Web based Construction Management System

SE2030 – Software Engineering

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Introduction

What is the project about?

This project focuses on designing and developing a Web-Based Construction Management System for Build Smart Constructions, a growing construction company in Sri Lanka. At present, most project coordination and management are handled manually through phone calls, paperwork, spreadsheets, and emails. These manual methods make it difficult to track project progress in real time, slow down communication between teams, and often lead to misunderstandings or errors during execution. As the company takes on more projects at the same time, these challenges become even more significant, leading to delays and inefficiencies.

The goal of our group was to build a centralized web-based system that brings all project-related tasks, data, and communication into one platform. This solution is designed to replace inefficient manual processes with a faster, more accurate, and highly collaborative system, making project tracking and coordination easier for everyone involved. With our system, everything related to project tasks, timelines, updates, and communication will be stored and managed in one place, helping the company work faster, avoid errors, and keep all teams aligned and up to date.

Objectives and goals

The main objective of this project is to build a modern, user-friendly, and scalable web application that streamlines and automates day-to-day operations in construction project management.

Key Goals include:

- Creating and tracking construction projects effectively
- Managing workforce assignments and work status
- Keeping records of materials and inventory usage
- Handling equipment details and availability
- Scheduling tasks and tracking their progress
- Providing a client portal for updates, communication, and payments.

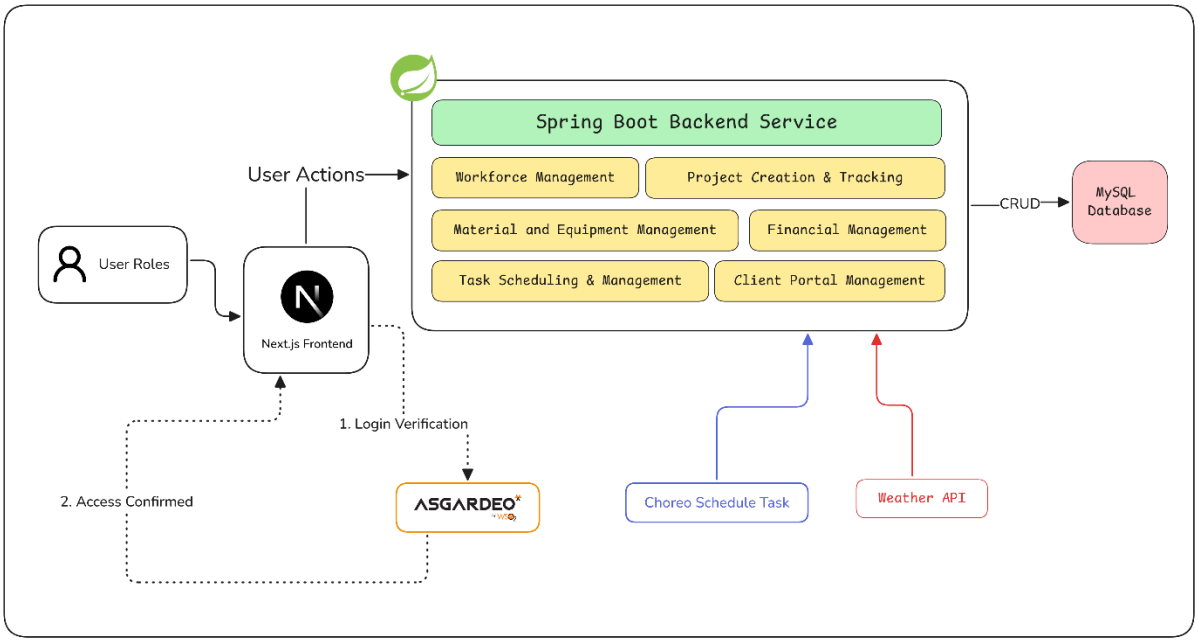
Target users and stakeholders

The System is designed for multiple user types within the construction ecosystem:

- Internal Users: Company owner, Project Managers, Finance Officers, Civil Engineers, Site Supervisors and IT Administrator
- External Users: Clients and Customers

All users will access the system through a web interface, which is designed to be responsive and usable on desktops, laptops, tablets, and modern smartphones. The system prioritizes user-friendly experience, making it suitable for individuals with varying levels of technical skills, from office staff to site workers.

System Overview Diagram



When a user opens the web app, they first log in through WSO2 Asgardeo, which checks their identity and gives access based on their role. After logging in, a project manager can create a new project by entering details like timelines and requirements. This information is shared automatically with other parts of the system.

The system shows available workers to assign, calculates needed materials, and creates a task schedule with milestones. Supervisors assign workers to tasks, which update the schedule and send notifications. Material use is tracked in real time, with alerts when supplies are low. The system also tracks expenses compared to the budget.

Clients can log in to see project updates, approve changes, and manage payments without accessing internal tools. The system keeps logs of all actions, sends alerts for important events, and uses weather data to help plan outdoor work. It also backs up data automatically to keep everything safe.

The system architecture follows a modern web application structure and a tech stack:

Frontend Layer: Built with Next.js, providing responsive user interfaces accessible across devices.

Authentication Layer: WSO2 Asgardeo handles secure user authentication and role-based access control.

Backend Services: Java Spring Boot backend manages all business logic and system operations.

Data Layer: SQL database stores all system data with automated backup capabilities.

External Integrations:

- Weather API (openweathermap.org) for real-time weather information
- WSO2 Choreo Scheduled Tasks Component for automated notifications and system maintenance

Deployment: Entire system deployed and managed through WSO2 Choreo platform for scalability and security.

Functional Requirements

These are the essential system functions that directly support the primary business operations. Each functional component has been assigned to specific team members for development

1. **Project Creation and Management**

   Assigner – IT24103918 (Wagawala W.L.U.N)

   Core Functions:

   - Create new construction projects with detailed specifications
   - Track project progress through various phases
   - Update project status and milestone completion
   - Generate project reports and progress summaries
   - Remove cancelled or completed projects from active management

2. **Workforce Management**

Assigner – IT24103913 (Mahindarathne R.M.P.K.T)

Core Functions:

- Create and maintain comprehensive worker profiles (skills, availability, roles)
- Assign workers to specific projects and tasks with ability to update assignment
- Track worker availability and workload distribution
- Monitor worker performance and productivity
- Manage work schedules and shift assignments including removal of inactive workers

3. **Material and Equipment Management**

Assigner – IT24103979 (Hamshithan. V)

Core Functions:

- Maintain inventory database of materials and equipment with add/remove capabilities
- Track stock levels and usage patterns with modification rights
- Monitor equipment, maintenance schedules and availability
- Generate low-stock alerts and reorder notifications
- Record supplier information and procurement history

4. **Task Scheduling and Management**

Assigner – IT24103885 (Senarathna Y.M.C.S)

Core Functions:

- Create and assign tasks within projects with modification capabilities
- Set and update deadlines and priority levels as needed
- Track task progress and completion status
- Manage task dependencies and scheduling conflicts including task removal
- Generate automated deadline reminders

5. **Financial Management**

   Assigner – IT24103965 (Shruthihan S)

   Core Functions:

   - Record and categorize project expenses with modification and removal options
   - Track budget allocation and spending patterns with update capabilities
   - Generate financial reports and budget analysis
   - Manage cost control and budget variance tracking

6. **Client Portal and Communication**

   Assigner – IT24103927 (Hettiarachchi H.S.A)

   Core Functions:

   - Create and manage client accounts with secure access to project information
   - Maintain comprehensive client profiles including contact details and project preferences
   - Share and update project documents, progress reports, and communication records
   - Remove outdated client information and archive completed project communications

Non-Functional Requirements

The system is expected to meet the following non-functional requirements to ensure smooth performance, user satisfaction, and secure operation:

- **Performance:** The system should support over 1,000 users and ensure that all pages are loaded within 3 seconds to maintain user efficiency.

- **Security:** All data transmissions will be secured using HTTPS. User authentication and access control will be managed through **WSO2 Asgardeo**, with role-based permissions to protect sensitive information.

- **Usability:** The system will have a clean, user-friendly interface suitable for desktop and tablet use. Built-in help guides will be provided to assist users with common tasks.

- **Reliability:** The system will ensure 99.9% uptime, with regular automated backups to prevent data loss and support business continuity.

- **Deployment:** The application will be deployed using **WSO2 Choreo**, providing cloud-based hosting, integration, and monitoring capabilities.

Major Stakeholders

The system supports six primary stakeholder groups, each with specific roles and access permissions:

Internal Stakeholders

1. **Company Owner** - Complete system oversight and strategic decision-making
2. **Senior Project Manager** - Project creation, planning, and high-level management
3. **Finance Officer** - Financial tracking, budget management, and expense control
4. **Civil Engineer** - Material and equipment specification and management
5. **Site Supervisor** - Workforce management and on-site coordination
6. **IT Administrator & Client Relationship Officer** - System administration and client communication

External Stakeholders

7. **Clients** - Project monitoring, communication, and approval processes

Minor Functions

In addition to the core functions, the system will include the following minor features to improve user experience and system usefulness.

- **Notifications and Alerts:**
  Automatic alerts will be sent for upcoming task deadlines, low material stock, and other key updates. This will be implemented using **WSO2 Choreo Scheduled Tasks** to ensure timely notifications.

- **Simple Reporting:**
  The system will generate basic reports on project progress, resource usage, and workforce data to support decision-making.

- **User Profile Management:**
  Users can update their own profile details, such as name and password, ensuring account information remains accurate and secure.

- **External Service Integration:**
  The system may connect to third-party services such as **weather APIs**, providing real-time weather updates for project locations to support better task planning.

System Limitations / Constraints

- **Browser Compatibility:**
  The system is designed to work on modern web browsers such as Google Chrome (Chromium-based), Mozilla Firefox, Comet and Safari. It may not perform correctly on outdated, unsupported, or less common browsers such as Internet Explorer or older versions of Microsoft Edge.

- **Internet Dependency:**
  An active and stable internet connection is required to use the system. All

features are cloud-based, and there is no offline support. Users will not be able to access or interact with the system when disconnected from the internet.

- **No Direct Payment Handling:**
  The system does not handle or process online payments such as credit card or bank transactions. It only allows tracking of budgets, recording of payment statuses, and cost management for internal and reporting purposes.

- **Single-Tenant Architecture**

  Currently, the system is built with a single-tenant architecture, meaning each deployment is isolated for a single organization. It does not support multi-tenancy, where multiple organizations or clients could use the same system instance with separated data.

- **Device Compatibility**
  The system is primarily optimized for desktop and laptop use. While it may work on tablets and mobile devices through a responsive interface, some advanced features and dashboards may not be fully mobile optimized in the first release.

- **Third-Party Integration Limitations**
  At launch, the system will have limited integration with external third-party services. APIs or plugins for popular tools like Google Drive, Slack, or payment gateways are not included in the initial version and may be considered in future updates.

- **Data Backup and Recovery**

  While basic data protection measures will be in place, advanced backup automation, versioning, and recovery features may be limited and require manual intervention during failures or data corruption.

Project Timeline

Phase 1: Planning and Design (Weeks 4)

In the first four weeks, we will focus on designing the user interface and creating a clear database structure to support the system.

Phase 2: Core Development (Weeks 5-9)

Next, we'll build the main parts of the system, starting with user login and continuing with modules for projects, workforce, materials, and tasks. The database will be developed and connected during this time.

Phase 3: Advanced Features (Weeks 10-11)

After the core is ready, we'll add features like a notification system and basic reports and analytics to improve usability and insights.

Phase 4: Integration and Testing (Weeks 12)

The full system will be tested for performance and security, and any issues will be fixed to ensure it works smoothly.

Phase 5: Deployment and Go-Live (Weeks 13)

Finally, the system will be deployed to the WSO2 Choreo platform, where both the frontend and backend will be hosted. We also plan to use Choreo's managed MySQL database as our main database. Once everything is set up and tested, the system will go live for users.

Conclusion

This project focuses on building a **Web-Based Construction Management System** that will simplify and automate the everyday tasks of construction companies. The system brings together key functions such as project setup and tracking, workforce and material management, equipment handling, task scheduling, financial tracking, and client communication all in one user-friendly platform.

Implementing this system will be highly valuable, as it directly addresses common challenges in the construction field like delayed communication, lack of progress visibility, material

shortages, and poor record-keeping. With this solution, companies can reduce manual work, improve coordination among teams, and offer clients greater transparency and a better service experience. It also supports modern work methods by offering real-time access, automated alerts, and simple reports to help ensure projects are completed on time and within budget.

Our team is fully committed to completing this project successfully. We will divide responsibilities clearly among all team members, follow a structured development plan, and thoroughly test each feature.