Software Requirements Specification

for

Automated Manpower Allocation By Performance Analysis and Project Categorization For Construction Projects

Version 1.0 approved

Prepared by Munagama M.K.H, Isuranga K.M.S, Devashika R.P.P.A, Perera K.M

Sri Lanka Institute of Information Technology

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Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

The proposed project aims to revolutionize the manpower allocation process in the construction industry, focusing on MAGA Engineering Pvt Ltd. MAGA is one of the top construction firms in Sri Lanka, working on a variety of projects such roads, buildings, and irrigation systems. The existing method of allocating resources, which is mostly reliant on the experience of project managers, frequently results in delays, inefficiencies, and less than ideal use of human resources. This project presents a data-driven solution that makes use of predictive analytics, project categorization, and Key Performance Indicators (KPIs) to address these issues.

The primary objective is to develop a robust web application that integrates seamlessly with existing systems, enabling precise categorization of construction projects and optimal allocation of employees. Creating a solid web application that works well with current systems is the main goal in order to accurately classify building projects and allocate workers in the most efficient manner. The program will categorize projects according to complexity, risk, and other characteristics, recommend the best personnel for each project, and create KPIs through performance analysis and CV evaluation. The technology will also predict labor needs, project budgets, and schedules, which will help with decision-making and increase project efficiency in general.

In addition to increasing operational effectiveness, this project establishes a standard for technological development in the construction sector overall. The suggested approach supports the industry's objectives of innovation, efficiency, and sustainability by tackling important problems like resource mismanagement, inconsistent labor demands, and a lack of data-driven insights. By guaranteeing equitable and transparent distribution according to measurable standards, it also raises employee satisfaction, which helps to boost project completion and sectors growth in general.

Modern technologies like Python, ReactJS, Node.js, and MySQL will be used in the development of the solution to ensure accuracy and scalability. The solution gives project managers and HR teams the ability to make well-informed decisions with its intuitive UI and real-time prediction capabilities.

Therefore, timely project delivery, cost efficiency, and enhanced performance across all construction activities are guaranteed by this novel approach to workforce allocation.

1.2 Document Conventions

1.3 Intended Audience and Reading Suggestions

All parties interested in the development and implementation of the suggested manpower allocation system specifically designed for the construction sector can use this document as a guide. Project managers, human resources staff, software developers, testers, and other key decision-makers are among its audience members. Specific insights and practical advice that are in line with each group's responsibilities and contributions to the project will be provided.

The document offers a comprehensive overview of how the system improves resource management, expedites decision-making, and improves personnel allocation for project managers and HR teams. These sections describe how labor and project forecast, employee allocation, project classification, and KPIs can change conventional methods into a more effective, data-driven strategy.

Detailed explanations of the system architecture, data specifications, and functional requirements will be helpful to developers and testers. The internal functioning of the system are described in these technical parts, which guarantee that implementation complies with operational standards and project objectives. Before diving into the specifics, it is advised that they first comprehend the overarching goals.

Readers should begin with the overview parts, which present the project's objectives and purpose, and then go on to the sections that are most relevant to their roles in order to get the most out of the document. This strategy guarantees that every audience obtains an accurate understanding of the system, encouraging cooperation and alignment in the pursuit of the project's successful completion.

1.4 Product Scope

Assigning manpower resources to construction projects is made easier with the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects solution.

The solution guarantees optimal workforce allocation through the use of advanced analytics, machine learning, and real-time data processing, which raises productivity, lowers expenses, and improves project outcomes.

Purpose

The system's main goal is to improve and automate workforce management decision-making for building projects by:

1. Assessing employee performance using both previous and current data.
2. Sorting projects based on their priorities, requirements, and level of complexity.
3. Effectively allocating personnel in accordance with project requirements, availability, and skill sets.

Pertinent Advantages

Efficiency Gains: Saves time and money by reducing the amount of manual labor required for workforce planning.

Cost optimization reduces travel expenses and delays by allocating personnel according to availability and proximity.
Better Utilization: Prevents underutilization or overburdening by distributing the task evenly across employees.

Data-Driven Decisions: Guarantees that choices about allocation are founded on precise performance indicators and project requirements.

Regulatory Compliance: Reduces legal risks by abiding by safety regulations and labour laws.

Objectives

Precise Performance Analysis: Offer comprehensive information about employee dependability and efficiency to inform allocation choices.

Dynamic Project Categorization: Organize projects in real time according to evolving specifications and limitations.

Smooth Integration:

Integrate with databases, external tools, and current corporate systems with ease.

Scalability:

Assist businesses of various sizes, from startups to major construction companies overseeing several projects.

Goals

Assign the appropriate staff to the appropriate duties to help construction companies finish projects on schedule and within budget.

Increase worker productivity and job satisfaction by managing resources fairly and effectively.
Offer a stable and intuitive platform that can be adjusted to meet changing business requirements and organizational procedures.

Consistency with Business Objectives

The methodology complements business plans to:

Boost operational effectiveness by implementing digital transformation.
Make use of data-driven decision-making to increase your competitive advantage.
Encourage sustainability through process optimization and resource waste reduction.

1.5 References

2. Overall Description

2.1 Product Perspective

A new standalone solution called Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects was created to solve workforce management inefficiencies in the construction sector. It automates and optimizes the distribution of labor by combining project management methodologies with sophisticated data analytics.

1. Issues Facing the Context and Origin Industry:

   Budget overruns and delays are caused by ineffective manual allocation procedures.
   Matching employee skill sets to project objectives can be challenging.
   Data-driven methods are not widely used in workforce management.

2. Connection to Current Systems:

   The solution can be integrated with current project management, human resource management, and enterprise resource planning (ERP) systems, or it can be used as a stand-alone system.

   provides compatibility with technologies including payroll software, compliance management platforms, and performance tracking systems.

3. Place in a Bigger System

This product serves as a fundamental part of an ecosystem for construction project management. It engages in the following interactions with other subsystems:

HRM Systems: Disseminate information about employee performance, availability, and profiles.
Project management tools: Offer statistics on personnel distribution and project classification to guarantee adherence to budgets and schedules.

Compliance systems make sure that safety rules, labour laws, and certification requirements are followed.

4. External Interfaces

User Interfaces: HR staff and project managers can access a web-based dashboard.

Employees can view assignments and performance indicators using this mobile-friendly software.

Third-party APIs: Google Maps API for worker assignment based on location.
For safe user authentication, use OAuth 2.0.
Subsystem Relationships

The following are the main parts of the system:

The Performance Analysis Module uses both historical and current data to assess employee performance.

The Project Categorisation Module groups projects according to their resource requirements, complexity, and deadlines.

Manpower Allocation Engine: Optimises allocations by matching worker skill sets with project requirements.

Worker profiles, project information, and allocation records are managed and stored by the data management layer.

2.2 Product Functions

<Summarize the major functions the product must perform or must let the user perform. Details will be provided in Section 3, so only a high level summary (such as a bullet list) is needed here. Organize the functions to make them understandable to any reader of the SRS. A picture of the major groups of related requirements and how they relate, such as a top level data flow diagram or object class diagram, is often effective.>

2.3 User Classes and Characteristics

<Identify the various user classes that you anticipate will use this product. User classes may be differentiated based on frequency of use, subset of product functions used, technical expertise, security or privilege levels, educational level, or experience. Describe the pertinent characteristics of each user class. Certain requirements may pertain only to certain user classes. Distinguish the most important user classes for this product from those who are less important to satisfy.>

2.4 Operating Environment

The employee allocation system's operational environment is made to meet the various demands of the construction sector. In order to guarantee accessibility across various organizational configurations, the application will operate as a web-based solution compatible with modern operating systems. Real-time data processing, safe storage, and smooth upgrades will be made possible by its cloud-hosted architecture, which will make it suitable for both small and large construction companies.

In order to provide a reliable, scalable, and effective solution for the distribution of labor in the construction sector, the suggested system is constructed utilizing a strong stack of modern technologies. The backend programming language, Python v3.10, facilitates the integration of predictive analytics models and effective data processing. For front-end development, React.js is

used, which provides a responsive and user-friendly interface that guarantees smooth interaction on a range of devices. As the server-side runtime environment, Node.js facilitates effective request processing and guarantees the scalability and performance of the system. MySQL is selected for database administration because it offers a dependable and safe platform for storing and retrieving huge datasets, such as resource allocations, project specifics, and employee KPIs.

Real-time processing, great dependability, and user-friendliness are just a few of the crucial requirements of the construction sector that this well-chosen technology stack guarantees the system will meet. By integrating these technologies, it becomes easier to generate and apply data-driven insights, which enable construction companies to accurately predict labor requirements, optimize manpower allocation, and improve project execution.

A crucial factor is hardware compatibility, which enables the system to run well on desktops and laptops used by HR teams, and project managers. The system's essential features, such as real-time KPI updates, predictive labor forecasts, and project monitoring dashboards, manpower allocation, project categorization require internet connectivity.

This environment guarantees that the program functions well in both remote construction sites and office situations. Its design considers different degrees of technical proficiency and features an easy-to-use interface that makes data entry, report generating, and resource allocation simpler. Additionally, adherence to security procedures and industry standards guarantees the system's integrity, protecting private projects and personnel information. Construction businesses can make data-driven decisions, optimize operations, and improve project outcomes with the help of this all-inclusive operational environment.

2.5 Design and Implementation Constraints

Design and implementation constraints define the boundaries within which the manpower allocation system must be developed, ensuring is secure, efficient and scalability. These constraints stem from organizational policies, hardware and software limitations, security needs, and user requirements.

2.5.1 Corporate Policies

The system must follow with internal IT policies, ensuring alignment with the organization's existing infrastructure and workflows. Also, adherence to data privacy regulations such as General Data Protection Regulation is mandatory, as the system handles sensitive employee and project data. Mainly design standards must ensure that the application meets the organization's branding and operational guidelines.

2.5.2 Hardware Limitations

The web application must run efficiently on commonly used devices within the organization, including desktops, laptops, and mobile devices. Mainly minimum hardware specifications for end-user devices include:

Desktops/Laptops: Dual-core processors, 4 GB RAM, and 256 GB storage.

Mobile Devices: Android (8.0 and above) or iOS (12.0 and above) with 2 GB RAM.

Also, backend servers must support high processing loads, requiring at least 16 GB RAM and multi-core processors for database queries and machine learning computations.

2.5.3 Software and Technological Constraints

The backend must be developed using Python for scalability and flexibility and the frontend is required to use React.js to ensure a modern, responsive interface. Mainly the database must use MySQL for relational data storage. We can use HTTPS protocols can be used for communication between components, ensuring secure data transmission.

Interfaces with Other Applications

Integration with project management tools like Jira or Microsoft Project is required for streamlined operations. Also, for categorizing projects based on geographical factors and data sharing mechanisms, we must ensure real-time updates across modules.

2.5.4 Security Considerations

Encryption mechanisms must secure sensitive data during storage and transfer.

User authentication protocols, multi-factor authentication, are mandatory to prevent unauthorized access.

- The system must include role-based access controls to restrict sensitive operations.

Design Standards

The web application must follow coding standards for Python for easy maintenance. So, the application must support scalability, enabling future expansion of functionalities without significant redesign. Mainly, these constraints ensure that the system is secure, efficient, and aligned with organizational needs, providing a robust foundation for successful implementation.

2.6 User Documentation

Comprehensive user documentation will be included with the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects system to help all stakeholders use it efficiently. The following describes the standards, delivery formats, and documentation components:

1. Components of User Documentation: User Manual

Project managers, human resources staff, administrators, and employees make up the audience.
Content: Synopsis of the features and capabilities of the system.
detailed instructions for activities like allocation review, project classification, and data entry.
Troubleshooting advice for typical problems.
Format: PDF file with printed copies available upon request.
The system has a digital handbook that may be searched.

2. Internet-Based Help System:

All users are in the audience.
Content: Within the application, context-sensitive assistance is available.
answers to frequently asked enquiries (FAQs).
interactive explanations of important procedures.
Format: Web-based assistance that is integrated within the program.
Content with hyperlinks for simple navigation.

3. Quick Start Manual:

First-time users are the audience.
Content: Fundamental login and system configuration steps.
An outline of the key features and how to use them.
Format: One-page printed guide or PDF document.
Upon initial login, an interactive instructional is embedded.

4. Videos for Tutorials:

All users, but especially new ones, are the target audience.
Content: Quick, task-oriented movies that show standard procedures like adding worker profiles.
Project classification.
examining and approving allocations that are automated.
diagnosing problems.
Format: Available through a special "Help" section on the system's website.
Video files that can be downloaded and used offline.

5. Technical Guide:

The intended audience consists of IT support personnel and system administrators.
Content: Installation and configuration details.
integration with external systems, including APIs, and databases.
procedures for technical troubleshooting and system maintenance.
Format: PDF document and web-based resource.

6. Release Notes:

The audience consists of all users.

Content: Details about the problem fixes, enhancements, and new features included in each software release.
Format: Available in-system or as a PDF download that is included with all software updates.

Standards and Formats for Delivery
Formats: PDF for papers that can be printed.
both in-app and web-based digital assistance systems.
MP4-formatted multimedia tutorial videos.

Criteria:

IEEE Std 1063-2001 for software user documentation is one example of an industry standard for user manuals that is followed in the documentation.
Content that adheres to usability best practices (e.g., WCAG compliance for online help) and is clear and accessible.

The system guarantees that all users can swiftly comprehend and efficiently use its capabilities by offering these thorough documentation resources, which reduces training time and support demands.

2.7 Assumptions and Dependencies

The creation, implementation, and operation of the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects system may be impacted by several presumptions and dependencies. The success of the project could be impacted by modifications or inaccuracies; thus, these assumptions and dependencies need to be closely watched.

Assumptions regarding the Quality and Availability of Data:

presupposes having access to current and accurate information on skills, projects, and worker performance.

It is expected that the data sources are trustworthy, consistent, and presented correctly.
Facilities:

The hardware and network infrastructure needed to install and run the system will be supplied by the client company.
To communicate with external APIs and exchange data in real time, the system depends on a reliable internet connection.

Adoption and Training of Users:

assumes that end users—such as administrators and project managers—will receive sufficient training to operate the system efficiently.
Users will supply precise input data for the procedures of allocation and analysis.
Stability of External APIs:

assumes that during the system's existence, third-party APIs (such Google Maps and OAuth 2.0) will continue to be reliable and available.
The regulatory environment

assumes that there won't be any big changes to data privacy laws (like the CCPA or GDPR) that would call for significant system upgrades.

Dependencies
Components of third-party software:

For data processing, analytics, and user interface development, the system depends on third-party libraries and technologies (such as Pandas, NumPy, Scikit-learn, and React.js).
The project may be impacted by any modifications to these libraries' support or compatibility.
System for Database Management:

relies on PostgreSQL for data management and storage. The system may be impacted by any PostgreSQL modifications or constraints that influence compatibility.
External Services and APIs:

Google Maps API: For analyzing the location of project sites and allocating workers according to proximity.
For safe user authentication, use OAuth 2.0.
Functionality may be hampered by any outages, adjustments to prices, or termination of these services.

Operating Environment:

The system's functionality depends on how well its software components work with the supporting operating systems (macOS, Linux, and Windows).
Adjustments may be necessary when certain operating systems undergo changes (such as security updates or deprecated features).
Organizational Procedures:

depends on the company's current processes for gathering, validating, and integrating input data.
System changes may be required in response to changes in these procedures.
Integration of Data:

assumes seamless integration with current enterprise systems (such as project tracking tools and HR management systems). Implementation may be delayed by legacy system compatibility difficulties.

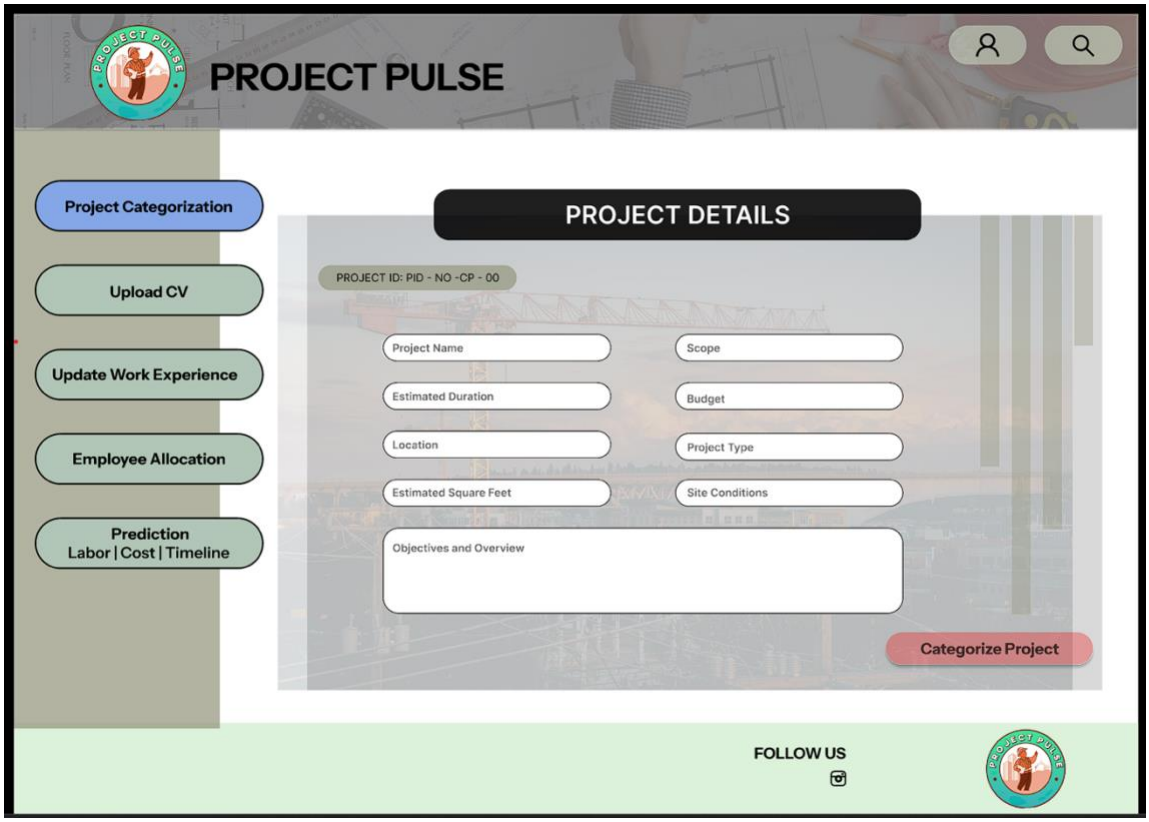
Risk Reduction for Dependencies and Assumptions
To keep an eye on service modifications, maintain regular contact with outside providers.
carrying out recurring evaluations to guarantee adherence to changing regulations.
putting in place backup plans (such as alternative APIs or caching important data) to deal with interruptions.
To guarantee seamless adoption, users should receive comprehensive documentation and training.

The project team can proactively handle possible hazards and guarantee the system's dependability and efficacy in construction project management by acknowledging these assumptions and dependencies.

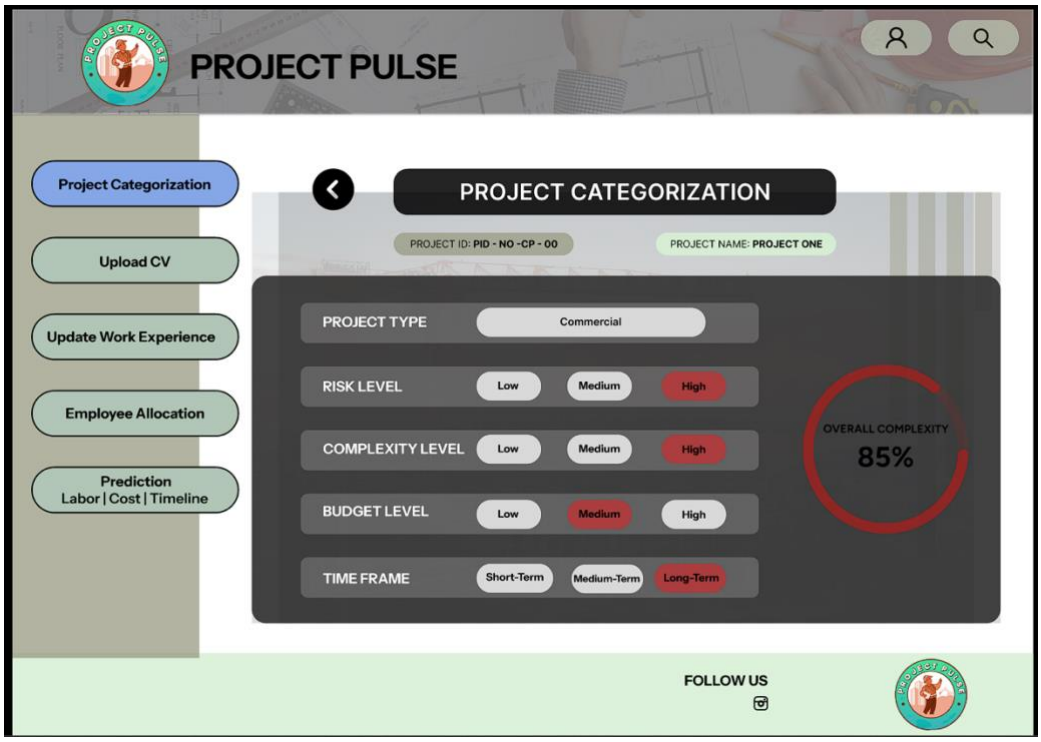
3. External Interface Requirements

3.1 User Interfaces

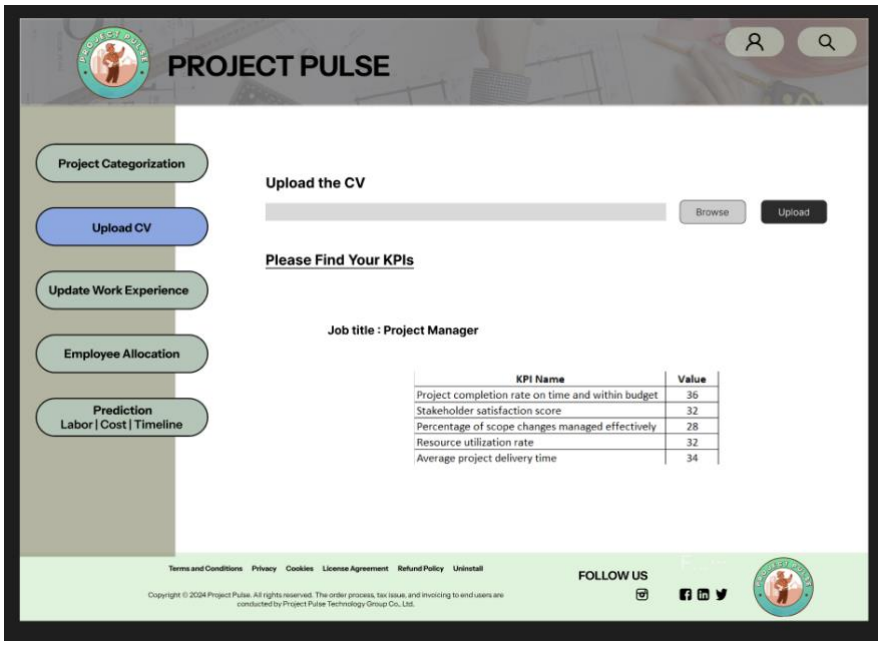
Entering project details interface



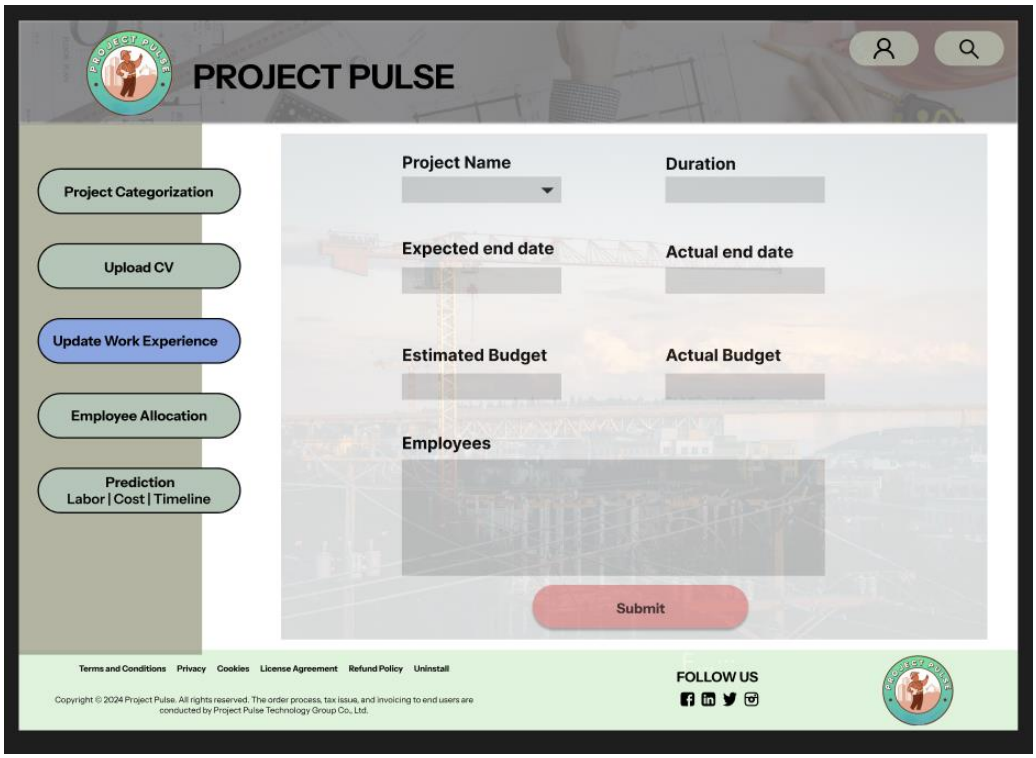
Categorizing project interface



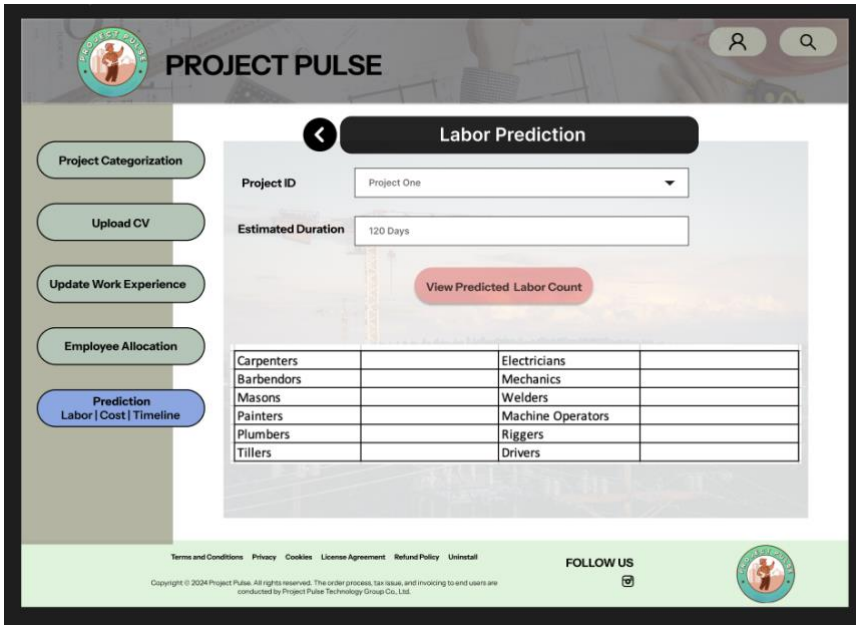
Interface to upload CV



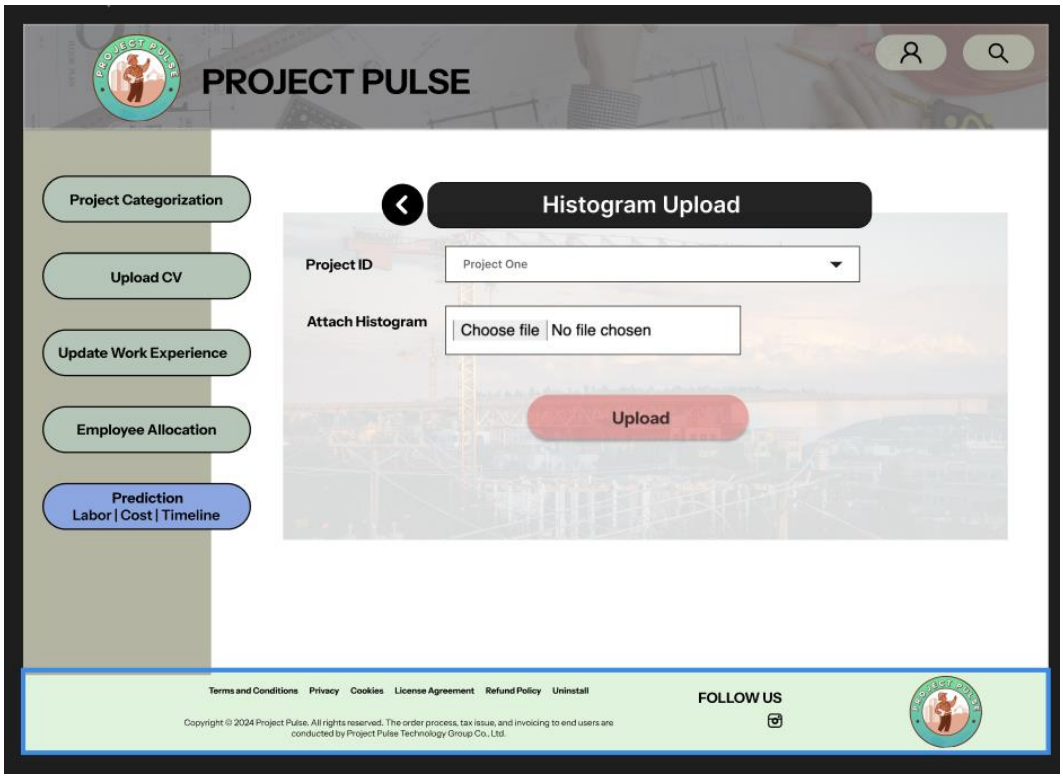
Interface to update the work experience



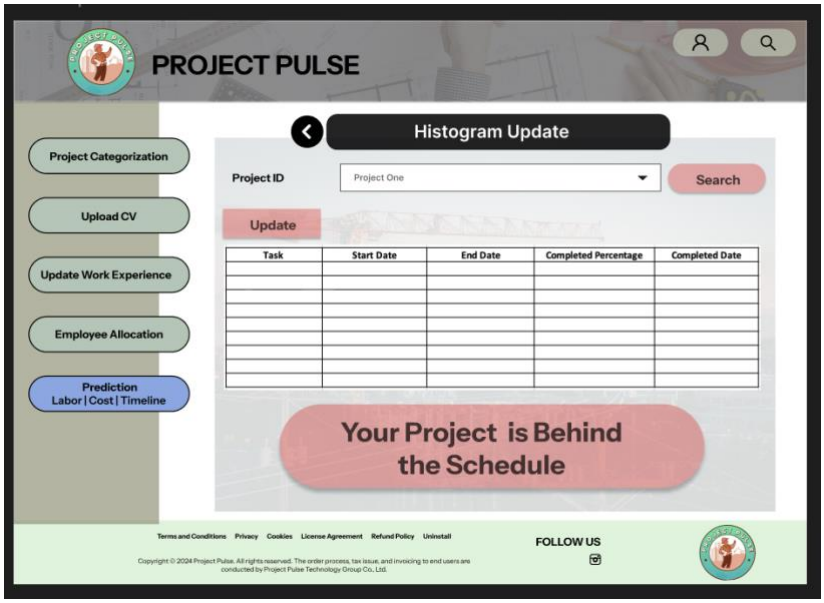
Interface to get the predicted labor count



Interface to Upload Histogram



Interface to Update the Histogram



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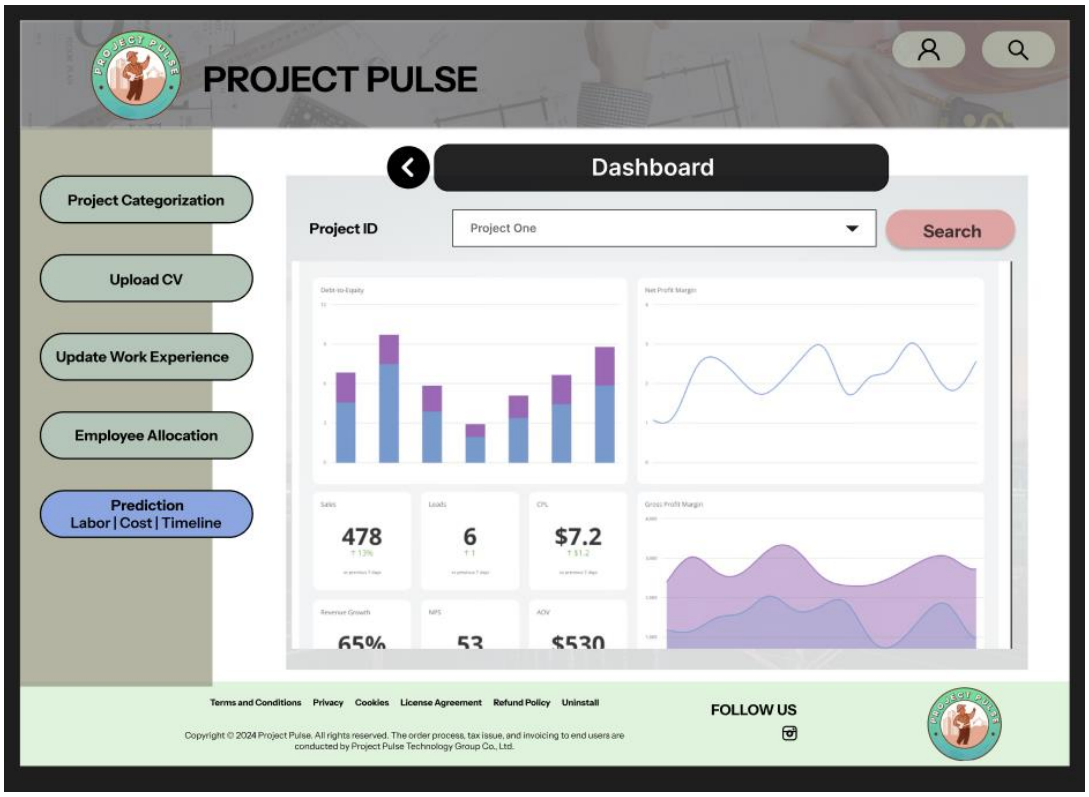
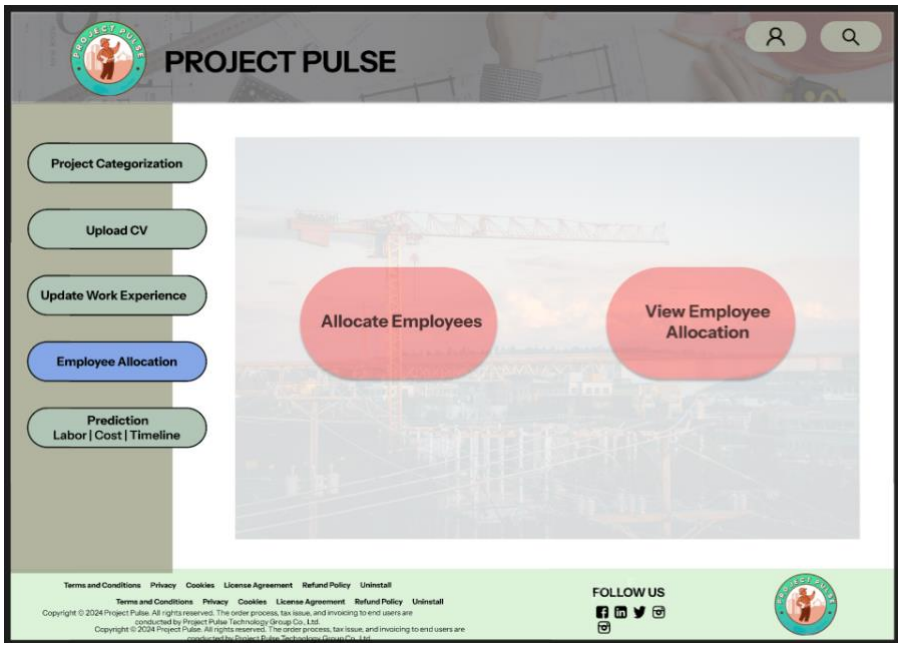
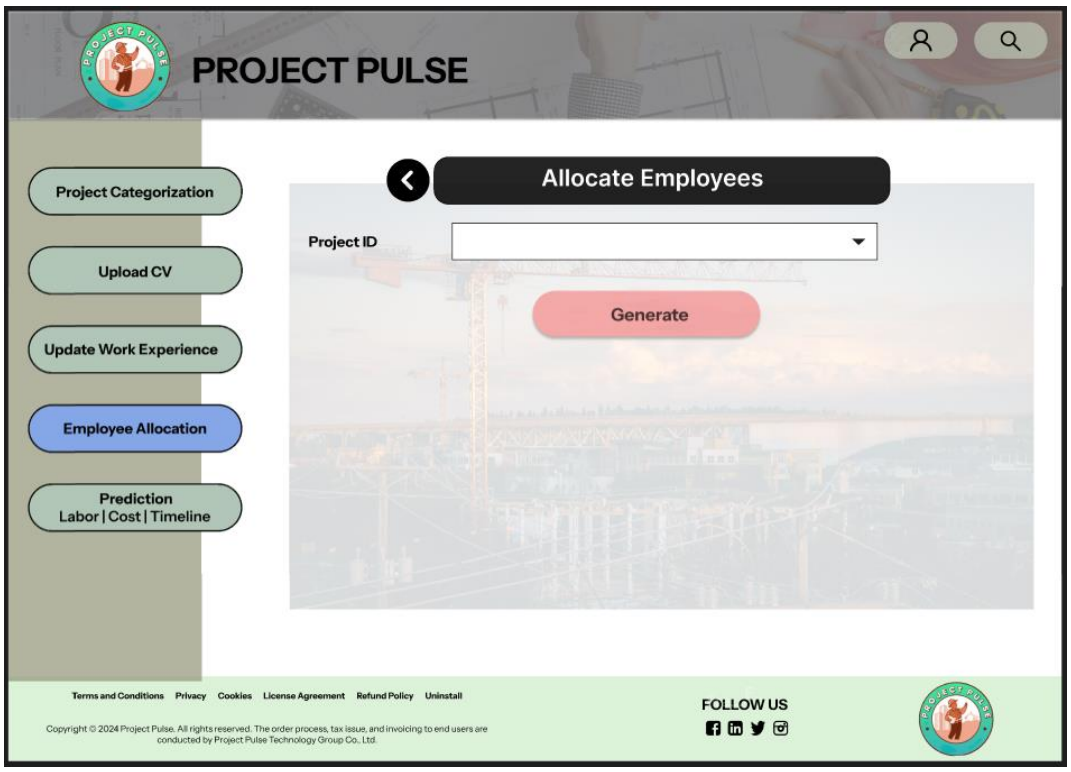
Interface to View the project progress

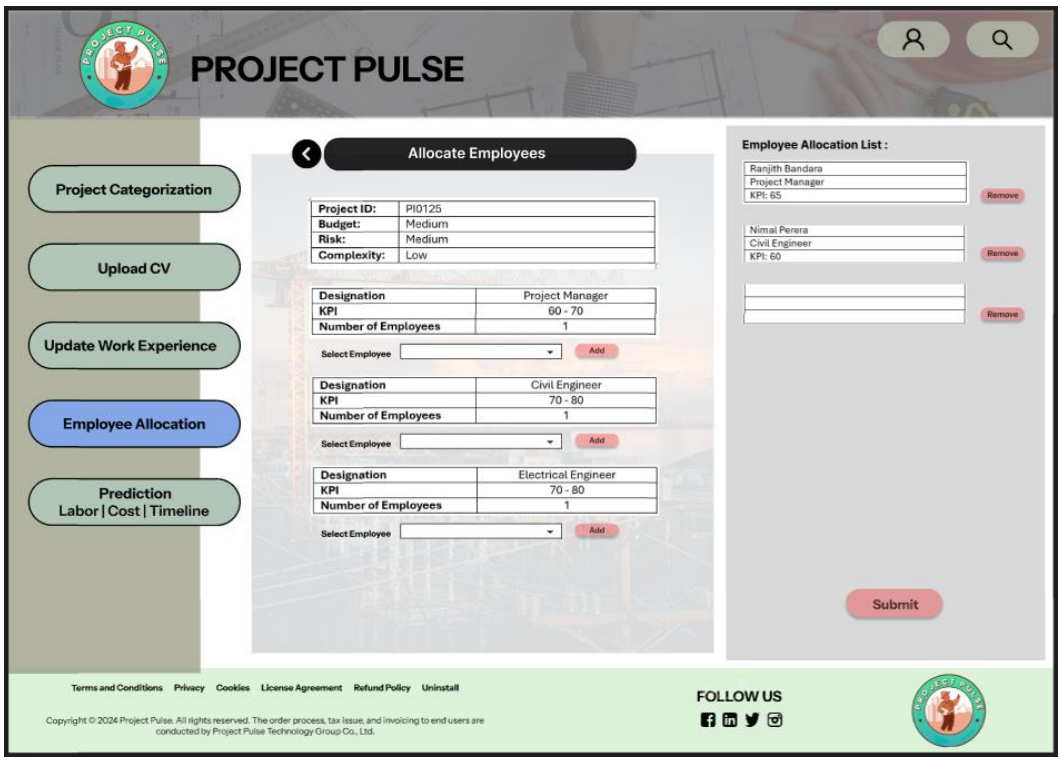


Interface to select a project for employee allocation

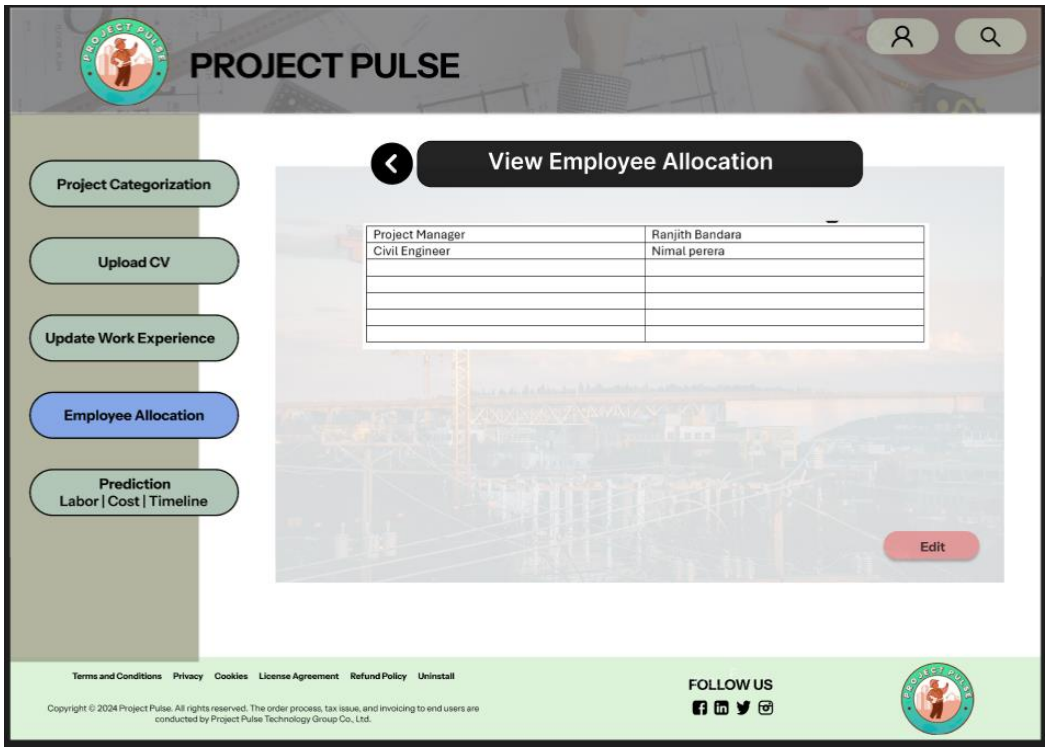




Interface to allocate employees



Interface to view employee allocation



3.2 Hardware Interfaces

The suggested system is made to interface with a variety of hardware elements to guarantee a smooth transition into the operational environments of the construction sector. Desktops and laptops are among these hardware interfaces, which serve both field workers and office-based teams. Regardless of the organization's hardware setup, the system's compatibility with common devices guarantees accessibility and usability.

For reliable and safe connectivity between devices and the cloud-hosted components of the system, hardware communication depends on industry-standard protocols like Ethernet and Wi-Fi. For tasks like KPI creation, predictive analytics, and project monitoring, this guarantees continuous data transfer and real-time updates. The system is designed to function well even with different hardware resource levels, guaranteeing scalability and reliable performance in a range of building project environments.

The system's strong and dependable hardware interfaces enable construction companies to easily incorporate technology into their operations, enhancing teamwork, productivity, and decision-making throughout the company.

3.2.1 Logical Characteristics

The web application supports a variety of input and output devices. Input devices include keyboards and mice for standard data entry, while touchscreens on mobile devices enable intuitive interaction for field users. For outputs, high-definition monitors and printers are essential for displaying and printing categorized project details, employee assignments, and risk predictions. The system will also integrate with mobile devices, allowing access through smartphones and tablets for remote and on-site functionality.

3.2.2 Physical Characteristics

The platform will run on a range of devices:

- Desktops and Laptops: Devices must have at least Intel i5 or AMD Ryzen 5 processors, 8 GB RAM, and 256 GB SSD storage to handle computational tasks efficiently.
- Servers: Cloud servers, with at least 16 GB RAM and multi-core processors, will host data storage, machine learning models, and web applications. Servers should ensure scalability to handle growing user demands.

3.2.3 Communication Protocols

The system uses TCP/IP protocols for stable communication across devices. Secure interactions are facilitated through HTTPS, encrypting data exchanges between clients and the server. Remote access is further enabled by Wi-Fi or Ethernet connections, ensuring reliability. Mobile devices will use cellular data or secure public Wi-Fi to maintain connectivity.

3.2.4 Integration with Hardware

For real-time risk monitoring, the system can interface with IoT sensors, such as vibration or soil monitors on construction sites, feeding real-time data into the system for immediate analysis.

3.2.5 Scalability and Compatibility

The system is designed to integrate with newer hardware as technology evolves, ensuring long-term usability and efficiency. This flexibility allows companies to upgrade their infrastructure without replacing the software. By ensuring compatibility with commonly used devices and communication protocols, the system meets the diverse needs of construction projects while maintaining operational efficiency and security.

3.3 Software Interfaces

The web application interfaces of the manpower allocation system ensure smooth interaction between various software components, databases, operating systems, and external services. These interfaces streamline processes such as project categorization, risk analysis, and employee allocation.

3.3.1 Databases

The system uses relational databases like MySQL to store and manage data. This includes project details, employee CVs, performance metrics, and risk assessments. SQL queries handle data operations such as retrieving categorized projects or updating employee KPIs. Centralized databases enable seamless data synchronization and sharing across all modules.

3.3.2 Operating Systems

The web application is compatible with major platforms, including Windows 10/11, macOS, and desktop applications.

3.3.3 External Tools and Libraries

The backend uses Django frameworks to handle server-side logic and API interactions. Libraries like TensorFlow the machine learning models for project classification and risk prediction. For data manipulation and preprocessing, tools like Pandas and NumPy are utilized. Visualization tools such as Power BI to generate graphical insights, such as workforce trends or risk heatmaps.

3.3.4 Data Sharing and Integration

Data flows between project categorization, risk assessment, and manpower allocation modules through a centralized repository. APIs ensure consistency, enabling real-time updates across modules.

For example, risk levels determined in the categorization module feed into the employee allocation process.

3.3.5 Security and Authentication

The web application integrates for secure user authentication, ensuring data privacy. Encryption mechanisms protect sensitive information, such as employee CVs and project details, during transmission and storage. By enabling smooth communication between components and ensuring secure data handling, these interfaces enhance the system's functionality and user experience.

3.4 Communications Interfaces

<Describe the requirements associated with any communications functions required by this product, including e-mail, web browser, network server communications protocols, electronic forms, and so on. Define any pertinent message formatting. Identify any communication standards that will be used, such as FTP or HTTP. Specify any communication security or encryption issues, data transfer rates, and synchronization mechanisms.>

4. System Features

<This template illustrates organizing the functional requirements for the product by system features, the major services provided by the product. You may prefer to organize this section by use case, mode of operation, user class, object class, functional hierarchy, or combinations of these, whatever makes the most logical sense for your product.>

4.1 System Feature 1

4.1.1 Description and Priority

The hardware interfaces described earlier are essential components of the **Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects** system. Below is a description and prioritization of each interface based on its importance to the system's core functionality, user experience, and operational efficiency.

User Devices

- **Description:**
- These are the primary interfaces through which users interact with the system. They include desktops, laptops, tablets, and smartphones, supporting web browsers or mobile applications for accessibility.
- **Priority:**

High – Critical for end-user interaction and system usability. Without this interface, users cannot access or operate the system.

Servers

- **Description:**

Servers host the application and database, enabling backend processing and data storage. They are essential for running the system and supporting multiple users concurrently.

- **Priority:**

High – Central to system functionality and reliability. Server unavailability directly impacts all operations.

Database Systems

- **Description:**

Databases store and manage all system data, including worker profiles, project details, and performance records. They are integral for data retrieval and analysis.

- **Priority:**

High – Fundamental to the system's ability to process and store information. Performance or failure issues could lead to data loss or downtime.

Networking Equipment

- **Description:**

Networking equipment ensures connectivity between user devices, servers, and external systems. It supports secure data exchange and system communication.

- **Priority:**

High – Essential for system access, particularly for remote users or cloud-hosted deployments.

4.1.3 Functional Requirements

FR1	Predicting the number of laborers for the particular project.
Input	Project categorization result, Types of labors required for a project, Past project categorization results with the number of labors worked.
Processing	Training the model using past project details to predict.
Output	Required labor quantity for the project.
Definition	Displaying the required number of labors for the project through a dashboard.

FR2	Providing a platform to enter the completed tasks of the project.
Input	Labor Histogram prepared by the project manager, daily completed tasks
Processing	Creating an upload portal to upload the labor histogram and enabling it to edit.
Output	Recording the daily completed tasks.
Definition	Project manager should mark the completed tasks daily.

FR3	Providing a platform to enter the daily attendance of the employees.
Input	Daily attendance of the labors

Processing	Creating a platform to enter the number of labors worked per a day.
Output	Recording the daily attendance of the labors.
Definition	Project manager should mark the daily attendance of labors.

FR4	Predicting the real time status of the project according to the progression.
Input	Daily attendance of the labors, Completed tasks of the project.
Processing	Training the model how the cost and timeline should vary from the plan.
Output	Showing the variations of cost and timeline. (Over budgeted/Ahead the schedule)
Definition	Showing the timeline and cost variations through the dashboard.

FR5	Should generate KPIs according to the designation and criteria provided by MAGA.
Input	Designation, criteria provided by MAGA
Process	Generating KPIs for the designation
Output	KPIs

FR6	Should calculate KPI values after entering the worked project details by the employees.
Input	Project Details
Process	Updating KPI values
Output	KPI value percentage

FR7	Should create an upload portal to upload CVs.

Input	CV file
Process	Extracting text from CV and storing them in Data Base
Output	Data in Data Base

FR8	Should create a dashboard to view KPI values.
Input	KPI values, employee name
Process	Matching KPI values with employee name
Output	Displaying KPI values in Dashboard

FR9:	Matching the most appropriate employees according to the project categorization based on KPI value.
Input:	• Project categorization data. • Generated employee Key Performance Indicator (KPI) values.
Processing:	Analyze employee data and KPI values to match employees with the most suitable projects based on project categorization and required skill sets.
Output:	A list of employees ranked according to their suitability for specific projects based on their KPIs.
Definition:	The system will identify and match the most appropriate employees to categorized construction projects using KPIs to ensure optimal allocation and improved project outcomes.

FR10:	Displaying the suggestions of the matching employees.

Input:	Matched employee data based on the processing from the first requirement.
Processing:	Filter and sort the list of matched employees according to various criteria such as availability, KPI ranking, and project needs.
Output:	A user-friendly display of suggested employees for each project, showing their ranking and suitability based on KPI analysis.
Definition:	The system will present a ranked list of suggested employees for project managers to review and select, based on the matching process that considers KPIs and project categorization

FR11:	Manual Adjustment of Employee Allocation by Project Manager
Input:	• Suggested list of employees matched to the project based on KPIs. • Project manager's experience and knowledge of the team.
Processing:	The project manager reviews the suggested employees and manually adjusts the allocations based on personal experience, specific project needs, or additional factors not captured by the KPI-based matching system.
Output:	Finalized employee allocation list that includes the project manager's adjustments, which may override or refine the system's suggestions.
Definition:	The system allows project managers to make manual adjustments to the employee allocations suggested by the automated system. This ensures that

	human expertise and real-world knowledge are incorporated into the allocation process, allowing for flexibility and consideration of factors beyond the scope of automated KPI-based matching.

FR12:	Collect Project Information
Input:	Project details such as scope, budget, estimated duration, square footage, site conditions, project type, location, and objectives.
Processing:	The system validates and stores the provided data in a structured database for further categorization.
Output:	A detailed project profile saved in the database, ready for analysis and categorization.
Definition:	The system should allow users to input all necessary project details through a user-friendly interface and store the data securely for categorization and risk assessment.

FR13:	Categorize Project by Type
Input:	Stored project details, including the type of construction (e.g., residential, commercial, industrial).
Processing:	The system analyzes the input data and categorizes the project into predefined types based on scope and specifications
Output:	Project type classification displayed to users (e.g., Residential, Commercial, Industrial, Infrastructure).

Definition:	The system must classify projects into specific types based on input details to enable tailored planning and resource allocation.

FR14:	Assess Risk and Complexity Levels
Input:	Project details such as scope, budget, estimated duration, square footage, site conditions, project type, location, and objectives.
Processing:	The system evaluates risk factors using predefined criteria.
Output:	Risk levels categorized as low, medium, or high, shown alongside the project type.
Definition:	The system should assess and display potential risks for each project based on key factors, aiding project managers in proactive planning.

FR15:	Define Project Timeline and Budget Levels
Input:	Project details such as scope, budget, estimated duration, square footage, site conditions, project type, location, and objectives.
Processing:	Categorized project timeline and budget levels displayed in the project summary.
Output:	A detailed project profile saved in the database, ready for analysis and categorization.
Definition:	The system must determine and display project timelines and budget levels, helping teams prioritize and plan resources efficiently

5. Other Nonfunctional Requirements

5.1 Performance Requirements

To guarantee effectiveness, scalability, and dependability in practical applications, the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects system needs to fulfil the following performance requirements. These needs are divided into groups according to the main purposes of the system:

1. Performance Analysis

Accuracy of Performance Metrics: When assessing employee performance using historical data, real-time monitoring, and key performance indicators (KPIs), the system must have an accuracy of at least 95%.

Justification: guarantees trustworthy allocation choices that complement worker skills and project objectives.

Processing Speed: Within two seconds for individual employees and thirty seconds for teams of up to fifty, the performance evaluation module must evaluate input data and deliver findings.

Justification: aids in making decisions in real time in dynamic construction settings.

2. Project Categorization

The system must classify projects according to their nature, complexity, and necessary skill sets with at least 90% accuracy.

Justification: Assures proper workforce matching with project requirements, lowering the possibility of mismatches.

Data Processing Efficiency: A project dataset with up to 1,000 entries must be processed and categorized by the categorization algorithm in less than five minutes.

Justification: Enables prompt project allocation and planning in extensive operations.

3. Manpower Allocation

Response Time: For a medium-sized project (up to 100 workers), the system must assign personnel in 10 seconds, and for a large-scale project (up to 500 workers), it must do so in 1 minute.

Justification: Preserves operational effectiveness by cutting down on allocation decision delays.

Scalability: Up to 20 projects' worth of allocation procedures must be supported concurrently by the system without causing performance issues.

Justification: Provides strong capability for big businesses overseeing several projects.

4. System Usability and Reliability

User Interface Responsiveness: Under normal operating circumstances, the dashboard must load in one second and react to user inputs in half a second.

Justification: Facilitates decision-making in high-stress situations and improves user experience.

System Uptime: The system must have a minimum of 99.5% availability and no more than 4 hours of planned outage per month.

Justification: Guarantees dependability during crucial project stages.

5. Real-Time Monitoring and Updates

Data Synchronization: Within one minute of real-time occurrences, worker performance metrics and project statuses must be updated.

Justification: Encourages precise decision-making considering the state of the project and the personnel.

Notification Latency: Within five seconds of a decision, the system must notify stakeholders of allocation or reallocation.

Justification: Quickly keeps everyone informed and on the same page.

6. Security and Compliance

Data Encryption: When being stored or sent, all sensitive performance and project data must be encrypted using at least 256 bits of encryption.

Justification: Prevents unwanted access and guarantees adherence to industry norms.

Audit Logging: All allocation choices and system changes must be recorded by the system, and the logs must be available for examination within ten seconds.

Justification: Promotes accountability and makes debugging and compliance audits easier.

5.2 Safety Requirements

Safety is paramount for any system handling sensitive data, especially in industries like construction where resource allocation impacts project timelines and budgets. This system's safety requirements are designed to minimize risks such as data breaches, loss of sensitive information, and operational failures.

5.2.1 Data Protection

Sensitive data, such as employee CVs, performance metrics, and project details, must be encrypted using both storage and transmission. This ensures that unauthorized entities cannot access or exploit the data. Multi-factor authentication will safeguard user accounts, reducing the risk of unauthorized access.

5.2.2 System Safeguards

- Backup Mechanisms: Regular backups will ensure that data can be restored quickly in case of system failures or cyberattacks.
- Error Handling: Comprehensive error logs will capture anomalies and system failures, allowing quick diagnosis and resolution.
- Failover Systems: Redundant servers will take over in case of primary server downtime, ensuring continuous operation.

5.2.3 Access Control

Role-based access control will limit access to sensitive system functions. For example, only project managers can modify project categorizations, while employees can update their KPIs but not view others' data.

5.2.4 Risk Mitigation

Safety measures include monitoring data traffic for anomalies, implementing firewalls, and setting up intrusion detection systems (IDS). Additionally, any attempts to alter sensitive data will trigger alerts and lockdown measures.

5.2.5 User Safety

The system will provide clear guidelines on safe usage. For example, avoiding public Wi-Fi for system access will be recommended. Training will be provided to users on recognizing phishing attempts and other security threats. By implementing these safety requirements, the system minimizes risks, protects data integrity, and ensures reliability for all stakeholders.

5.3 Security Requirements

To safeguard private information and guarantee safe operations, the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects system needs to follow strict security guidelines. Confidentiality, availability, and integrity are all addressed by these security criteria, which also adhere to pertinent laws and guidelines.

1. Data Protection

Encryption: During storage and transmission, any sensitive information, such as employee performance reviews, project specifics, and allocation choices, must be secured using at least 256 bits of encryption.

Justification: Prevents data breaches and illegal access.

Access Control: To guarantee that users can only access information and features pertinent to their responsibilities, role-based access control, or RBAC, must be put into place.

Justification: Lowers the possibility of insider threats and restricts exposure to critical information.

2. Privacy Protection

Data Anonymization: Personal information and worker performance data must be anonymized before being shared with third parties or used for analytics.

Justification: Guarantees adherence to data privacy regulations and safeguards personal identities.

Regulatory Compliance: The system needs to abide by applicable laws, such as the California Consumer Privacy Act (CCPA), the General Data Protection Regulation (GDPR), or comparable local privacy statutes.

Justification: Fulfils legal requirements while safeguarding user privacy.

3. System Security

Firewall and Intrusion Detection: To stop unwanted access and identify malicious behavior, the system has to have firewall protection and intrusion detection tools.

Justification: Increases the system's resistance to outside threats.

Secure APIs: Tokens for authentication, encryption, and defense against injection attacks are essential components of any API used for data exchange.

Justification: Preserves the accuracy of data exchanges.

4. Backup and Disaster Recovery

Data Backup: Every day, all important data must be automatically backed up and safely stored offshore.

Justification: Prevents data loss from cyberattacks or system malfunctions.

Disaster Recovery Plan (DRP): In the event of a significant incident, the system must have a DRP that guarantees complete operation restoration within four hours.

Justification: Reduces downtime and its effect on building project schedules.

5.4 Software Quality Attributes

The quality attributes of the system are designed to meet the needs of both end-users and developers, ensuring a robust and reliable application.

- Adaptability

The system is modular, allowing future enhancements like new project categories or updated risk parameters without the architecture. APIs facilitate integration with external tools as the organization's needs evolve.

- Availability

The system is designed for 99.9% uptime, ensuring minimal disruptions. Cloud-based infrastructure and redundant servers guarantee continuous operation, even during peak usage.

- Correctness

Accuracy is critical for project categorization and manpower allocation. Testing and validation processes ensure that algorithms classify projects correctly and allocate resources efficiently.

- Flexibility

The system supports multiple platforms, including desktops, laptops, and mobile devices. This flexibility allows project managers and employees to access the system from office settings or on-site locations.

- Interoperability

APIs enable seamless data exchange with external project management tools (e.g., Jira, Microsoft Project). The system also integrates data through services like APIs.

- Maintainability

Well-documented code and modular architecture make the system easy to maintain. Bug fixes and updates can be deployed quickly without disrupting ongoing operations.

- Reliability

Data backups and failover mechanisms ensure reliability. Automated alerts notify administrators of potential issues, enabling swift action to prevent downtime.

- Usability

The system prioritizes user-friendliness with a dashboard, clear navigation, and visual aids like charts and graphs. User training materials ensure that even non-technical users can operate the system efficiently.

- Portability

The application runs on major operating systems (Windows, macOS) ensuring accessibility. By addressing these quality attributes, the system delivers high performance, reliability, and ease of use for its stakeholders.

5.5 Business Rules

The following business principles govern how the Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects system functions to guarantee efficiency, equity, and adherence to company guidelines and industry norms. These guidelines specify particular behaviors under predetermined conditions and direct the system's functionality and design.

1. Access Control Based on Roles

Details of the project can be created, edited, and seen by the project manager.
can approve or overturn automatic decisions about the deployment of manpower and has access to workforce performance reports.

HR staff are able to enter performance data, change skill sets, and manage employee profiles.
able to produce worker availability and utilization reports.
Administrators are able to control user roles, set up system preferences, and manage system interface with other systems.

General Users (Workers): Have access to their assigned tasks and personal performance metrics.

2. Worker Allocation Guidelines

Skillset Match: Employees can only be assigned to projects if their skill set is compatible with that of the project.

Availability Check: Throughout the project's duration, employees must be available (that is, not on leave or already assigned to another project).

To cut down on travel time and expenses, workers that are geographically closer to the project site are given preference when it comes to allocation.

Workload Balancing: To prevent overworking or underusing individual employees, the system makes sure that duties are distributed fairly.

3. Rules for Project Categorization

Projects are grouped according to predetermined standards including resource requirements, duration, and complexity.

When allocating staff, projects with greater complexity or pressing deadlines are given priority.
Prior to final allocation, the project manager must examine and approve the classification results.

4. Integrity and Confidentiality of Data

According to the role-based access control (RBAC) model, only authorized roles have access to performance data, employee profiles, and project specifics.

It is not possible to change historical performance data; any corrections must be recorded as new entries with appropriate explanation.

5. Regulations and Compliance

The system must guarantee that the distribution of workers conforms with labor rules and regulations, including those pertaining to safety certificates, mandatory breaks, and maximum working hours.

It is not possible to allocate workers to certain activities (such operating heavy machinery) if they do not possess the necessary credentials.

6. Alerts and Notifications

Notifications of important events, including employee unavailability or approaching project commencement dates, must be sent to project managers and human resources staff.

Alerts about new assignments, modifications to project schedules, or necessary certifications must be sent to employees.

7. Decision Overrides

In extraordinary circumstances, including emergencies or unanticipated changes in project requirements, the system permits authorized roles (such as project managers) to override automated allocation decisions.

For auditing purposes, every override needs to be recorded with a justification and a timestamp.

8. Guidelines for Performance Evaluation

Standardized KPIs including job completion rates, work quality, and punctuality serve as the foundation for employee performance reviews.

Before being used in allocation choices, performance scores need to be updated on a regular basis and verified by HR staff.

9. Limitations on Resources

Budgetary restrictions must be considered when allocating manpower to ensure that, without stakeholder approval, resource allocation does not surpass project budgets.

10. Audit and Reporting

For auditing purposes, all system operations, including data updates, allocation choices, and overrides, must be recorded.

Reports on worker performance, project progress, and manpower utilization must be produced on a regular basis and distributed to the appropriate parties.

These business rules guarantee that the system follows established protocols, encourages openness, and supports organizational goals while upholding adherence to legal and industry norms.