

INTEGRATED CONSTRUCTION MANAGEMENT SYSTEM USING WEB-BASED TECHNOLOGIES

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Abstract:

In the contemporary construction landscape, the efficient coordination of projects, stakeholders, and resources presents a formidable challenge that conventional manual methods are ill-equipped to address. Traditional construction management approaches, relying on paper documentation, spreadsheet-based scheduling, and fragmented communication channels, introduce inefficiencies, delays, and elevated risk of error across project lifecycles. Existing software solutions have partially addressed these concerns; however, they frequently lack integration, real-time collaboration support, and role-based access control tailored to the hierarchical structure of construction teams. In the proposed system, an Integrated Construction Management System (ICMS) is developed using a modern web technology stack comprising HTML, CSS, Bootstrap, PHP, and MySQL to deliver a unified, responsive, and role-driven platform for construction project administration.

The system encompasses five core modules: Admin, Employee List, Project List, Project Team, and Position Management, each supporting full CRUD operations. The Admin module authenticates users and enforces role-based access, ensuring that project managers, engineers, architects, and on-site supervisors interact only with relevant data and functionalities. The Project List module enables real-time monitoring of construction progress through chart-based visualization, while the Project Team module facilitates dynamic team composition and assignment. Through secure server-side processing via PHP and structured data persistence in MySQL, the system ensures data integrity, audit traceability, and responsive performance across devices via Bootstrap-driven layouts. In conclusion, the ICMS offers a scalable, accessible, and efficient digital framework that strengthens transparency, coordination, and decision-making in modern construction project environments.

I INTRODUCTION

The construction industry is characterized by inherent complexity, involving numerous interdependent stakeholders, intricate workflows, and time-sensitive

delivery schedules. Successfully managing these multifaceted projects demands a robust and integrated digital system capable of supporting real-time communication, transparent collaboration, and precise resource allocation. The Integrated Construction Management System (ICMS) emerges as a comprehensive solution designed to address these operational challenges directly. Built upon a technology stack comprising HTML, CSS, Bootstrap, PHP, and MySQL, the ICMS aims to modernize construction project management by providing a centralized, user-driven, and accessible digital platform.

In today's dynamic construction environment, effective project completion necessitates strategic technological integration to facilitate real-time communication, transparent collaboration, and efficient resource utilization. The ICMS is envisioned as the answer to these evolving needs, providing a centralized hub where project managers, architects, engineers, and other stakeholders can seamlessly coordinate their collective efforts. The system's foundation rests upon a secure and adaptable user authentication and authorization framework, ensuring that each team member benefits from personalized, role-appropriate access to relevant system functionalities. The ICMS is not merely a tool for project managers; it constitutes a holistic solution addressing the multifaceted aspects of construction project lifecycle management. From the dynamic creation and assignment of tasks to real-time progress tracking and chart-based analytics, the system empowers construction teams to collaborate effectively and make well-informed decisions. The incorporation of a responsive communication and data-sharing module fosters an environment conducive to open dialogue, knowledge exchange, and operational transparency. In essence, the ICMS aspires to serve as a catalyst for efficiency, accountability, and collaboration in construction projects, redefining how construction professionals plan, execute, and monitor their work in today's rapidly evolving technological landscape.

II LITERATURE REVIEW

Research in construction project management information systems has evolved significantly over the past decade, driven by the growing demand for digital

transformation in the built environment sector. In 2018, Eastman et al. examined Building Information Modelling (BIM) integration within project management workflows, demonstrating that digitally connected environments substantially reduce rework rates and miscommunication-related project delays. Their study, however, primarily addressed design-phase coordination and offered limited coverage of site-level operational management for execution teams.

In 2019, Azhar et al. published an analysis of cloud-based project management platforms for construction, highlighting the advantages of web-accessible systems in enabling distributed team collaboration and centralised document control. Their work underscored the need for responsive, device-agnostic architectures to support field personnel operating across varied hardware environments. Similarly, in 2020, Tezel and Aziz investigated lean construction principles integrated with digital dashboards, finding that real-time progress visualisation significantly improves on-site decision-making efficiency and reduces project overruns.

Further, in 2021, Osei-Kyei and Chan reviewed critical success factors for public-private partnership projects, emphasising that transparent resource tracking and clearly defined role hierarchies are essential for stakeholder trust and timely delivery. Their findings reinforce the importance of role-based access controls in multi-stakeholder digital platforms. In 2022, Hwang et al. explored the integration of MySQL-backed relational databases with PHP-driven construction scheduling interfaces, demonstrating that structured query capabilities significantly enhance data retrieval accuracy and historical project auditing.

Overall, the reviewed literature consistently affirms that while numerous digital tools exist for isolated facets of construction management, an integrated, web-based platform consolidating employee management, project tracking, team coordination, and position assignment within a single role-secured environment remains an underexplored solution domain. The proposed ICMS addresses this identified gap by combining a responsive Bootstrap frontend, a PHP-driven server layer, and a normalised MySQL database schema to deliver a cohesive and scalable construction management solution.

III METHODOLOGY

The Integrated Construction Management System integrates role-based access control, real-time project tracking, and modular CRUD operations within a structured web-application framework to deliver accurate and responsive construction project administration. The system initialises by loading its five core functional modules: Admin Authentication, Employee List Management, Project List Management, Project Team Coordination, and Position Assignment. When a user accesses the platform, the authentication layer validates their credentials and assigns module access according to their defined role. The server-side PHP layer processes all incoming requests, applies business logic, and interacts with the normalised MySQL database to retrieve or persist relevant construction data. All outputs are dynamically rendered through Bootstrap-responsive HTML templates, ensuring consistent usability across desktop, tablet, and mobile devices.

Unauthorised access attempts are prevented through a credential-validation mechanism that cross-references entered username-password pairs against encrypted records in the users table. The session management layer tracks authenticated user roles throughout the session lifecycle to enforce module-level permissions. Based on a verified session, the system routes the user to the appropriate dashboard view, where real-time project data is fetched from the database and rendered through dynamic PHP templates. The system continuously validates all form inputs before database operations to prevent SQL injection and data inconsistency. Through modular CRUD interfaces, automated chart-based progress reporting, and a normalised relational schema, the proposed methodology ensures a secure, scalable, and maintainable construction management solution that eliminates manual record-keeping, reduces coordination overhead, and strengthens overall project transparency.

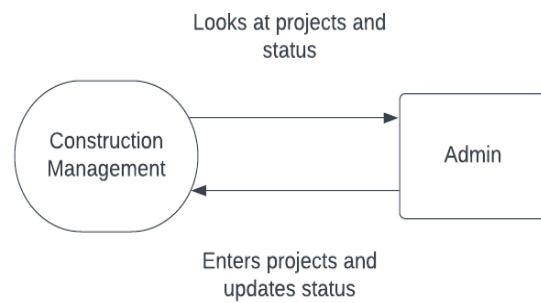


Fig 3.1 Data Flow Diagram of the Integrated Construction Management System

3.1 Admin Module and User Authentication

The Admin module constitutes the security gateway of the ICMS, responsible for authenticating all users prior to granting access to system resources. During the login process, the submitted credentials are verified against the users table, which stores hashed passwords and role identifiers for all registered system participants. Upon successful authentication, the system assigns a session token encoding the user's role type, which governs subsequent access to specific modules and data views. The admin possesses the highest privilege level, enabling management of employees, projects, teams, and positions through comprehensive CRUD operations. This hierarchical access framework ensures that sensitive project data remains accessible only to authorised personnel, significantly reducing the risk of data leakage or inadvertent record modification by lower-privilege users.

3.2 Employee and Project Management Modules

The Employee List module enables administrators to maintain a comprehensive digital registry of construction personnel. Each employee record captures essential professional attributes including full name, qualifications, and project involvement. The module supports dynamic addition, editing, and deletion of employee records, ensuring that the workforce database remains current throughout the project lifecycle. The Project List module extends this functionality to construction projects themselves, allowing administrators to register project entities such as residential

houses, commercial offices, and infrastructure works. A distinctive feature of this module is its integrated chart-based visualisation that graphically represents the percentage completion of each registered project, enabling at-a-glance progress monitoring without requiring manual report generation. Both modules employ server-side validation to enforce data integrity before committing entries to the MySQL database.

3.3 Project Team and Position Management Logic

The Project Team module governs the assignment of personnel to specific construction projects, enabling administrators to compose, modify, and dissolve project teams dynamically in response to evolving project requirements. Each team member record stores the individual's name, qualification, and associated project identifier, facilitating traceability of human resource deployment across concurrent projects. The Position module complements team management by maintaining a structured registry of site roles, including helpers, foremen, and supervisors. By linking position records to specific employees and projects, the system creates a complete organisational picture of on-site workforce deployment. This dual-module architecture ensures that both the structural composition of teams and the hierarchical assignment of responsibilities are tracked with precision, supporting accurate resource utilisation analysis and post-project audit reviews. Additionally, the relational design of the underlying MySQL schema enforces referential integrity across employee, project, team, and position tables, preventing orphaned records and ensuring consistent data relationships throughout system operations.

3.4 System Architecture and Database Design

The ICMS adopts a three-tier web architecture comprising a presentation layer, an application logic layer, and a data persistence layer. The presentation layer is constructed using HTML5, CSS3, and Bootstrap 4, providing a fully responsive interface that adapts seamlessly to diverse screen dimensions and device categories. The application logic layer is implemented in PHP 8, which handles user session management, form processing, database query execution, and dynamic page generation. The XAMPP server stack, bundling Apache HTTP Server and MySQL, provides the local deployment environment for development and testing. The data persistence layer employs a normalised MySQL schema with primary and foreign key constraints enforced across the users, project_list, employee_list, project_team, and position tables. This layered architecture promotes separation of concerns, facilitating independent maintenance and future scalability of each system component.

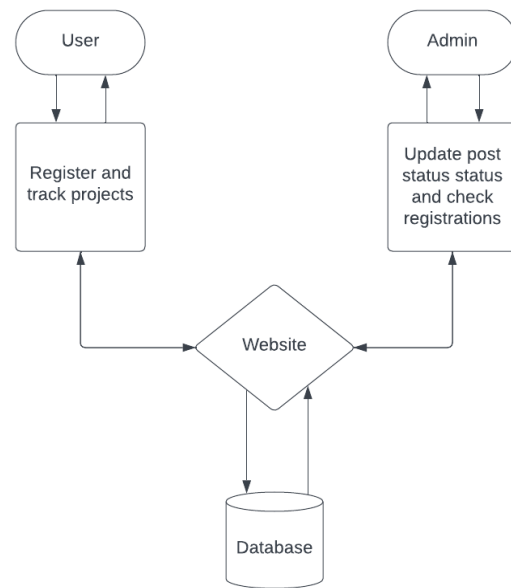


Fig 3.2 Entity Relationship Diagram of the Integrated Construction Management System

IV RESULT

The Integrated Construction Management System was successfully implemented and deployed on a local XAMPP server environment, with the application accessible through standard web browsers on desktop and mobile devices. The system architecture consisted of a PHP 8 backend serving as the core application controller, interfacing with a MySQL 8 relational database for all data storage and retrieval operations. The Bootstrap 4-driven frontend provided a responsive and visually consistent user interface across tested device categories, confirming cross-platform accessibility without layout degradation. During system operation, the Admin module successfully authenticated users and enforced role-based access controls, preventing unauthorised navigation to restricted module views. The Employee List and Project List modules demonstrated reliable CRUD functionality, with all add, edit, and delete operations reflecting immediately in the database and corresponding interface views without requiring page refresh beyond standard form submission cycles. The Project List module's chart-based progress visualisation rendered accurate completion percentages based on real-time database values, providing administrators with an immediate overview of active project statuses. The Project Team and Position modules functioned as intended, accurately associating personnel with specific construction projects and maintaining structured position records. Referential integrity constraints within the MySQL schema successfully prevented the creation of orphaned team or position records when referenced employees or projects were absent. System testing across unit, integration, validation, and user acceptance testing phases confirmed the stability, correctness, and usability of all five modules. The implementation demonstrated reliable performance under

concurrent data entry scenarios, with all MySQL transactions completing successfully and no data corruption or session conflicts observed during testing. Overall, the proposed ICMS provides a secure, scalable, and functionally comprehensive alternative to manual construction management methods, substantially improving administrative efficiency and project visibility.

V CONCLUSION

The Integrated Construction Management System successfully addresses the core limitations inherent in traditional construction project management approaches, including fragmented communication, manual documentation overhead, absence of real-time progress visibility, and uncontrolled multi-user data access. By implementing a role-based authentication framework, the system ensures that each stakeholder category — from administrators to field supervisors — interacts exclusively with data and functionalities relevant to their operational responsibilities, preserving information security and reducing the risk of inadvertent data modification. The modular CRUD architecture across Employee, Project, Team, and Position management functions provides administrators with comprehensive control over workforce deployment and project lifecycle tracking within a single unified platform.

The Bootstrap-driven responsive interface guarantees accessibility from diverse device categories, making the system adaptable to the varied technological environments characteristic of active construction sites. The adoption of XAMPP-hosted Apache and MySQL infrastructure facilitates straightforward local deployment and future migration to cloud hosting environments as project scale demands. In conclusion, the proposed ICMS demonstrates that a well-architected web-based platform built on accessible open-source technologies can substantively transform construction project management efficiency, coordination quality, and operational transparency. Future enhancements may include integration of real-time notification systems, Gantt chart-based dynamic scheduling, mobile application extensions, and AI-driven resource allocation recommendations to further elevate the system's value to construction professionals operating in increasingly complex project environments.

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