Zewail City of Science, Technology and Innovation

University of Science and Technology

School of Computational Sciences and Artificial Intelligence

CSAI 202 - Fall 2025

Introduction to Database Systems

Supply Chain Management System

Phase 1 Report

Team Members:

Mahmoud Sakr ID: [202402130]
Mohamed Tamer ID: [202403014]
Ahmed Noman ID: [202401324]

Contact:

s-mahmoud.shrief@zewailcity.edu.eg
s-mohmed.refaay@zewailcity.edu.eg
sahmed.naba@zewailcity.edu.eg

December 13, 2025

Contents

1 Executive Summary

This report presents a comprehensive analysis of the Supply Chain Management System, a sophisticated web-based application designed to revolutionize how businesses manage their supply chain operations. The system integrates multiple facets of supply chain management into a unified, user-friendly platform that streamlines operations from inventory management to final delivery.

This phase of the project focuses on two critical components: a robust database schema design and professional frontend interface mockups. The database has been

carefully architected following industry best practices, while the interface designs demonstrate the planned user experience and functionality.

2 Project Overview

2.1 Project Vision

The Supply Chain Management System was conceived to address the complex challenges faced by modern businesses in managing their supply chains. Traditional supply chain management often involves disparate systems and manual processes that lead to inefficiencies, errors, and delayed decision-making. Our system provides a unified solution that brings all supply chain operations under one digital roof.

2.2 Core Objectives

Streamline Operations: Reduce manual work and automate routine tasks

Enhance Visibility: Provide real-time insights into all supply chain activities

Improve Accuracy: Minimize errors through automated data validation

Increase Efficiency: Optimize inventory levels and reduce operational costs

Empower Decision-Making: Provide actionable analytics and reports

2.3 Technology Stack

The system is designed to be built using modern, enterprise-grade technologies:

Database: Microsoft SQL Server for robust, scalable data management

Backend (Planned): C# for powerful server-side business logic

Frontend: HTML5, CSS3, and JavaScript for responsive, interactive user interfaces

Architecture (Planned): MVC (Model-View-Controller) pattern

2.4 Current Phase

This report documents **Phase 1** of the project, which includes:

Complete database schema design with all tables, relationships, and constraints

Professional frontend interface mockups demonstrating planned functionality

Documentation of system features and workflows

Technical specifications for future implementation

Note: The backend integration connecting the database to the frontend will be implemented in the next phase of development.

3 Database Architecture

3.1 Schema Overview

The database schema consists of 15 interconnected tables that represent the complete supply chain ecosystem. The design follows third normal form (3NF) to eliminate data redundancy while maintaining data integrity through carefully crafted relationships and constraints.

3.2 Design Principles

Our database design adheres to several key principles:

Normalization: Tables are normalized to 3NF to minimize redundancy

Referential Integrity: Foreign keys ensure data consistency across tables

Data Validation: Check constraints enforce business rules at the database level

Scalability: Structure supports growth in data volume and complexity

Performance: Strategic use of indexes (planned) will optimize query performance

3.3 Key Database Tables

3.3.1 User Management

Role: Defines user permissions and access levels for the RBAC system

User: Stores authentication credentials, email, and password hashes

Customer: Extended user information for customer-specific data

Supplier: Supplier-specific data including contact information

Warehouse Manager: Links managers to their assigned warehouses

3.3.2 Product and Inventory

Category: Hierarchical product classification system

Product: Complete product catalog with pricing and supplier links

Inventory: Real-time stock levels across multiple warehouse locations

3.3.3 Order Management

Purchase Order: Customer order headers with status and totals

Order Details: Line-item details for each order

Payment: Payment transaction records with multiple payment methods

Feedback: Customer reviews and ratings for quality tracking

3.3.4 Logistics

Warehouse: Storage facility locations and management assignments

Shipment: Real-time tracking information for all deliveries

Notification: System alerts and user notifications

3.4 Data Integrity Features

Primary Keys: Both IDENTITY auto-incrementing and composite keys

Foreign Keys: Maintain referential integrity across all relationships

Check Constraints: Enforce business rules (positive prices, valid ratings 1-5)

Unique Constraints: Prevent duplicate emails and ensure data quality

Default Values: Automatic initialization (e.g., Reorder Level = 10)

3.5 Entity Relationships

The database implements several types of relationships:

One-to-One: User to Customer/Supplier/Warehouse Manager

One-to-Many: Customer to Orders, Supplier to Products, Warehouse to Shipments

Many-to-Many: Orders to Products (via Order_Details), Products to Warehouses (via Inventory)

4 Frontend Interface Design

This section showcases the professional interface mockups that demonstrate the planned user experience and system functionality. Each screen has been carefully designed with user-centric principles.

4.1 Dashboard Overview

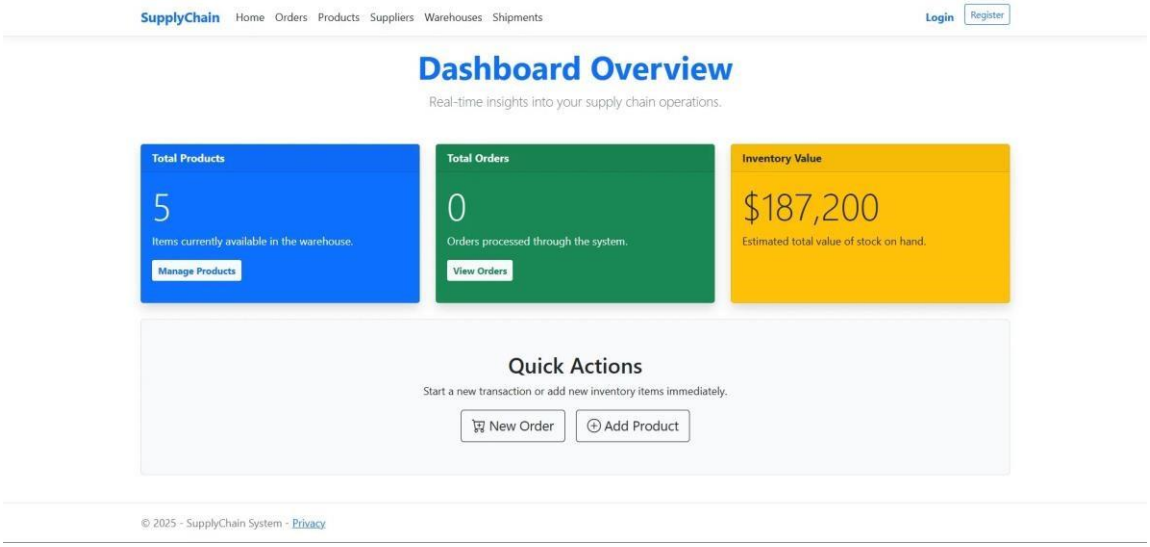

Figure 1: Main Dashboard - Real-time Supply Chain Metrics

4.1.1 Purpose and Functionality

The Dashboard serves as the central command center for the supply chain management system, providing users with immediate visibility into critical business metrics and quick access to common operations.

4.1.2 Key Features

KPI Cards: Three prominent metric cards display Total Products, Total Orders, and Inventory Value, each color-coded for quick visual recognition

Quick Actions: Two action buttons (”New Order” and ”Add Product”) enable users to initiate common tasks without navigation

Navigation Menu: Horizontal menu bar provides access to all major system modules: Home, Orders, Products, Suppliers, Warehouses, and Shipments

User Authentication: Login and Register buttons in the top-right corner manage user access

Responsive Layout: Clean, card-based design that adapts to different screen sizes

4.1.3 Design Rationale

The dashboard uses a color-coded approach (blue, green, yellow) to help users quickly distinguish between different types of information. The layout prioritizes the most important metrics at the top, with action buttons prominently placed for easy access. The design follows modern UI/UX best practices with ample white space and clear visual hierarchy.

4.2 Order Management

4.2.1 User Orders History

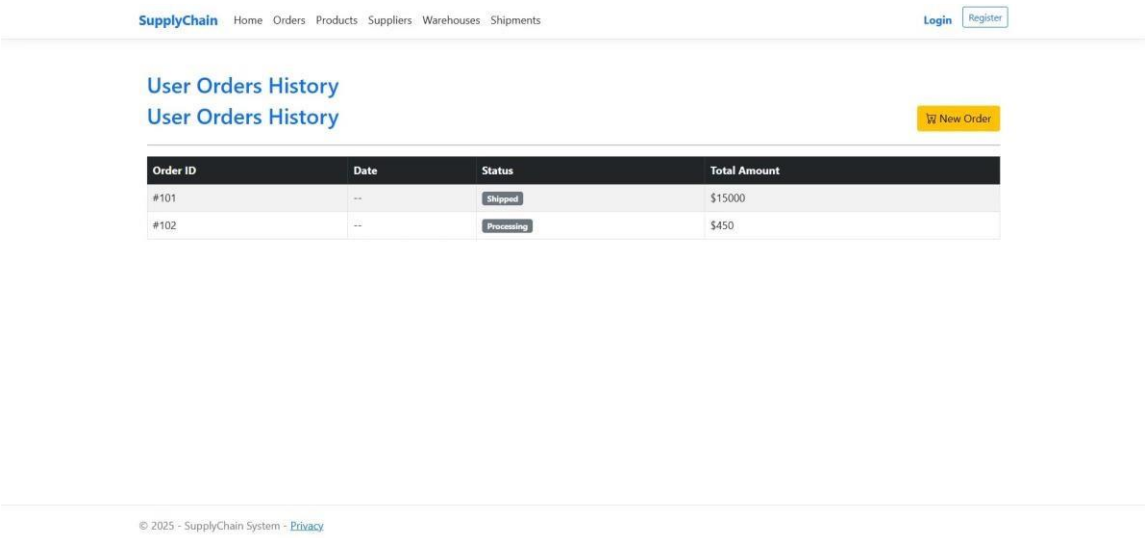

Figure 2: Order History - Customer Order Tracking

Purpose and Functionality: This screen enables customers to view their complete order history, providing transparency and easy access to past transactions for reference or reordering purposes. **Key Features:**

Order Table: Clean tabular display showing Order ID, Date, Status, and Total Amount for each transaction

Status Badges: Visual status indicators (Shipped, Processing, etc.) provide quick order state recognition

New Order Button: Prominent yellow action button enables quick order placement

Sortable Columns: Table headers designed to support sorting by different criteria

Consistent Navigation: Full navigation menu remains accessible throughout

Design Rationale: The tabular format presents order information in a scannable, organized manner. Status badges use neutral colors to avoid visual clutter while still providing clear state information. The ”New Order” button is positioned prominently in the top-right for easy access.

4.2.2 Create New Order

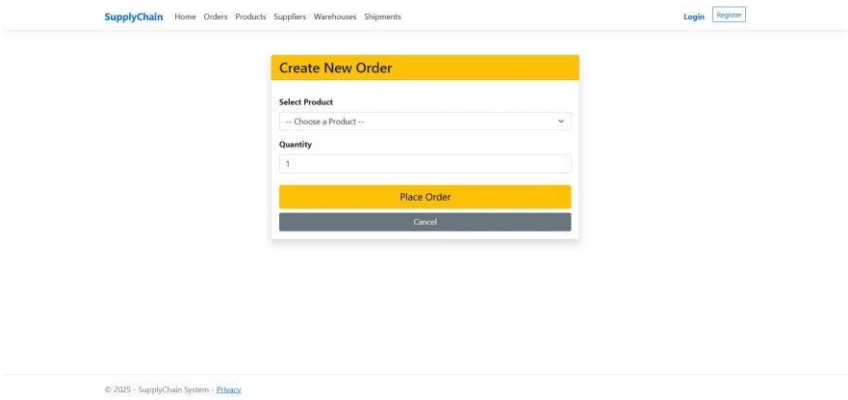

Figure 3: Order Creation - Streamlined Purchase Process

Purpose and Functionality: The order creation interface provides a focused, streamlined process for customers to place new product orders quickly and efficiently. **Key Features:**

Product Selector: Dropdown menu for choosing from available inventory

Quantity Input: Numeric field for specifying order amount with default value

Modal Design: Overlay interface keeps users focused on the order task

Clear Actions: ”Place Order” button for submission and ”Cancel” for abandoning

Form Validation: Fields designed to validate input before submission

Minimal Friction: Only essential fields to speed up the ordering process

Design Rationale: The modal pattern prevents distraction by overlaying the current page rather than navigating away. The bright yellow ”Place Order” button draws attention to the primary action. The form includes only necessary fields to minimize user effort and speed up transactions.

4.3 Product Management

4.3.1 Product Inventory

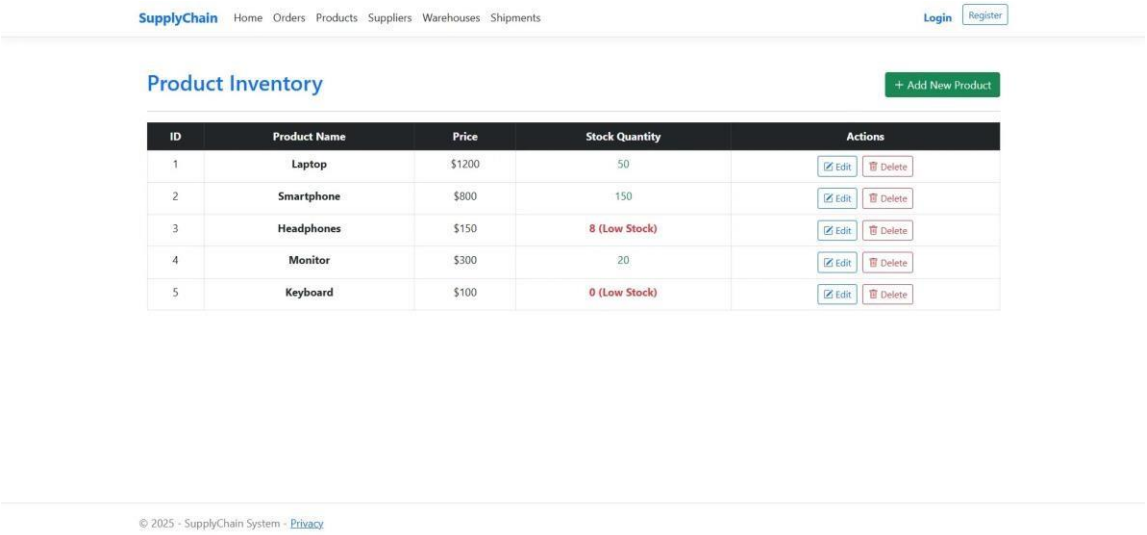

Figure 4: Product Inventory - Catalog and Stock Management

Purpose and Functionality: The Product Inventory screen provides comprehensive catalog management capabilities, enabling administrators and warehouse managers to monitor stock levels and manage product information. **Key Features:**

Comprehensive Table: Displays Product ID, Name, Price, Stock Quantity, and Actions in organized columns

Stock Indicators: Visual color coding (green for adequate, red for low stock) enables quick identification of inventory issues

Row Actions: Edit and Delete buttons on each row for immediate product management

Add Product: Green button in top-right corner for expanding the catalog

Currency Formatting: Clear dollar sign formatting for all prices

Inventory Alerts: ”Low Stock” warnings highlight items needing attention

Design Rationale: The color-coded stock indicators provide immediate visual feedback about inventory status, allowing managers to quickly identify problematic items. Row-level action buttons eliminate the need for navigation to separate detail pages. The table structure balances information density with readability.

4.3.2 Add New Product

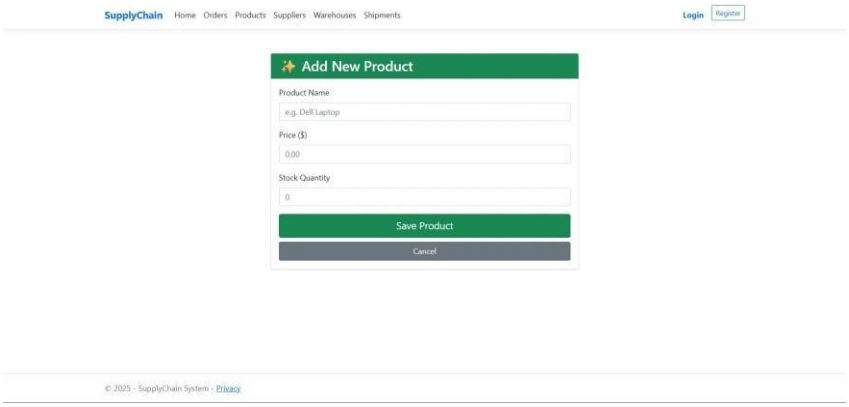

Figure 5: Product Creation - Expanding the Catalog

Purpose and Functionality: This interface allows authorized users to add new products to the system catalog, capturing essential product information in a simple, focused form.
Key Features:

Product Name: Text input with helpful placeholder example

Price Field: Decimal input with currency symbol for monetary values

Stock Quantity: Integer input for initial inventory levels

Save Action: Green ”Save Product” button confirms addition

Cancel Option: Gray button dismisses modal without changes

Validation Ready: Form structure designed for validation implementation

Design Rationale: The form follows a natural top-to-bottom flow. Placeholder text provides guidance without cluttering the interface. The green ”Save Product” button uses color psychology to encourage action completion. Input fields are appropriately sized for their expected content.

4.4 Supplier Management

4.4.1 Suppliers Directory

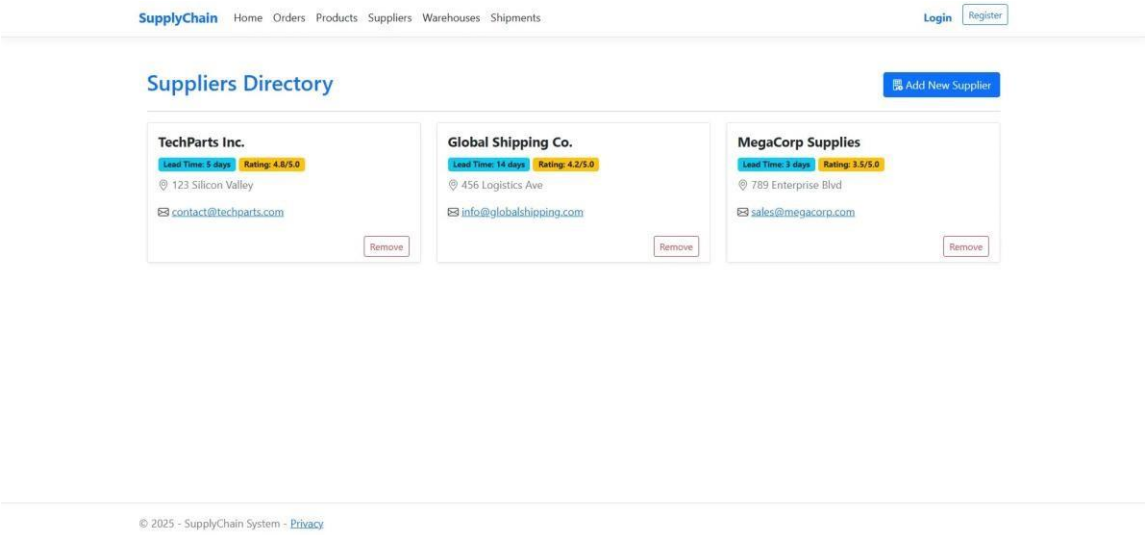

Figure 6: Suppliers Directory - Business Partner Management

Purpose and Functionality: The Suppliers Directory serves as a centralized hub for managing business partner relationships, displaying key supplier information and performance metrics at a glance. **Key Features:**

Card Layout: Each supplier presented in a visually distinct card with complete information

Performance Badges: Lead time and rating indicators provide quick performance assessment

Contact Details: Physical address and email prominently displayed

Visual Hierarchy: Company name emphasized, followed by metrics and contact information

Add Supplier: Blue button for onboarding new business partners

Remove Function: Red button enables supplier relationship termination

Email Links: Clickable email addresses for quick communication

Design Rationale: The card-based design creates a scannable, visually appealing interface where each supplier's information is self-contained. Performance metrics are prominently displayed using color-coded badges to aid in supplier evaluation. The layout provides all necessary information without requiring drill-down navigation.

4.4.2 Add New Supplier

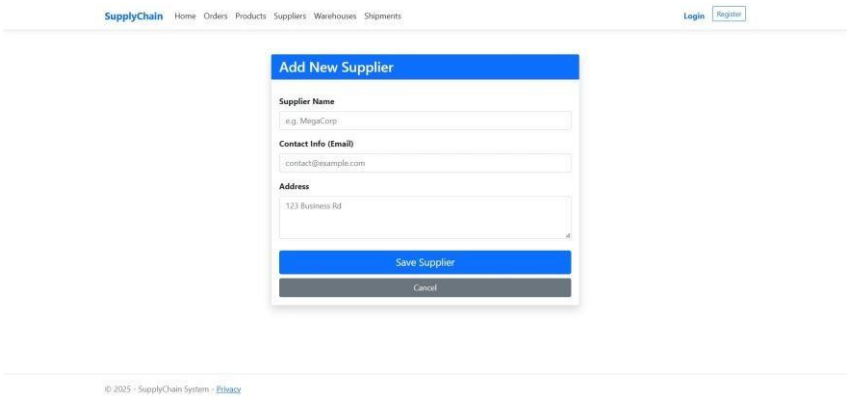

Figure 7: Supplier Registration - Onboarding Business Partners

Purpose and Functionality: This form facilitates the onboarding of new suppliers, collecting essential business contact information required for establishing vendor relationships.

Key Features:

Supplier Name: Text input for company identification

Contact Email: Email field for primary communication channel

Address Field: Multi-line text area accommodates complete physical addresses

Placeholder Guidance: Each field includes examples of expected input format

Save Action: Blue button submits supplier information

Cancel Option: Gray button abandons the operation

Design Rationale: The form uses a logical field ordering that matches typical data entry patterns. The multi-line address field prevents truncation of complete addresses. The blue save button maintains color consistency with the Suppliers section theme.

4.5 Warehouse Operations

4.5.1 Storage Locations

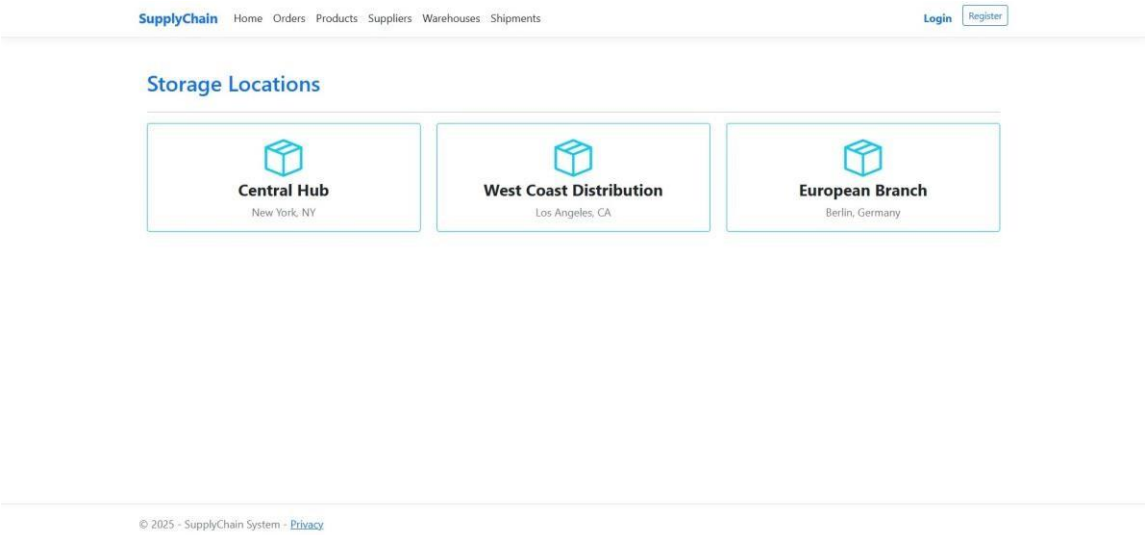

Figure 8: Warehouse Locations - Distribution Network

Purpose and Functionality: This screen provides a geographic overview of all warehouse facilities in the distribution network, enabling users to understand the physical infrastructure supporting operations. **Key Features:**

Card-Based Display: Each warehouse presented in uniform, visually consistent cards

Warehouse Icons: Visual package/box icons for instant recognition

Location Information: Facility name and geographic location clearly displayed

Equal Treatment: All warehouses given same visual prominence

Clean Aesthetic: Minimalist design focuses on essential information

Expandable Design: Layout accommodates additional warehouses as network grows

Design Rationale: The warehouse display employs a clean, icon-driven design that makes the distribution network immediately understandable. The card layout allows for easy comparison between facilities and provides a foundation for future enhancements like inventory summaries or capacity information.

4.6 Logistics and Shipping

4.6.1 Active Shipments

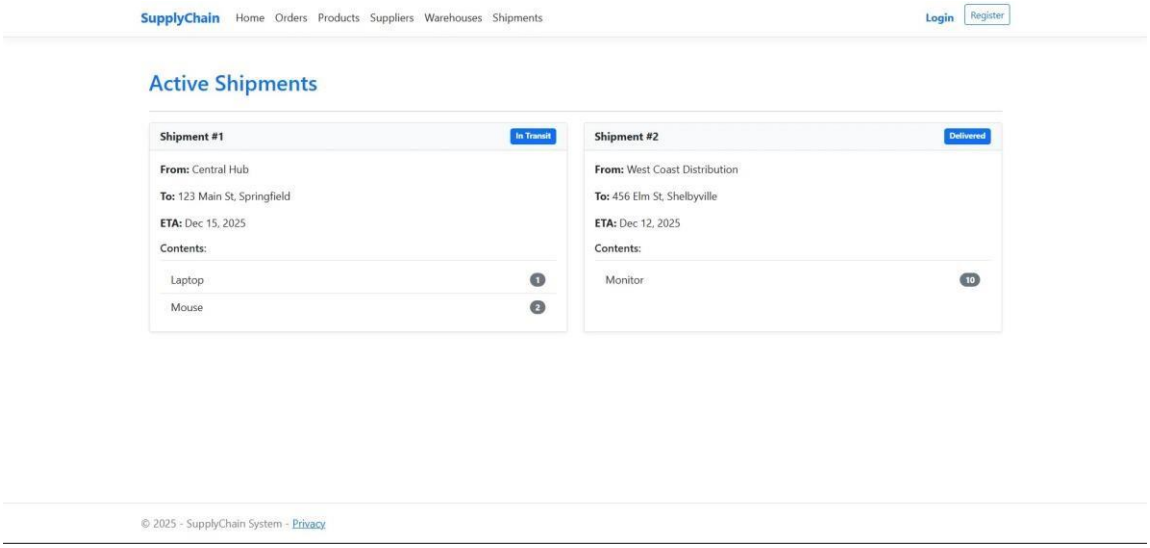

Figure 9: Active Shipments - Real-Time Delivery Tracking

Purpose and Functionality: The Active Shipments screen provides comprehensive visibility into all ongoing deliveries, serving as the logistics command center for tracking products in transit. **Key Features:**

Shipment Cards: Each delivery displayed with complete tracking information

Status Badges: Visual indicators show current shipment state (In Transit, Delivered)

Route Information: Clear display of origin (From) and destination (To) locations

ETA Display: Expected delivery dates for planning and customer communication

Contents Listing: Itemized display of products and quantities in each shipment

Side-by-Side Layout: Multiple shipments visible simultaneously for comparison

Comprehensive Details: All relevant logistics information in one view

Design Rationale: The shipment cards balance information density with readability, presenting complex logistics data in an organized, scannable format. Each card is selfcontained with complete tracking details. The contents section uses bullet points for easy scanning of shipment items.

4.7 User Authentication

4.7.1 User Registration

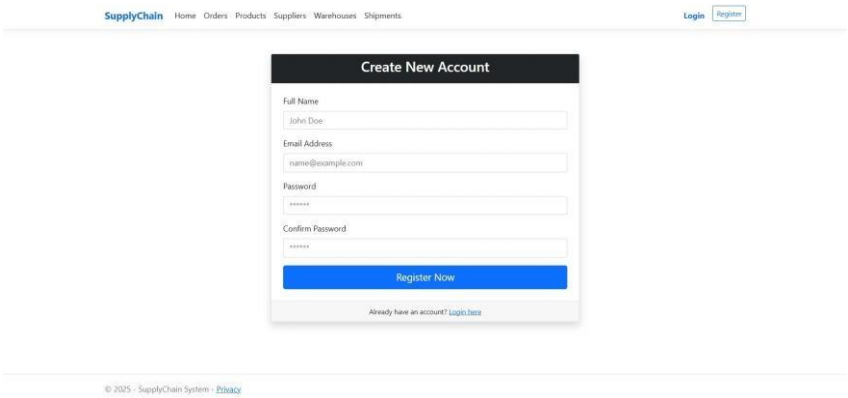

Figure 10: User Registration - Account Creation

Purpose and Functionality: The registration page enables new users to create accounts, collecting necessary credentials and personal information for system access. **Key Features:**

Full Name: Text input for user identification **Email**

Address: Serves as unique login identifier

Password Field: Secure masked input for credential creation

Password Confirmation: Verification field prevents entry errors

Register Button: Prominent blue action button for account creation

Login Link: Direct navigation for existing users

Clean Layout: Centered design with clear visual hierarchy

Design Rationale: The registration form follows standard conventions that users expect, reducing learning curve. Password fields are masked for security, while the confirmation field catches typos. The ”Login here” link prevents accidental duplicate registrations. The form uses action-oriented language (”Register Now”) to encourage completion.

4.7.2 User Login

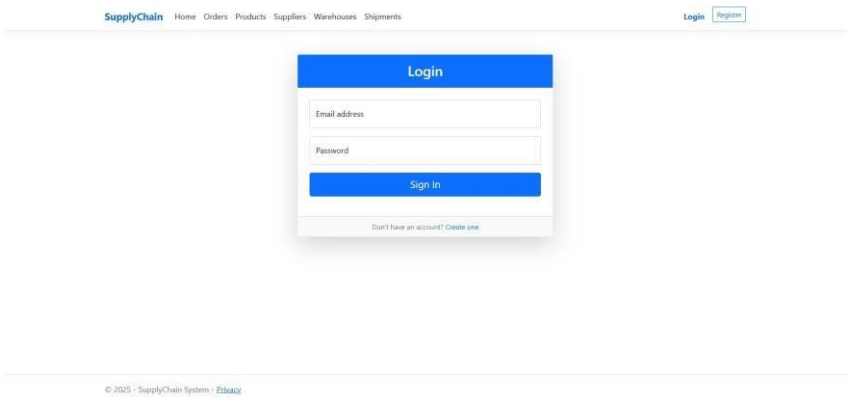

Figure 11: User Login - Secure System Access

Purpose and Functionality: The login page serves as the secure gateway to the system, authenticating users and providing access to role-appropriate interfaces. **Key Features:**

Email Input: User identification field

Password Field: Secure credential entry with masking

Sign In Button: Primary action button for authentication

Registration Link: ”Create one” link for new user onboarding

Minimalist Design: Focused interface eliminates distractions

Professional Appearance: Clean, trustworthy design inspires confidence

Design Rationale: The login page embraces simplicity, presenting only essential elements. The centered layout with generous white space creates a sense of security and professionalism. The blue color scheme maintains consistency with the rest of the application. The ”Create one” link provides an obvious path for new users.

5 Planned System Workflows

5.1 Order Fulfillment Workflow

The following workflow will be implemented when backend integration is complete:

1. Customer places order through the Create New Order interface
2. System validates product availability in Inventory table
3. Order record created in Purchase Order table with ”Pending” status
4. Order Details records created for line items

5. Inventory quantities updated to reflect reserved stock
6. Payment record created in Payment table
7. Shipment record generated with initial ”Processing” status
8. Order status updated as shipment progresses
9. Customer notified at key milestones
10. Feedback can be provided after delivery

5.2 Inventory Management Workflow

1. Manager accesses Product Inventory screen
2. Clicks ”Add New Product” to open creation modal
3. Enters product details (name, price, stock quantity)
4. System validates input data
5. Product record inserted into Product table
6. Initial Inventory record created for warehouse
7. Product appears in inventory list with appropriate stock indicator
8. System monitors stock levels against reorder thresholds 9. Low stock alerts displayed when thresholds are reached

5.3 User Authentication Workflow

1. New user accesses Registration page
2. Completes form with name, email, and password
3. System validates email uniqueness and password strength
4. Password hashed and User record created
5. Default role assigned based on registration type
6. User redirected to Login page
7. User enters credentials on Login screen
8. System verifies email and password hash
9. Session created with user identity and role

10. User redirected to role-appropriate dashboard

6 Security Considerations

6.1 Planned Security Features

When backend implementation begins, the following security measures will be incorporated:

6.1.1 Authentication and Authorization

Password Security: Passwords will be hashed using industry-standard algorithms (BCrypt, PBKDF2, or Argon2)

Session Management: Secure session cookies with HTTP-only and secure flags

Role-Based Access Control: Implemented using the Role table to restrict feature access

Email Verification: Optional email confirmation to validate user accounts

6.1.2 Data Protection

SQL Injection Prevention: All database queries will use parameterized statements

Input Validation: Both client-side and server-side validation of all user inputs

XSS Protection: Proper encoding of user-generated content before display

CSRF Protection: Anti-forgery tokens in all forms

HTTPS Enforcement: All traffic encrypted using SSL/TLS

6.1.3 Database Security

Connection strings will be encrypted and stored securely

Database accounts with minimum required permissions Regular

automated backups Audit

logging for sensitive operations

7 Design Principles

7.1 User Interface Design

The frontend interfaces were designed following these principles:

7.1.1 Usability

Clarity: Clear labels, intuitive icons, and logical information hierarchy

Consistency: Uniform color scheme, button styles, and layout patterns

Efficiency: Quick actions and streamlined workflows minimize user effort

Feedback: Visual indicators provide immediate response to user actions

7.1.2 Visual Design

Color Coding: Strategic use of colors to convey meaning (green for success, red for warnings, blue for actions)

White Space: Generous spacing prevents visual clutter and improves focus

Typography: Clear, readable fonts with appropriate sizing and weight

Icons: Recognizable symbols support quick comprehension

7.1.3 Responsive Design

Layouts designed to adapt to various screen sizes

Mobile-first approach ensures usability on all devices

Touch-friendly button sizes for mobile users

Graceful degradation for older browsers

7.2 Database Design Principles

The database schema was architected following these guidelines:

7.2.1 Normalization

Third Normal Form (3NF) to eliminate redundancy

Each table represents a single entity type

No repeating groups or transitive dependencies

Atomic values in all columns

7.2.2 Integrity

Primary keys ensure unique record identification

Foreign keys maintain referential integrity

Check constraints enforce business rules

Appropriate use of NULL/NOT NULL constraints

7.2.3 Performance

Strategic table relationships minimize joins where possible

Appropriate data types chosen for each column

IDENTITY columns for efficient auto-incrementing

Design ready for index implementation

8 Future Implementation Plan

8.1 Phase 2: Backend Integration

The next phase will focus on connecting the database to the frontend:

8.1.1 C# Development

Implement MVC architecture with Controllers, Models, and Views

Create data access layer for database communication

Develop business logic services

Implement authentication and authorization

Build RESTful API endpoints for frontend communication

8.1.2 Database Connectivity

Establish secure database connections

Implement CRUD operations for all entities

Create stored procedures for complex operations

Develop data validation logic

Implement transaction management

8.1.3 Frontend Integration

Connect interface mockups to backend APIs

Implement JavaScript for dynamic behavior

Add form validation and error handling

Create AJAX calls for asynchronous operations

Develop real-time updates where appropriate

8.2 Phase 3: Advanced Features

After core functionality is complete, advanced features will be added:

Reporting: Comprehensive reports and analytics dashboards

Notifications: Email and in-app notification system

Search: Advanced search and filtering capabilities

Export: Data export functionality (PDF, Excel, CSV)

Audit Logging: Complete audit trail of system changes

API: Public API for third-party integrations

9 Technical Specifications

9.1 Database Specifications

DBMS: Microsoft SQL Server 2019 or later

Total Tables: 15 interconnected tables

Relationships: 20+ foreign key relationships

Constraints: Check, unique, and default constraints implemented

Normalization: Third Normal Form (3NF)

9.2 Frontend Specifications

HTML: HTML5 with semantic elements

CSS: CSS3 with Grid and Flexbox layouts

JavaScript: ES6+ standards

Responsive: Mobile-first responsive design **Browsers:**

Support for Chrome, Firefox, Safari, Edge

9.3 Planned Backend Specifications

Language: C# (.NET Framework 4.8 or .NET 6+)

Architecture: MVC (Model-View-Controller)

Authentication: Forms Authentication or ASP.NET Identity

API: RESTful Web API

ORM: Entity Framework or Dapper (to be decided)

10 Project Repository

10.1 GitHub Repository

The complete source code and documentation are available at:
https://github.com/Mahmoud-nasser33/CSAI202-Supply-Chain-Management

10.2 Repository Contents

/Database - SQL Server schema scripts and data

/Frontend - HTML, CSS, and JavaScript files

/Documentation - Additional project documentation

README.md - Project overview and setup instructions

11 Conclusion

11.1 Phase 1 Achievements

This phase of the Supply Chain Management System project has successfully delivered:

Complete Database Schema: A robust, normalized database design with 15 tables

Professional Frontend Mockups: 11 carefully designed interface screens

Comprehensive Documentation: Detailed specifications and design rationale

Solid Foundation: Architecture ready for backend implementation

11.2 Learning Outcomes

Through this project, the team has gained valuable experience in:

Database Design: Entity-relationship modeling, normalization, and constraint implementation

SQL: Table creation, relationship definition, and data integrity enforcement

UI/UX Design: User interface design principles and user experience considerations

System Architecture: Planning and designing multi-tier applications

Web Technologies: HTML5, CSS3, and responsive design techniques

Project Planning: Phased development approach and milestone definition

11.3 Project Impact

The Supply Chain Management System demonstrates how thoughtful design and planning create a foundation for successful software development:

Scalability: Database design supports future growth

Usability: Interface mockups show focus on user experience

Maintainability: Clear structure and documentation ease future development

Professional Quality: Enterprise-grade design principles applied throughout

11.4 Next Steps

With the database schema and frontend designs complete, the project is well-positioned for Phase 2 implementation. The solid foundation established in this phase will enable efficient backend development and system integration.

11.5 Final Thoughts

This project represents a significant achievement in database design and system planning. The combination of a well-architected database schema and thoughtfully designed user interfaces creates a strong foundation for a production-quality supply chain management system.

The team has demonstrated mastery of database concepts, design principles, and the ability to translate business requirements into technical specifications. This work serves as both an educational milestone and a practical blueprint for real-world application development.

12 Acknowledgments

We extend our sincere gratitude to:

The CSAI 202 instructional team for their expert guidance and feedback

Zewail City for providing exceptional educational resources and facilities

Our classmates for their valuable peer reviews and suggestions

The broader database and web development communities for excellent documentation

Thank you for reviewing our Supply Chain Management System!

Phase 1: Database Schema Design & Frontend Interface Mockups Technology Stack: SQL Server, HTML, CSS, JavaScript, C# (planned)