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Smart Textile Inventory and Production Platform

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Abstract: *The Smart Textile Inventory and Production Platform is a web-based application developed to improve inventory control, production planning, and warehouse management in textile industries. The existing manual system of maintaining inventory and production records is time-consuming, error-prone, and inefficient. It often results in inaccurate stock information, production delays, material shortages, overstocking, and increased operational costs. Monitoring raw materials, work-in-progress, and finished products manually also makes it difficult to ensure smooth production and timely delivery of customer orders. The proposed platform provides an integrated digital solution that automates these activities and improves overall operational efficiency.*

There are several types of users in the system, including System Administrator, Inventory Manager, Production Manager, Warehouse Manager, Sales Manager, and Supplier. The System Administrator manages user accounts, roles, and overall system settings. The Inventory Manager maintains records of raw materials, stock levels, and inventory transactions. The Production Manager creates production plans, monitors manufacturing progress, and tracks resource utilization. The Warehouse Manager manages the storage and movement of materials and finished goods, while the Sales Manager handles customer orders and delivery status. Suppliers update raw material availability and order information. The system provides real-time inventory tracking, production monitoring, order management, and report generation to support effective business decisions.

The project is implemented using ASP.NET Core MVC, Entity Framework Core, SQL Server, HTML, CSS, Bootstrap, and JavaScript. The platform follows a layered architecture with secure authentication and role-based access control to ensure data security and reliable system performance. It also generates inventory reports, production reports, stock summaries, and sales reports, enabling management to analyze business performance and make informed decisions. The main objective of the Smart Textile Inventory and Production Platform is to provide an efficient, secure, and user-friendly solution that minimizes manual work, improves inventory accuracy, optimizes production processes, reduces operational costs, and enhances the overall productivity and profitability of textile manufacturing industries..

Keywords: *Smart Textile Inventory*.

1. INTRODUCTION

The textile industry is one of the largest manufacturing sectors and plays a vital role in economic growth by producing fabrics, garments, and other textile products. Efficient management of raw materials, production processes, inventory, and finished goods is essential to ensure smooth business operations and meet customer demands. However, many small and medium-sized textile industries still rely on manual methods or standalone software for managing inventory and production, which often leads to errors, delays, duplicate records, stock shortages, and poor production planning. These challenges reduce productivity and increase operational costs.

The Smart Textile Inventory and Production Platform is a web-based solution designed to overcome these limitations by integrating inventory management and production planning into a single system. The platform enables organizations to manage raw materials, suppliers, production schedules, warehouse operations, customer orders, and finished

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products through a centralized database. It provides real-time stock monitoring, automated production tracking, and accurate reporting, allowing managers to make informed decisions and optimize resource utilization.

The system supports multiple user roles, including System Administrator, Inventory Manager, Production Manager, Warehouse Manager, Sales Manager, and Supplier, each with specific responsibilities and access privileges. Through role-based authentication, users can securely perform their assigned tasks, such as updating inventory, scheduling production, managing warehouse stock, processing customer orders, and generating business reports. This improves collaboration among departments while ensuring data security and consistency.

The proposed platform is developed using ASP.NET Core MVC, Entity Framework Core, SQL Server, HTML, CSS, Bootstrap, and JavaScript. By automating inventory control, production management, and reporting, the system minimizes manual effort, reduces human errors, enhances operational efficiency, and improves customer satisfaction. The Smart Textile Inventory and Production Platform serves as a reliable, scalable, and cost-effective solution for modern textile industries, supporting digital transformation and sustainable business growth.

II. RELATED WORK AND RESEARCH GAP

With the rapid growth of the textile industry and digital transformation, research on inventory management, production planning, and warehouse automation has become increasingly important. Researchers have proposed various solutions, including Enterprise Resource Planning (ERP) systems, cloud-based inventory management, IoT-enabled smart warehouses, and data-driven production scheduling. These systems aim to improve inventory accuracy, reduce production delays, optimize resource utilization, and enhance supply chain efficiency.

Research Gap:

A detailed study of the existing literature on textile inventory and production management systems has identified several research gaps that the proposed Smart Textile Inventory and Production Platform aims to address.

Gap in Integrated Inventory and Production Management

Most existing systems concentrate only on inventory management or production planning independently. Very few systems provide an integrated platform that connects inventory, production, warehouse management, supplier management, and sales operations. This lack of integration leads to duplicate data, inefficient communication, and delays in business processes.

Gap in Real-Time Inventory Monitoring

Many traditional inventory management systems do not provide real-time stock updates. Inventory records are often updated manually, resulting in inaccurate stock information, material shortages, excess inventory, and production interruptions. There is a need for a system that continuously tracks inventory and provides real-time visibility of stock levels.

Gap in Automated Production Planning

Several existing systems require manual scheduling of production activities, making it difficult to optimize resources and meet delivery deadlines. Limited automation in production planning reduces operational efficiency and increases the possibility of production delays. An intelligent and automated production management system is required to improve workflow efficiency.

Gap in Warehouse and Supplier Management

Most available systems provide limited support for warehouse operations and supplier management. Tracking material movement, managing warehouse stock, and monitoring supplier performance are often handled separately. A centralized platform that efficiently manages warehouse operations and supplier information is still lacking.

Gap in User-Friendly Interface

Many commercial ERP solutions are complex, expensive, and require extensive technical knowledge for implementation and operation. Small and medium-sized textile industries often face difficulties in adopting such systems. There is a need for a simple, secure, and user-friendly platform that can be easily used by administrators, inventory managers, production managers, warehouse staff, and sales personnel without extensive training.

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Gap in Reporting and Decision Support

Most existing systems provide only basic reports and limited business analytics. Managers require comprehensive inventory reports, production reports, stock movement analysis, supplier performance reports, and sales summaries to support better decision-making. The lack of advanced reporting capabilities reduces operational visibility and business efficiency.

The proposed Smart Textile Inventory and Production Platform addresses these gaps by integrating inventory management, production planning, warehouse management, supplier management, sales processing, and reporting into a single web-based application. The system provides real-time inventory tracking, secure role-based access control, automated report generation, and centralized data management, thereby improving operational efficiency, reducing manual errors, optimizing resource utilization, and supporting informed business decisions in textile manufacturing industries.

III. METHODOLOGY

Step 1: Requirement Collection and System Analysis

The first step involved identifying the requirements of the textile industry and understanding the overall business workflow. The major stakeholders include System Administrator, Inventory Manager, Production Manager, Warehouse Manager, Sales Manager, and Supplier. The administrator manages users and system settings, while inventory and production managers handle stock and manufacturing operations. Warehouse managers monitor material movement, suppliers provide raw materials, and sales managers process customer orders. Existing manual inventory and production processes were analyzed to identify challenges such as inaccurate stock records, production delays, and inefficient warehouse management.

Step 2: System and Database Design

After gathering the requirements, the overall system architecture was designed using a three-layer architecture consisting of the Presentation Layer (User Interface), Business Logic Layer (ASP.NET Core MVC), and Data Layer (SQL Server Database). An Entity Relationship (ER) Diagram was prepared to define the relationships among users, suppliers, inventory, production orders, warehouses, customers, and sales. The database structure was designed to ensure efficient data storage, consistency, and security.

Step 3: Development Environment Setup

The development environment was prepared by installing Visual Studio 2022, ASP.NET Core MVC, Entity Framework Core, SQL Server, and the required front-end technologies such as HTML, CSS, Bootstrap, and JavaScript. The project structure was organized into Models, Views, Controllers, Services, and Database layers to simplify development and future maintenance.

Step 4: Inventory Management Module Development

The inventory management module was developed to maintain records of raw materials, stock availability, stock transactions, and inventory updates. The system automatically updates stock quantities whenever materials are purchased, consumed during production, or dispatched. It also provides low-stock alerts to prevent shortages and improve inventory planning.

Step 5: Production and Warehouse Management

The production module was implemented to manage production schedules, manufacturing processes, and finished product records. Simultaneously, the warehouse management module was developed to monitor the storage, movement, and availability of raw materials and finished goods. Both modules work together to ensure smooth production flow and accurate inventory tracking throughout the manufacturing process.

Step 6: User Authentication and Role-Based Access

A secure authentication system was implemented using ASP.NET Identity with Role-Based Access Control (RBAC). Each user is assigned a specific role such as Administrator, Inventory Manager, Production Manager, Warehouse

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Manager, Sales Manager, or Supplier. Based on their assigned role, users can securely access only the modules relevant to their responsibilities, ensuring data security and controlled system access.

Step 7: Supplier, Sales, and Report Management

The supplier management module was developed to maintain supplier details, purchase orders, and raw material deliveries. The sales module manages customer information, product orders, invoices, and product dispatch. The system also generates inventory reports, production reports, warehouse reports, supplier reports, and sales reports, enabling management to analyze business performance and make informed decisions.

Step 8: Module Integration and System Automation

All system modules were integrated into a centralized platform to ensure smooth communication between inventory, production, warehouse, suppliers, and sales. Whenever inventory is updated or a production order is completed, the related modules automatically synchronize their data, eliminating duplicate entries and maintaining consistency across the system.

Step 9: Testing and Validation

Finally, comprehensive testing was performed to verify the functionality, security, performance, and usability of the system. Unit testing, integration testing, system testing, and user acceptance testing (UAT) were conducted to identify and resolve defects. The application was optimized for speed, accuracy, and reliability, ensuring that the Smart Textile Inventory and Production Platform provides an efficient, secure, and user-friendly solution for modern textile manufacturing industrie

IV. DATASET DESCRIPTION

The Smart Textile Inventory and Production Platform uses a SQL Server database to store and manage all system data. It contains information about users, suppliers, raw materials, inventory, production, warehouse, customers, and sales. The tables are connected using primary and foreign keys to maintain data accuracy. The database is updated whenever stock, production, or sales activities occur. This helps in real-time monitoring, report generation, and better decision-making.

A. Dataset Distribution

The dataset is divided into different tables based on the system modules, including Users, Suppliers, Raw Materials, Inventory, Production Orders, Warehouse, Finished Products, Customers, Sales Orders, and Reports. Each table stores related information and is connected through primary and foreign keys. The Raw Materials and Inventory tables contain the largest amount of data because they are updated regularly. The Production, Warehouse, and Sales tables store manufacturing, stock movement, and customer order details.

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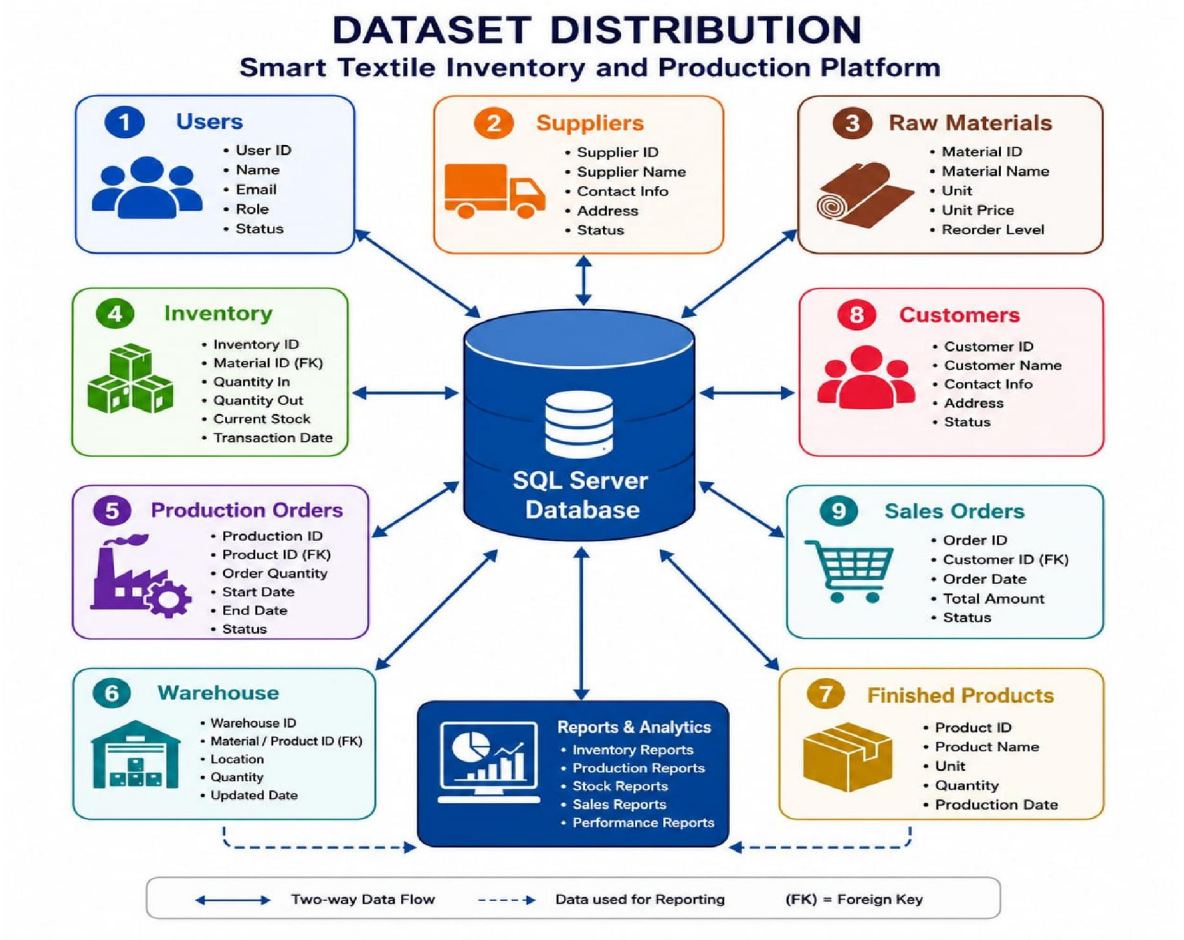

Figure 1: Dataset Distribution

B. Statistical Analysis

The statistical analysis of the Smart Textile Inventory and Production Platform is based on the data stored in the SQL Server database. It analyzes information related to inventory, production, warehouse, suppliers, customers, and sales. The system generates reports on stock availability, production progress, warehouse usage, and sales performance. It also tracks inventory movement, material consumption, and completed production orders. These statistics help managers monitor business activities and make better decisions. Overall, the analysis improves inventory control, production efficiency, and business performance.

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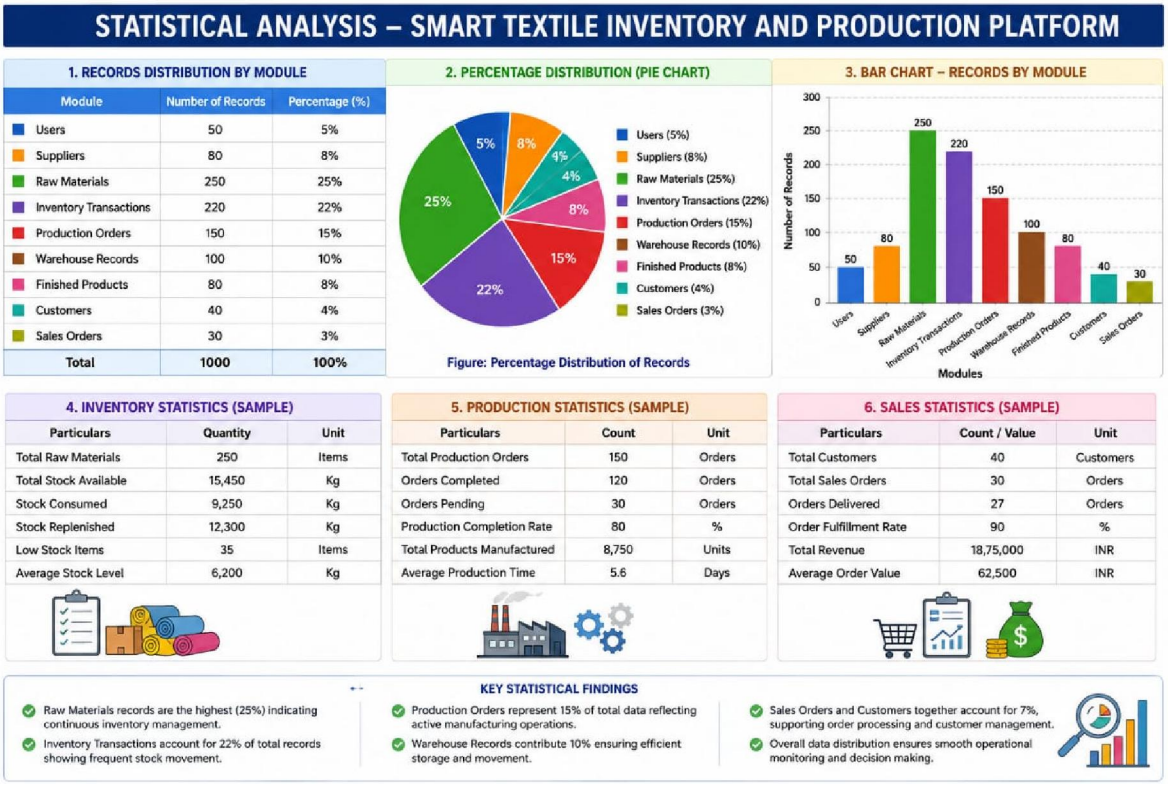

Figure 2: Statistical Summary

V. IMPLEMENTATION

The implementation of the Smart Textile Inventory and Production Platform converts the system design into a fully functional web application using ASP.NET Core MVC, Entity Framework Core, SQL Server, HTML, CSS, Bootstrap, and JavaScript. The application follows the Model-View-Controller (MVC) architecture, which separates the user interface, business logic, and database operations. This architecture ensures smooth communication between the frontend, backend, and database while providing a secure, reliable, and efficient platform for managing textile inventory and production activities.

5.1 Environment Setup

The development environment was prepared by installing Visual Studio 2022, .NET 8 SDK, ASP.NET Core MVC, SQL Server, and SQL Server Management Studio (SSMS). Frontend technologies such as HTML, CSS, Bootstrap, and JavaScript were used to create responsive and user-friendly web pages. The project was organized into different folders, including Models, Views, Controllers, Services, and Data, to simplify development, maintenance, and future enhancements.

5.2 Database Configuration

The application uses SQL Server as the backend database, and the database schema was created using Entity Framework Core Code-First Migration. Primary keys, foreign keys, and relationships were implemented to maintain data integrity and reduce redundancy. The database consists of tables such as Users, Suppliers, Raw Materials, Inventory, Production Orders, Warehouse, Finished Products, Customers, Sales Orders, and Reports. These interconnected tables enable efficient management of inventory, production, warehouse operations, supplier details, customer information, sales transactions, and reporting.

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5.3 Front-End Implementation

The frontend of the application was developed using ASP.NET Razor Views, HTML, CSS, Bootstrap, and JavaScript to provide an attractive and responsive user interface. A professional landing page was designed with navigation menus, login functionality, project information, and dashboard shortcuts. The dashboard displays important business information such as total raw materials, inventory status, production orders, warehouse stock, customer orders, and sales reports using tables, charts, and summary cards. User-friendly forms were also developed for supplier registration, raw material entry, inventory updates, production order creation, warehouse management, customer registration, and sales order processing with proper input validation.

5.4 Back-End Implementation

The backend was implemented using ASP.NET Core MVC Controllers and Entity Framework Core. User authentication is managed through ASP.NET Identity, providing secure login, logout, password encryption, and role-based authorization. The inventory management module allows users to add, update, delete, search, and monitor stock records, while automatically updating stock quantities after every inventory transaction. The production management module enables managers to create production orders, assign manufacturing tasks, monitor production status, track material consumption, and record finished products

5.5 Authentication Implementation

The application uses ASP.NET Identity with Role-Based Access Control (RBAC) to provide secure authentication and authorization. When users log in, their session information is stored securely, and access to different modules is granted according to their assigned roles. The supported roles include System Administrator, Inventory Manager, Production Manager, Warehouse Manager, Sales Manager, and Supplier. Passwords are encrypted before being stored in the SQL Server database, ensuring data security and protecting user accounts from unauthorized access.

5.6 Inventory and Production Processing

The inventory and production modules work together to automate the manufacturing process. Inventory managers first enter raw material details received from suppliers, after which the system automatically updates stock levels. Production managers then create production orders, and the required raw materials are automatically deducted from inventory during manufacturing. Once production is completed, the finished products are transferred to the warehouse, and warehouse stock is updated accordingly. Customer orders are processed through the sales module, invoices are generated, and product quantities are reduced from warehouse stock automatically. The system also generates inventory, production, warehouse, supplier, and sales reports to support business analysis and decision-making.

5.7 Reporting Module

The reporting module generates detailed reports that help management monitor business performance and make informed decisions. The system produces Inventory Reports, Production Reports, Warehouse Reports, Supplier Reports, Customer Reports, Sales Reports, and Stock Summary Reports. Interactive dashboards display charts, tables, and statistical information related to inventory levels, production performance, warehouse utilization, and sales activities in real time. These reports improve operational visibility, support better planning, and enhance overall business efficiency.

Certificate Generation

The certificate generation module creates professional PDF certificates with embedded QR codes.

The process includes:

- Production Order Selection: The production manager selects an approved production order from the system.
- Material Verification: The system checks the availability of required raw materials before starting production.
- Material Consumption: The required raw materials are automatically deducted from the inventory during manufacturing.
- Finished Product Creation: After production is completed, the system generates a finished product record containing the product ID, product name, quantity, production date, and batch details.

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• Warehouse Update: The finished products are automatically transferred to the warehouse, and stock levels are updated.

• Inventory Status Update: The inventory database is refreshed to reflect the latest stock availability and production completion.

• Report Generation: The system updates production reports, inventory reports, warehouse reports, and stock summary reports, allowing management to monitor manufacturing performance and inventory status.

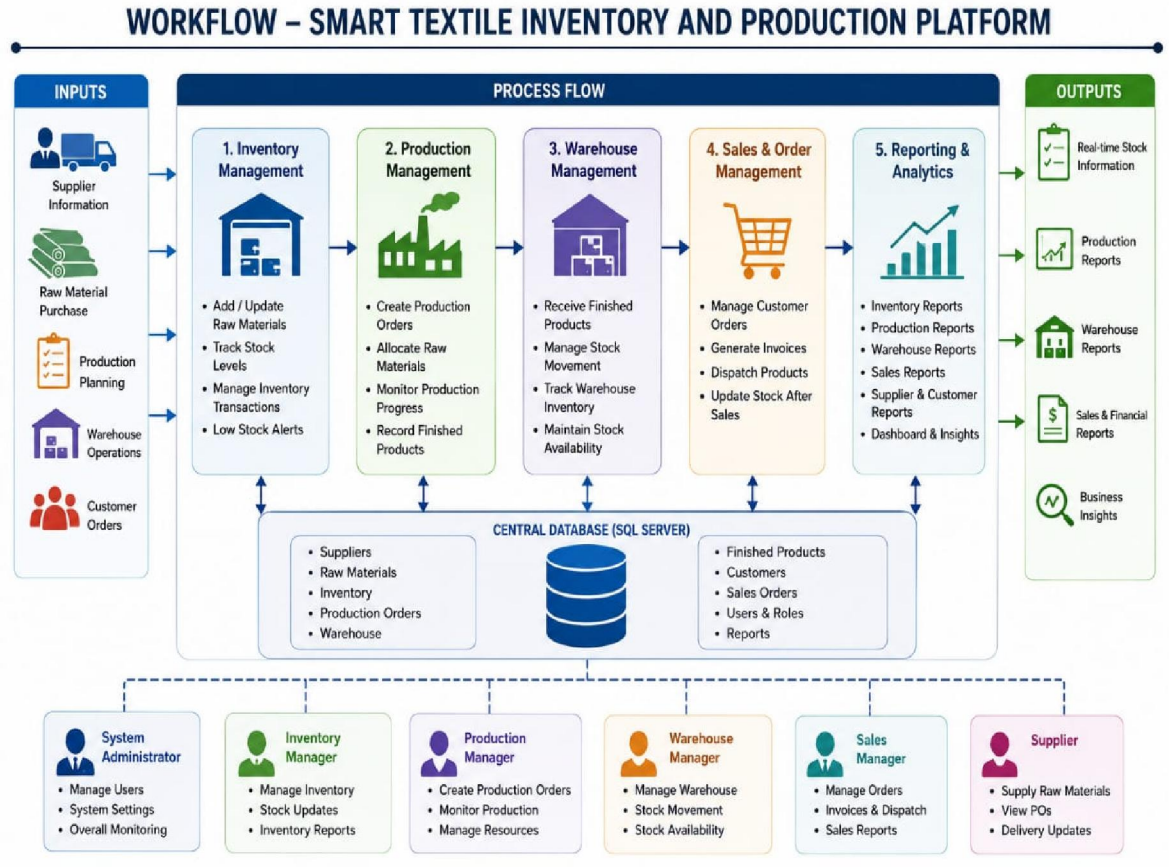

Figure 3: Workflow

VI. FUTURE WORK

The future scope of the Smart Textile Inventory and Production Platform focuses on improving automation, scalability, intelligence, and operational efficiency by integrating advanced digital technologies. In the future, the system can be enhanced by incorporating Artificial Intelligence (AI) and Machine Learning (ML) to provide demand forecasting, inventory optimization, and predictive production planning. AI algorithms can analyze historical inventory and sales data to recommend optimal stock levels, reduce material wastage, and improve production scheduling. The platform can also be deployed on cloud infrastructure such as Microsoft Azure or Amazon Web Services (AWS) to support multiple textile manufacturing units with secure, scalable, and highly available inventory and production management.

Further improvements can be made by integrating Internet of Things (IoT) devices such as RFID tags, barcode scanners, and smart warehouse sensors to enable real-time monitoring of raw materials, production processes, and finished products. Advanced analytics and business intelligence dashboards can be introduced to monitor inventory trends, production performance, supplier efficiency, warehouse utilization, and sales growth. Mobile applications for

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Android and iOS can also be developed, allowing managers, warehouse staff, and sales teams to access real-time information and manage business operations from anywhere.

The platform can also be integrated with Enterprise Resource Planning (ERP) systems, accounting software, customer relationship management (CRM) systems, and e-commerce platforms to automate business processes and improve data sharing across departments. Real-time notification services through email, SMS, or mobile alerts can inform users about low stock levels, production completion, order dispatch, and supplier deliveries. These future enhancements will transform the Smart Textile Inventory and Production Platform into a secure, intelligent, scalable, and fully automated textile management solution that improves productivity, reduces operational costs, enhances customer satisfaction, and supports the digital transformation of textile manufacturing industries.

VII. CONCLUSION

The Smart Textile Inventory and Production Platform provides an efficient and integrated solution for managing inventory, production, warehouse operations, suppliers, customers, and sales within textile industries. The system overcomes the limitations of traditional manual management by automating inventory tracking, production planning, stock monitoring, and report generation through a centralized web-based platform. By providing real-time access to inventory and production information, the platform improves operational efficiency, reduces human errors, minimizes inventory shortages, and enhances decision-making across different departments.

The platform is developed using ASP.NET Core MVC, Entity Framework Core, SQL Server, HTML, CSS, Bootstrap, and JavaScript, ensuring a secure, scalable, and user-friendly environment. The implementation of role-based authentication, automated inventory updates, production scheduling, warehouse management, supplier management, customer order processing, and comprehensive reporting improves overall business productivity and data accuracy. The integrated architecture enables seamless communication between all functional modules while maintaining data consistency and security.

Overall, the Smart Textile Inventory and Production Platform serves as a reliable and cost-effective solution for modern textile manufacturing industries. It supports digital transformation by optimizing resource utilization, improving production efficiency, reducing operational costs, and enhancing customer satisfaction. With future integration of Artificial Intelligence (AI), Internet of Things (IoT), cloud computing, and advanced analytics, the platform has the potential to become a comprehensive smart manufacturing solution capable of meeting the evolving needs of the textile industry.

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