assign repair requests to technicians
 - Allows the Maintenance Manager to view all incoming repair requests and assign them to available technicians.
- Schedule routine maintenance tasks (weekly/monthly)
 - Enables the scheduling of regular maintenance tasks for machinery and vehicles.
- Receive notifications for reported issues and scheduled tasks
 - Technicians receive notifications for new repair requests and upcoming scheduled maintenance.
- View upcoming maintenance schedules and next maintenance times
 - Provides a calendar view or list of upcoming maintenance tasks and their scheduled times.
- Set priority levels for maintenance tasks
 - Allows the Maintenance Manager to prioritize tasks based on urgency and importance.
- Log and update the status of maintenance and repair tasks
 - Technicians can log their progress and update the status of tasks (e.g., in progress, completed).
- Search maintenance tasks by machine, vehicle, or time period
 - Enables searching for specific maintenance tasks based on various criteria.
- Receive notifications for assigned repair requests
 - Technicians are notified when they are assigned a new repair request.
- Update the status of repairs (in progress, completed)
 - Technicians can update the status of repair tasks to keep the Maintenance Manager informed.
- Log maintenance activities for machinery and vehicles
 - Detailed logging of all maintenance activities performed on machinery and vehicles.
- Generate and view maintenance reports
 - The system can generate reports detailing all maintenance activities, which can be viewed by the Maintenance Manager.
- Store basic data for each machine and vehicle (name, ID, type)
 - Maintains records of all machinery and vehicles, including essential details.
- Store assigned driver information for vehicles

- Keeps track of which driver is assigned to each vehicle.
- View and update machinery and vehicle records
 - The Maintenance Manager can view and update records for all machinery and vehicles.

Non-Functional Requirements

- User Friendliness
 - The system should have a user-friendly interface to manage maintenance tasks and records efficiently.
- Performance
 - The system should handle large amounts of data without delays and allow multiple users to perform tasks simultaneously.
- Maintainability
 - The system should be easy to maintain and update as needed.

Technical Requirements

- Compatibility
 - The system should be compatible with all web browsers and mobile devices.
 - Responsive web design.
- Real-time Updates
 - The system should support real-time notifications and updates for users.
 - Proper hooks for real time updates.
- Authenticated api access
 - Users without permission should not be able to browse data through api calls.
- Predictive Maintenance
 - Use data analytics to predict and schedule maintenance.
- Resource Management
 - Efficient allocation of maintenance resources.

7. Literature Review

In our research, we investigated various tea estate management systems to understand their functionalities and how they compare to our proposed solution. We explore systems from Asia Siyaka, Forbes & Walker, Lanka Com, Eastern Brokers, and John Keels by reviewing their websites, annual reports, and monthly reports. This review aims to identify the Pros and Cons of each system and explain why they may not be suitable for our needs.

Features	Asia Siyaka	Forbes & Walker	Lanka Com	Eastern Brokers	Jhon Keels	Our solution
Employee Management	✓	✓	✓	✓	✓	✓
Inventory Management	✓	✓	✓	✓	✓	✓
Transport Management	✓	✓	✓	✓	✓	✓
Supply Management	✗	✗	✗	✓	✗	✓
Field and Harvest Management	✗	✗	✗	✗	✗	✓
Sales and Order Management	✗	✓	✓	✓	✓	✓
Product Management	✗	✗	✗	✓	✓	✓
Maintenance Management	✓	✗	✗	✗	✓	✓

Figure 2 Literature Review

1. Asia Siyaka

- **Strengths:**
 - Comprehensive employee management, inventory management, and transport management.
 - Maintenance management is also well-handled.
- **Weaknesses:**
 - Lacks supply management, field and harvest management, sales and order management, and product management.

- **Critical Review:**

- Asia Siyaka's system, while robust in core operational areas such as employee, inventory, transport, and maintenance management, falls short in several crucial domains. The absence of supply management means that the system cannot handle the procurement and distribution of essential materials efficiently. This gap can lead to logistical bottlenecks and increased operational costs. Moreover, the lack of field and harvest management is a significant drawback for tea estates, where tracking field activities and harvest data is essential for optimizing productivity and quality. The missing sales and order management feature means the system cannot streamline the sales process or manage customer orders effectively, which is critical for revenue generation. Finally, the absence of product management implies that the system cannot oversee the lifecycle of tea products, from production to sale, hindering the ability to maintain quality and meet market demands.[3]

2. Forbes & Walker

- **Strengths:**

- Effective in employee, inventory, transport, and maintenance management.

- **Weaknesses:**

- Does not offer supply management, field and harvest management, sales and order management, and product management.

- **Critical Review:**

- Forbes & Walker's system shows similar strengths and weaknesses to Asia Siyaka's. While it handles employee, inventory, transport, and maintenance management competently, it lacks supply, field and harvest, sales and order, and product management functionalities. The inability to manage supply chains can result in inefficiencies and increased costs due to poor procurement practices. Without field and harvest management, the system fails to provide crucial insights into crop management, which is vital for maximizing yield and quality. The lack of sales and order management limits the estate's ability to manage customer interactions and sales processes, affecting overall profitability. The absence of product management means the system cannot track product quality and market readiness, leading to potential losses and customer dissatisfaction.[4]

3. Lanka Communication

- **Strengths:**

- Strong in employee, inventory, transport management, and sales and order management.

- **Weaknesses:**

- Lacks supply management, field and harvest management, product management, and maintenance management.

- **Critical Review:**

- Lanka Com's system introduces sales and order management, a feature absent in both Asia Siyaka and Forbes & Walker, which adds value by streamlining sales processes and improving customer relationship management. However, it still lacks supply, field and harvest, product, and maintenance management. The absence of supply management can lead to disruptions in the procurement process, affecting overall efficiency. Without field and harvest management, the system cannot provide detailed insights into agricultural practices, which is crucial for optimizing tea production. The missing product management feature means the system cannot oversee product development and quality control, impacting the ability to meet market standards. Additionally, the lack of maintenance management can lead to increased downtime and operational inefficiencies due to unmanaged equipment and infrastructure maintenance.[5]

4. Eastern Brokers

- **Strengths:**

- Comprehensive coverage including employee, inventory, transport, field and harvest, sales and order, product, and maintenance management.

- **Weaknesses:**

- Only missing supply management.

- **Critical Review:**

- Eastern Brokers offers the most comprehensive solution among the reviewed systems, covering all major functionalities except supply management. This missing feature is critical because effective supply management is essential for maintaining a smooth flow of materials and ensuring that production processes are not interrupted. Without this capability, the system cannot optimize procurement processes or manage supplier relationships effectively, leading to potential delays and increased costs. Despite its comprehensive nature, the absence of supply management avoid Eastern Brokers from providing a truly integrated solution that can handle all aspects of tea estate operations seamlessly.[2][6]

5. John Keels

- **Strengths:**

- Covers employee, inventory, transport, field and harvest, sales and order, and maintenance management.

- **Weaknesses:**

- Missing supply and product management.

- **Critical Review:**

- John Keels' system covers a wide range of functionalities but misses supply and product management. The lack of supply management can lead to inefficiencies in the procurement process, resulting in increased costs and potential delays in production. Without product management, the system cannot effectively oversee the lifecycle of tea products, from production to market, which is essential for maintaining product quality and meeting consumer demands. These gaps mean that while John Keels' system is robust in many areas, it cannot provide the comprehensive oversight needed for a fully integrated tea estate management solution. This limitation can lead to operational inefficiencies and a failure to capitalize on market opportunities.

Summary

Based on our review, the existing systems provide valuable features but fall short in offering a comprehensive solution. The major shortcomings across these systems are the lack of supply management, field and harvest management, and product management. These are critical areas necessary for the efficient and integrated management of a tea estate. Therefore, none of the existing solutions fully meet our requirements.

Our Solution

Our proposed system addresses all the identified gaps in the existing systems. It includes:

- **Employee Management**
- **Inventory Management**
- **Transport Management**
- **Supply Management**
- **Field and Harvest Management**
- **Sales and Order Management**
- **Product Management**
- **Maintenance Management**

This comprehensive approach ensures that all aspects of tea estate management are covered, providing a seamless, efficient, and fully integrated management experience.

Conclusion

The existing tea estate management systems each have their strengths but ultimately lack the full suite of features necessary for a complete solution. Our proposed system fills these gaps, offering a more robust and comprehensive management tool that addresses the needs of modern tea estate operations.

8. Methodology

SDLC Method: Agile

The agile software development life cycle (SDLC) paradigm combines incremental and iterative process models, emphasising process flexibility and customer satisfaction through quick delivery of functional software.

The strategy places more emphasis on teamwork, swift delivery, and flexibility than it does on top-down management and rigid planning. Feedback is often given, giving stakeholders a chance to communicate regularly and giving team members the flexibility to adapt to obstacles as they appear.

The processes of planning, designing, implementing, and closing a project often move linearly under traditional project management. Before going on to the next step, the previous one must be finished. Agile has several benefits, such as improved teamwork, more project visibility, quicker project delivery and time to market, and lower project risk.

Alternatives and Justification:

- **Waterfall Methodology:**
 - While Waterfall follows a sequential, top-down approach with distinct project phases that must be completed before moving to the next, Agile's iterative and flexible approach offers several advantages. Agile allows simultaneous work on different phases, promotes constant stakeholder feedback, and adapts to changes, which enhances teamwork, project visibility, and overall delivery speed.
- **Spiral and Incremental Models:**
 - These models offer iterative development but can be more complex and less flexible compared to Agile. Agile's simplicity in managing iterative cycles and continuous stakeholder involvement makes it more suitable for projects requiring frequent adjustments and rapid delivery.




Requirements Engineering Methods:




- **Observation and interviews:**
 - Gather detailed requirements from stakeholders from site visit.
 - This involves gathering detailed requirements from stakeholders through direct observation and interviews. It provides insights into user needs, system constraints, and business processes.
- **Use Cases and User Stories:**
 - Define how users will interact with the system.

Design Methods:

- **UML Diagrams:** For system design and architecture (Use case, activity, sequence).
- **Wireframes and Prototypes:** To visualize user interfaces. (figma)

Development Tools and Technologies:

Selected tool / Technology	Description	Alternative	Reason for Selecting
MERN Stack 	Frontend: ReactJS Backend: Node.js, Express.js Database: MongoDB	Frontend: Angular, Vue.js Backend: Django (Python), Ruby on Rails Spring Boot (Java) Database: PostgreSQL, MySQL	JavaScript-centric development experience and the MERN stack provide a well-supported ecosystem with numerous resources and tutorials.
Postman 	API testing tool for creating, sending, and analyzing HTTP requests.	Insomnia, Curl	Postman's intuitive interface, collaboration features, and rich functionality make it a user-friendly choice for thorough API testing
Figma 	Web-based interface design tool for wireframing and prototyping	Sketch, Adobe XD, Balsamiq	Figma's collaborative features, accessibility, and free plan for basic use make it an excellent choice for team-based prototyping.

VS Code 	Versatile and extensible code editor by Microsoft	Sublime Text, Atom, IntelliJ IDEA	VS Code's wide language support, customization, and integration with development tools align well with your stack and streamline your workflow.
Trello 	Visual project management tool based on Kanban methodology.	Asana, Jira, Basecamp	Trello offers a collaborative and visually clear way to organize a smallscale project
GitHub 	Web-based version control system using Git.	GitLab, Bitbucket	GitHub's popularity, widespread adoption, and integration with many other tools make it a pragmatic choice for collaboration and code management.

Testing Methods:

- **Unit Testing:**
 - This involves testing individual components or units of code in isolation to ensure that each part functions correctly on its own
- **Integration Testing:**
 - This method assesses how different components or systems work together by testing their interactions and data exchanges.

Project Plan (Gantt chart)

ID	TASK NAME	WEEK											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Requirement Analysis & Documentation												
2	planning												
3	Page UI Design												
4	Database Design												
5	Coding the Structure												
6	Development												
7	Testing												
8	Launching the web Application												

Figure 3 Gantt Chart

Pre-Semester Preparation:

- We began gathering details before the semester officially started.
- Took two weeks from the start of the semester to complete the requirement analysis and documentation phase.
- Successfully collected all necessary information to fulfil our project requirements.

Week 2:

- Focused on detailed project planning to outline the project's direction and milestones.

Week 3:

- Initiated work on the UI design of the page, creating the visual layout and user interface elements.

Week 4:

- Decided to allocate about three weeks to the database design phase, focusing on structuring and organizing the database.

Week 5:

- Began coding the project, setting the foundation for implementation.

Weeks 5-8:

- Continued coding for the next four weeks, making steady progress on the development.

End of Week 9:

- Planned to complete the project by the end of this week.

Future Plans:

- Anticipate learning more about coding and exploring various development tools throughout the process.
- After the testing phase, we aim to launch the web application starting in the twelfth week.

Work Breakdown

Student ID and Name with initials	Task Description
DE SILVA R K D H IT22001252	Implementing the Employee Management section Completed Tools and Technology part in the system Methodology section of the proposal report.
PIYARATNE U A D T IT22088550	Implementing the Inventory Management section Completed Software Development Life Cycle part in the Methodology section of the proposal report.
HERATH D M S T IT22639776	Implementing Transport Management section Completed the Aims and Objectives of the proposal report.
VIVIPEM L B R V IT22639844	Implementing the Supply Management section Completed the Project Plan (Grantt Chart) in the Methodology section of the proposal report.
JANUKSHAN S IT22635266	Implementing Field and Harvest Management section Completed Background, Problems and Motivations section of the proposal report.
RANDENIYA A.A.S.L.B.R.P.W.R.C IT22236500	Implementing the Sales and Order Management section Completed Literature Review section of proposal report.
MIHISARANI A K S IT22175366	Implementing the Product Management section Completed Literature Review section of proposal report.
ASATH M M IT22633422	Implementing the Maintenance and Repair Management section Completed the System Diagram part in System Overview of the proposal report.

9. Evaluation Method

- **User Acceptance Testing (UAT):**

Involves end-users testing the system to confirm it meets their

Automated Testing: Utilizes tools and scripts to automate the execution of test cases, enhancing efficiency and repeatability.

- **Performance Testing:** Check system performance under different conditions.
- **Feedback Collection:** Gather feedback from users for further improvements

- **Feedback from Users:**

- **Surveys and Questionnaires:** Collect structured feedback on usability, functionality, and overall satisfaction.
- **Focus Groups:** Conduct group discussions with users to gather detailed insights and suggestions.
- **Usability Testing:** Observe users interacting with the application to identify pain points and areas for improvement.

- **Analyzing Errors in Generated Reports:**

- **Error Logging and Monitoring:** Implement tools to automatically log and monitor errors in real-time.
- **Report Review Sessions:** Regularly review generated reports to identify and analyze discrepancies or errors.
- **Root Cause Analysis:** Investigate the underlying causes of errors and implement corrective measures.

- **Performance Testing:**

- **Load Testing:** Simulate multiple users accessing the system simultaneously to evaluate performance under stress.
- **Stress Testing:** Push the system beyond its normal operational capacity to identify breaking points.
- **Benchmark Testing:** Compare the application's performance against predefined standards or benchmarks.
- **Response Time Monitoring:** Measure the time taken for various operations to ensure they meet acceptable thresholds.

- **User Behavior Analysis:**
 - **Analytics Tools:** Use tools like Google Analytics to track user behavior, page visits, and interaction patterns.
 - **Heatmaps:** Visualize user interactions to understand which areas of the application are most engaged with.

10. References

[1]“Stassen Tea,” *Stassentea.com*, 2024. <https://www.stassentea.com/> (accessed Aug. 06, 2024).

[2]Mahesh De Zoysa, “Market Report – 09th & 10th July 2024 – Ceylon Tea Brokers PLC,” *Ceylontebrokers.com*, 2024. <https://ceylontebrokers.com/market-report-09th-10th-july-2024/> (accessed Aug. 06, 2024).

[3]“Market Report - Asia Siyaka,” *Asia Siyaka*, Feb. 16, 2023. <https://asiasiyaka.lk/market-report/> (accessed Aug. 06, 2024).

[4]“Forbes and Walker Tea Brokers,” *Forbestea.com*, 2024. http://www.forbestea.com:9090/rpts/portal/report.jsp?sale_year=2024&sales_no=1 (accessed Aug. 06, 2024).

[5]“TEA MARKET REPORT,” 2024. Accessed: Aug. 06, 2024. [Online]. Available: <https://www.lcbl-sl.com/downloads/mr/2024-015.pdf>

[6]“Download Tea Market Reports | Eastern Brokers,” *Eastern Brokers*, 2024. <https://www.easternbrokerslimited.com/downloads/tea-market-reports> (accessed Aug. 06, 2024).

[7]“Infusions of Value TEA SMALLHOLDER FACTORIES PLC ANNUAL REPORT 2023/24.” Accessed: Aug. 06, 2024. [Online]. Available: <https://www.keells.com/resource/reports/group-annual-reports/Tea-Smallholder-Factories-PLC-Annual-Report-23-24.pdf>

9. Appendix

Figure 1 - System Diagram

A graphical representation of a system, showing the various components and their relationships. The system diagram typically includes various components, such as inputs, processes, outputs, feedback, and control mechanisms. Inputs are the data or materials that are fed into the system, and outputs are the results or products that are produced by the system.

Figure 2 - Literature Review

An essential component of research or project that provides a comprehensive analysis of existing knowledge on a given topic.

Figure 3 - Gantt Chart

Tool for project management that provides a visual representation of a project schedule and helps to ensure that the project is completed on time.