

# ERP System Design Documentation for EcoCraft Manufacturing

## 1. System Design Document

### 1.1 Introduction

#### Company Overview:

EcoCraft Manufacturing is a company dedicated to producing eco-friendly packaging materials, including biodegradable containers, recycled paper products, and reusable bags. The company operates in a market that values sustainability, and its mission is to reduce the environmental impact of packaging materials through innovative manufacturing processes.

#### Project Objective:

The objective of this project is to design a comprehensive ERP (Enterprise Resource Planning) system for EcoCraft Manufacturing. The ERP system will integrate various business processes to improve operational efficiency, streamline workflows, and support informed decision-making. The system will cover key functions such as Inventory Management, Production Planning, Sales and Order Processing, Purchasing, Finance, HR, and Reporting.

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### 1.2 System Architecture

#### Overview:

The ERP system will be designed using a three-tier architecture, consisting of the frontend, backend, and database layers. The system will be web-based, ensuring that it can be accessed from any location with an internet connection.

#### Technologies:

- **Frontend:** React.js will be used to build a dynamic and user-friendly interface that is accessible via web browsers.
- **Backend:** Node.js with Express will be employed to handle business logic, process requests from the frontend, and interact with the database.
- **Database:** PostgreSQL will be used for relational data storage, providing a reliable and scalable solution for managing data.
- **Security:** JSON Web Tokens (JWT) will be utilized for user authentication, and HTTPS will be implemented for secure data transmission.

#### Module Interactions:

The ERP system will consist of various modules that interact seamlessly to provide a unified platform for managing the company's operations. These modules include Inventory Management, Production Planning, Sales, Purchasing, Finance, HR, and Reporting. Each module

will interact with the others through the backend, ensuring data consistency and enabling comprehensive reporting.

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## 1.3 Module Design

### Inventory Management:

- **Purpose:** Manage raw materials, finished goods, and stock levels.
- **Features:**
  - Track inventory levels in real-time.
  - Set reorder points and trigger automatic purchase orders.
  - Monitor supplier performance and lead times.

### Production Planning:

- **Purpose:** Optimize production schedules and machine utilization.
- **Features:**
  - Create and manage production orders.
  - Monitor machine utilization and downtime.
  - Track production output against targets.

### Sales and Order Processing:

- **Purpose:** Streamline customer order management and sales tracking.
- **Features:**
  - Process customer orders and generate invoices.
  - Track sales performance by product, region, and time period.
  - Manage customer relationships and track communication history.

### Purchasing and Supplier Management:

- **Purpose:** Manage procurement and supplier relationships.
- **Features:**
  - Generate purchase orders and track delivery status.
  - Evaluate supplier performance based on quality, price, and delivery time.
  - Manage supplier contracts and agreements.

### Finance and Accounting:

- **Purpose:** Track financial transactions and generate reports.
- **Features:**
  - Record revenue, expenses, and financial transactions.
  - Generate financial statements, including profit and loss reports, balance sheets, and cash flow statements.

- Monitor budget performance and financial KPIs.

### **Human Resources Management:**

- **Purpose:** Manage employee data, payroll, and attendance.
- **Features:**
  - Maintain employee records, including personal details, job roles, and salary information.
  - Process payroll and manage tax deductions.
  - Track employee attendance and leave balances.

### **Reporting and Analytics:**

- **Purpose:** Provide insights into business performance.
- **Features:**
  - Generate reports on key metrics, including inventory levels, production efficiency, sales performance, and financial health.
  - Create custom dashboards for different user roles.
  - Allow for data export in various formats for further analysis.

## **1.4 Database Design**

**Overview:** The database for the EcoCraft Manufacturing ERP system will be designed to efficiently store and manage all the data required by various modules, such as Inventory, Production, Sales, Purchasing, Finance, and HR. The database will be implemented using PostgreSQL, a robust relational database management system that supports complex queries, relationships, and data integrity.

**Entity-Relationship Diagram (ERD):** The ERD will illustrate the relationships between key entities within the ERP system, such as Products, Orders, Employees, Suppliers, and Financial Transactions. The design will ensure normalization to reduce redundancy and improve data integrity.

### **Key Tables and Relationships:**

- 1. Products Table:**
  - **Attributes:** ProductID (Primary Key), ProductName, Description, Category, UnitPrice, QuantityInStock, ReorderLevel, SupplierID (Foreign Key)
  - **Relationships:** Linked to the Suppliers table through SupplierID, linked to SalesOrders and PurchaseOrders through ProductID.
- 2. Suppliers Table:**
  - **Attributes:** SupplierID (Primary Key), SupplierName, ContactName, Address, Phone, Email
  - **Relationships:** Linked to the Products table through SupplierID, linked to PurchaseOrders through SupplierID.
- 3. SalesOrders Table:**

- **Attributes:** SalesOrderID (Primary Key), OrderDate, CustomerID (Foreign Key), TotalAmount
  - **Relationships:** Linked to Customers through CustomerID, linked to SalesOrderDetails through SalesOrderID.
4. **SalesOrderDetails Table:**
- **Attributes:** SalesOrderDetailID (Primary Key), SalesOrderID (Foreign Key), ProductID (Foreign Key), Quantity, UnitPrice, TotalPrice
  - **Relationships:** Linked to SalesOrders through SalesOrderID, linked to Products through ProductID.
5. **PurchaseOrders Table:**
- **Attributes:** PurchaseOrderID (Primary Key), OrderDate, SupplierID (Foreign Key), TotalAmount
  - **Relationships:** Linked to Suppliers through SupplierID, linked to PurchaseOrderDetails through PurchaseOrderID.
6. **PurchaseOrderDetails Table:**
- **Attributes:** PurchaseOrderDetailID (Primary Key), PurchaseOrderID (Foreign Key), ProductID (Foreign Key), Quantity, UnitPrice, TotalPrice
  - **Relationships:** Linked to PurchaseOrders through PurchaseOrderID, linked to Products through ProductID.
7. **Employees Table:**
- **Attributes:** EmployeeID (Primary Key), FirstName, LastName, Position, Department, Salary, HireDate, ManagerID (Foreign Key)
  - **Relationships:** Linked to HR records, linked to the Finance module through payroll transactions.
8. **Customers Table:**
- **Attributes:** CustomerID (Primary Key), CustomerName, ContactName, Address, Phone, Email
  - **Relationships:** Linked to SalesOrders through CustomerID.
9. **FinancialTransactions Table:**
- **Attributes:** TransactionID (Primary Key), TransactionDate, AccountID (Foreign Key), Amount, TransactionType (e.g., Revenue, Expense), Description
  - **Relationships:** Linked to the Finance module, linked to various other tables through AccountID.
10. **HRRecords Table:**
- **Attributes:** RecordID (Primary Key), EmployeeID (Foreign Key), AttendanceDate, HoursWorked, LeaveType, PayrollProcessed (Boolean)
  - **Relationships:** Linked to Employees through EmployeeID.

**Normalization:** The database design will adhere to the principles of normalization to eliminate redundancy and ensure data integrity. Each table will be structured to avoid duplication of data, with foreign keys used to establish relationships between related entities.

**Indexes:** Indexes will be created on frequently queried columns, such as ProductID, CustomerID, and OrderDate, to enhance the performance of database operations.

## 2. Data Modeling and Preparation

### 2.1 Synthetic Data Creation

To effectively demonstrate the functionality of the ERP system for EcoCraft Manufacturing, synthetic data will be generated for key business areas such as Inventory, Sales, Production, Finance, and HR. This data will reflect realistic business scenarios and will be used to populate the database and power the Tableau dashboards.

#### Data Categories and Sample Data:

##### 1. Inventory Data:

###### ○ Products:

- **ProductID:** P001, P002, P003
- **ProductName:** Biodegradable Container, Recycled Paper, Reusable Bag
- **Category:** Containers, Paper Products, Bags
- **UnitPrice:** 2.50, 1.20, 3.00
- **QuantityInStock:** 5000, 20000, 3000
- **ReorderLevel:** 1000, 5000, 500
- **SupplierID:** S001, S002, S003

###### ○ Suppliers:

- **SupplierID:** S001, S002, S003
- **SupplierName:** Green Earth Supplies, EcoPaper Co., Sustainable Bags Ltd.
- **ContactName:** John Doe, Jane Smith, David Johnson
- **Address:** 123 Green St, 456 Paper Rd, 789 Bag Ln
- **Phone:** 555-1234, 555-5678, 555-9101

##### 2. Sales Data:

###### ○ Customers:

- **CustomerID:** C001, C002, C003
- **CustomerName:** EcoStore, GreenMart, EarthShop
- **ContactName:** Alice Brown, Bob White, Carol Black
- **Address:** 10 Eco Ave, 20 Green Blvd, 30 Earth Dr
- **Phone:** 555-2345, 555-6789, 555-1122

###### ○ Sales Orders:

- **SalesOrderID:** SO001, SO002, SO003
- **OrderDate:** 2024-08-01, 2024-08-05, 2024-08-10
- **CustomerID:** C001, C002, C003
- **TotalAmount:** 1250.00, 2400.00, 900.00

###### ○ Sales Order Details:

- **SalesOrderDetailID:** SOD001, SOD002, SOD003
- **SalesOrderID:** SO001, SO002, SO003
- **ProductID:** P001, P002, P003
- **Quantity:** 500, 2000, 300
- **UnitPrice:** 2.50, 1.20, 3.00
- **TotalPrice:** 1250.00, 2400.00, 900.00

### 3. Production Data:

- **Production Orders:**
  - **ProductionOrderID:** PO001, PO002, PO003
  - **OrderDate:** 2024-07-25, 2024-07-28, 2024-07-30
  - **ProductID:** P001, P002, P003
  - **Quantity:** 1000, 4000, 500
  - **MachineID:** M001, M002, M003
- **Machine Utilization:**
  - **MachineID:** M001, M002, M003
  - **MachineName:** Molder, Paper Press, Bag Stitcher
  - **UtilizationRate:** 85%, 90%, 75%
  - **Downtime:** 5 hours, 3 hours, 7 hours

### 4. Finance Data:

- **Financial Transactions:**
  - **TransactionID:** T001, T002, T003
  - **TransactionDate:** 2024-08-01, 2024-08-05, 2024-08-10
  - **AccountID:** A001, A002, A003
  - **Amount:** 5000.00, 3000.00, 7000.00
  - **TransactionType:** Revenue, Expense, Revenue
  - **Description:** Sales Income, Utility Payment, Sales Income
- **Accounts:**
  - **AccountID:** A001, A002, A003
  - **AccountName:** Revenue, Expenses, Cost of Goods Sold
  - **AccountType:** Income, Expense, COGS

### 5. HR Data:

- **Employees:**
  - **EmployeeID:** E001, E002, E003
  - **FirstName:** Emily, James, Sophia
  - **LastName:** Green, Taylor, Johnson
  - **Position:** Production Manager, Sales Executive, HR Manager
  - **Department:** Production, Sales, HR
  - **Salary:** 60000, 50000, 55000
  - **HireDate:** 2023-01-10, 2023-03-15, 2023-05-20
  - **ManagerID:** E004
- **HR Records:**
  - **RecordID:** HR001, HR002, HR003
  - **EmployeeID:** E001, E002, E003
  - **AttendanceDate:** 2024-08-01, 2024-08-02, 2024-08-03
  - **HoursWorked:** 8, 8, 7
  - **LeaveType:** None, None, Sick Leave
  - **PayrollProcessed:** True, True, True

## 2.2 Data Integration

### Relational Structure:

The synthetic data created will be organized in a relational structure that aligns with the

database design. The tables will be populated with this data, establishing the necessary relationships through foreign keys (e.g., linking ProductID in the SalesOrderDetails table to the Products table).

#### **Data Import:**

- **Database Seeding:** The synthetic data will be used to seed the PostgreSQL database. This process will involve creating SQL scripts to insert the data into the appropriate tables.
- **Validation:** After importing the data, it will be validated to ensure that all relationships are intact and that the data accurately reflects realistic business scenarios.

#### **Preparation for Tableau:**

- **Data Export:** The data from Excel will be exported in a format compatible with Tableau (e.g., CSV files).
- **Tableau Connection:** The exported data will be connected to Tableau, where it will be used to create interactive dashboards that visualize key business metrics.

### **3. Prototype Development (Tableau Dashboard)**

In this section, the prototype development process for creating Tableau dashboards will be detailed. These dashboards will be designed to visualize and analyze the synthetic data created in the previous section. The focus will be on key business areas such as Inventory, Sales, Production, Finance, and HR, with each dashboard providing actionable insights for decision-makers.

#### **3.1 Dashboard Design and Layout**

Each dashboard will have a clean, user-friendly interface that aligns with EcoCraft Manufacturing's business needs. The dashboards will be interactive, allowing users to drill down into specific data points and filter data dynamically.

#### **3.2 Inventory Management Dashboard**

##### **Key Metrics:**

- Total Stock Value
- Stock Levels by Product Category
- Reorder Levels by Product
- Supplier Performance Metrics
- Inventory Turnover Rate

### Design Elements:

- **Main Dashboard View:** An overview of the total stock value with a color-coded bar chart showing stock levels across different product categories.
- **Reorder Alert Section:** A list or bar chart highlighting products that are at or below their reorder levels.
- **Supplier Performance:** A heatmap or scatter plot to assess supplier reliability and delivery times.
- **Interactive Filters:** Users can filter data by product category, supplier, and time period.

## 3.3 Sales Dashboard

### Key Metrics:

- Total Sales Revenue
- Sales by Product
- Sales by Customer
- Monthly Sales Trend
- Sales Order Fulfillment Rate

### Design Elements:

- **Sales Overview:** A line chart showing the monthly sales trend alongside a KPI indicator for total sales revenue.
- **Product Sales Breakdown:** A treemap or pie chart displaying sales distribution by product.
- **Customer Insights:** A bar chart to show the sales contributions of top customers.
- **Interactive Filters:** Options to filter by date range, customer, and product.

## 3.4 Production Dashboard

### Key Metrics:

- Production Output by Product
- Machine Utilization Rates
- Downtime Analysis
- Production Efficiency Over Time

### Design Elements:

- **Production Output:** A stacked bar chart showing production output segmented by product type.
- **Machine Utilization:** A gauge or bar chart showing the utilization rates of different machines, with an indicator for downtime.
- **Efficiency Trends:** A line chart displaying production efficiency over time, with a trend line for easy analysis.



- **Interactive Filters:** Filters for product type, machine, and production date.

### 3.5 Finance Dashboard

#### Key Metrics:

- Total Revenue
- Total Expenses
- Profit Margin
- Cash Flow Overview
- Expense Breakdown by Category

#### Design Elements:

- **Financial Summary:** A KPI dashboard showing total revenue, total expenses, and net profit with clear, large visuals.
- **Expense Breakdown:** A donut chart or bar chart that categorizes expenses by type (e.g., COGS, utilities, payroll).
- **Cash Flow Analysis:** A line graph showing the cash inflows and outflows over a specified period.
- **Interactive Filters:** Filters for date range, transaction type, and account category.

### 3.6 HR Dashboard

#### Key Metrics:

- Employee Count by Department
- Attendance and Leave Records
- Employee Performance Metrics
- Payroll Summary

#### Design Elements:

- **Headcount Overview:** A bar chart displaying the number of employees in each department.
- **Attendance Records:** A calendar heatmap showing employee attendance and leave patterns.
- **Performance Metrics:** A scatter plot or bar chart to visualize employee performance ratings or milestones.
- **Payroll Overview:** A table or KPI widget summarizing payroll data by department and job role.
- **Interactive Filters:** Filters for department, job role, and time period.

### 3.7 Interactive Features and User Experience

#### Interactive Elements:

- **Drill-Down Capabilities:** Users can click on data points to drill down into more detailed views (e.g., clicking on a product in the inventory dashboard to view its stock levels over time).
- **Dynamic Filters:** Every dashboard will include filters to allow users to customize the data view according to specific criteria.
- **Tooltips:** Tooltips will provide additional context when hovering over data points, showing exact values and relevant details.

#### User Experience:

- **Navigation:** Each dashboard will be linked with navigational buttons for easy access to other dashboards, creating a seamless user experience.
- **Responsive Design:** The dashboards will be designed to be responsive, ensuring that they display correctly on different screen sizes and devices.

### 3.8 Deployment and Testing

#### Deployment:

- The dashboards will be deployed in Tableau Server or Tableau Online, ensuring secure access and sharing capabilities for EcoCraft Manufacturing's team.
- Access permissions will be set up based on user roles, with different views available for executives, managers, and analysts.

#### Testing:

- The dashboards will undergo rigorous testing to ensure data accuracy, performance, and usability.
- Feedback will be gathered from key stakeholders, and iterative improvements will be made based on their input.

## 4. Implementation Plan

### 4.1 Deployment Strategy

#### Server Setup:

- **Infrastructure Planning:** The hardware and software requirements will be determined based on the expected workload. A decision will be made between on-premises servers or cloud-based solutions (e.g., AWS, Azure).
- **Server Configuration:** Necessary servers will be set up with the required operating systems, databases (e.g., PostgreSQL), and application servers (e.g., Apache Tomcat for Java-based applications).
- **Database Deployment:** The ERP system's database schema will be deployed on the server, ensuring that all tables, relationships, and constraints are correctly implemented.

- **Application Deployment:** The ERP application will be deployed, with all necessary web servers, middleware, and front-end assets correctly configured.
- **Testing Environment:** A testing environment will be set up to simulate the live environment, and pre-deployment testing will be performed to identify potential issues.

#### **Data Migration:**

- **Data Mapping:** Existing data structures will be identified and mapped to the new ERP system, ensuring that data from legacy systems is accurately mapped to corresponding fields.
- **Data Extraction:** Data from legacy systems, including inventory, sales, production, finance, and HR records, will be extracted.
- **Data Transformation:** The extracted data will be cleansed and transformed to meet the new system's format, ensuring consistency and accuracy.
- **Data Loading:** Transformed data will be imported into the new ERP system using automated scripts where possible to ensure a smooth migration process.
- **Validation:** The data migration will be validated to ensure data integrity and accuracy. Spot checks and reports will be performed to confirm that data has been migrated correctly.

## **4.2 Training Plan**

#### **Training Needs Assessment:**

- **Role-Based Training:** Different roles within EcoCraft Manufacturing (e.g., managers, HR personnel, sales staff) will be identified, and specific training needs for each group will be determined.
- **Training Objectives:** Clear training objectives for each role will be defined, focusing on how employees will interact with the ERP system in their daily tasks.

#### **Training Methods:**

- **Workshops and Seminars:** In-person or virtual workshops will be conducted to introduce employees to the ERP system. These sessions will cover basic navigation, key functionalities, and specific tasks relevant to each role.
- **Hands-On Training:** Hands-on training sessions will be provided, allowing employees to practice using the system in a controlled environment, becoming familiar with the system's interface and features.
- **Training Materials:** Comprehensive training materials, including user manuals, video tutorials, and quick reference guides, will be developed and made accessible online for ongoing reference.

#### **Ongoing Support:**

- **Help Desk:** A dedicated help desk or support team will be established to assist employees with any questions or issues they encounter while using the ERP system.

- **Continuous Learning:** Follow-up training sessions and refresher courses will be offered to ensure employees stay up to date with system updates and new features.

## 4.3 Security Measures

### Access Controls:

- **Role-Based Access:** Role-based access controls will be implemented to ensure employees only have access to the data and functionalities necessary for their job, minimizing the risk of unauthorized access to sensitive information.
- **Multi-Factor Authentication (MFA):** Multi-factor authentication will be required for system access, adding an extra layer of security beyond just a password.
- **Audit Trails:** Audit trails will be set up to track user activities within the ERP system, helping to monitor any unauthorized or suspicious behavior.

### Data Encryption:

- **Data at Rest:** All sensitive data stored in the ERP system's database will be encrypted using strong encryption algorithms (e.g., AES-256).
- **Data in Transit:** All data transmitted between users and the ERP system will be encrypted using secure protocols such as TLS/SSL.
- **Backup Encryption:** All backup files will be encrypted to protect data from unauthorized access in the event of a security breach.

### Regular Security Audits:

- **Vulnerability Assessments:** Regular vulnerability assessments and penetration testing will be conducted to identify and address potential security weaknesses.
- **Compliance Checks:** The ERP system will be regularly checked to ensure compliance with industry standards and regulations (e.g., GDPR, HIPAA) relevant to EcoCraft Manufacturing.

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## 5. Testing and Refinement

### 5.1 Prototype Testing

#### Functionality Testing:

- **Test Scenarios:** A series of test scenarios covering all key functionalities of the ERP system, including inventory management, sales processing, production tracking, financial reporting, and HR management, will be developed and executed.
- **User Acceptance Testing (UAT):** A group of users representing different roles within EcoCraft Manufacturing will perform UAT, interacting with the system in a real-world setting and providing feedback on usability and functionality.

- **Performance Testing:** Performance testing will be conducted to ensure the ERP system can handle the expected load and perform efficiently under various conditions.

### **Tableau Dashboard Testing:**

- **Data Accuracy:** The data displayed in the Tableau dashboards will be verified to ensure accuracy and alignment with the underlying data in the ERP system.
- **Interactivity:** The interactive elements of the dashboards, including filters, drill-downs, and tooltips, will be tested to ensure they function correctly.
- **Usability:** The usability of the dashboards will be assessed, ensuring they provide a clear and intuitive user experience.

## **5.2 Feedback and Refinement**

### **Stakeholder Feedback:**

- **Gathering Feedback:** Feedback will be collected from key stakeholders (e.g., department heads, managers) on the ERP system's prototype, focusing on its ability to meet the business's needs.
- **Areas of Improvement:** Any areas where the system could be improved, such as additional features, interface enhancements, or performance optimizations, will be identified.

### **Prototype Refinement:**

- **Iterative Development:** Necessary adjustments to the ERP system and Tableau dashboards will be made based on the feedback received. This may involve refining existing features, adding new functionalities, or improving system performance.
- **Final Testing:** After refinements are made, another round of testing will be performed to ensure all changes have been successfully implemented and that the system meets all requirements.

### **Final Documentation:**

- **System Documentation:** The system documentation will be updated to reflect any changes made during the refinement process, including user manuals, technical documentation, and training materials.
- **Deployment Readiness:** It will be ensured that the ERP system is fully tested, refined, and ready for deployment, with all necessary training and support resources in place.