Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)

Project ID-2024-25J-018

Project Proposal Report

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August 2024

Declaration

We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning, and to the best of our knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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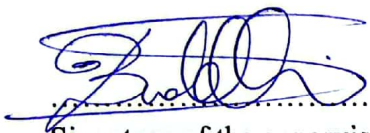
The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Name of supervisor: Ms. Buddhima Attanayake

Name of co-supervisor: Ms. Narmada Gamage



Signature of the supervisor:
(Mrs. Buddhima Attanayake)

16/08/2024
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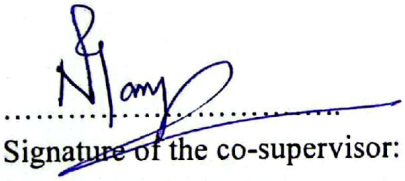

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Abstract

The project proposal titled "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)" aims to transform manpower allocation processes within the construction sector, focusing on MAGA Engineering Pvt Ltd. The proposed web application will utilize historical performance data and resume details to generate Key Performance Indicators (KPIs) for employees and categorize the projects based on historical project data and complexity factors. By considering project complexity alongside these KPIs, the system will optimize personnel assignment, ensuring that the appropriate skills are aligned with the right tasks. In addition to efficient manpower allocation, the application will provide predictive insights into labor needs, project budgets, and timelines, significantly enhancing decision-making and resource management. The proposal outlines the methodology, system requirements, and commercialization strategy for ProjectPulse, offering a comprehensive approach to improving operational efficiency in the construction industry. A thorough literature review is included, identifying current gaps and research needs that this project seeks to address.

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1. Introduction

The complexity of the construction sector makes it necessary to handle a wide range of resources well in order to guarantee project completion. The most important of these resources is human capital since worker productivity, experience, and abilities directly affect project results. But conventional ways of allocating people frequently fall short of making the best use of talent that is available, which results in inefficiencies, delays in projects, and overspending.

The project "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)" suggests developing a web application to transform labor allocation in the construction industry as a solution to these issues.

We are concentrating on two types of labor for this project: workers on building sites and employees of the corporation. Building projects, particularly those carried out by MAGA Engineering Pvt Ltd, are the focus of our research. We are focusing our investigation on "building projects," which fall within the larger category of construction [1].

1.1 Background Study

The construction industry is crucial to economic growth, but because of the complexity associated with its projects and the requirement for efficient resource allocation, it is still one of the most difficult industries to manage. In this context, effective human resource management is critical since it directly affects the outcome of building projects. Unfortunately, the sector frequently faces problems with mismatches in skill sets, labor shortages, and ineffective staffing, which can cause delays in projects, overspending, and lowered quality.

Construction projects of MAGA Engineering Pvt Ltd, have traditionally allocated manpower through a manual, experience-based approach. When assigning duties to staff members, project managers frequently do so without thoroughly evaluating each worker's qualifications, prior performance, or the particular requirements of the project. Instead, they depend on their instincts and prior experiences. Although this method can be successful at times, it is prone to mistakes and inefficiencies, particularly in large-scale projects with significant stakes.

New opportunities for resource allocation optimization in a variety of industries, including construction, have been made possible by recent developments in data analytics and machine learning. It is feasible to create predictive models that help guide better decision-making by utilizing historical data on worker performance and project outcomes.

1.2 Literature Survey

In the construction sector, assigning employees is a difficult operation that has a big impact on the productivity and success of projects. The need of creating reliable manpower forecasting models to precisely estimate labor requirements is shown by current developments. These models incorporate variables such as project scale, complexity, and historical performance information. Forecasting techniques have improved throughout time, but abrupt shifts in the market continue to present difficulties, according to a thorough review by Zhao et al. (2022). In dynamic environments like construction, where labor demand might shift suddenly, these forecasting models are essential for making well-informed decisions (Emerald) [2].

Technology adoption for workforce efficiency has gradually changed in the construction sector. Project delays and inefficient use of resources were common outcomes of the manpower allocation techniques used in the past. But because to the development of digital tools and predictive analytics, businesses are now better able to estimate labor requirements and distribute workforce based on real-time data. This shift is essential to tackling the problems caused by the erratic supply of skilled workers and the growing complexity of building projects (MDPI) [3].

Manpower allocation remains a major concern for the construction sector even with technological developments. Project complexity, particularly in large-scale infrastructure undertakings, necessitates a sophisticated grasp of a number of variables, including risk management, stakeholder involvement, and project scope. Research has indicated that a poor comprehension of these intricacies can result in unsuccessful projects. Consequently, it is crucial to incorporate cutting-edge project management technologies that take these aspects into account when allocating staff (MDPI) [3].

Implementing an automated workforce allocation system could greatly improve resource management and project efficiency for businesses such as MAGA Engineering Pvt Ltd. These systems can guarantee that the best employees are assigned to projects that align with their skill sets and past performance by utilizing KPIs and performance analysis. This strategy leads to better decision-making and project outcomes by optimizing resource use and assisting with labor needs, budgeting, and scheduling [4].

The future of construction workforce allocation depends on how well AI and machine learning are integrated with human decision-making. According to a recent review published in the International Journal of Construction Management, future studies should concentrate on hybrid models that integrate algorithmic efficiency with human expertise. By utilizing the advantages of both human intuition and data-driven insights, these models may present a well-rounded strategy [2] [5].

1.3 Research Gap

Effective allocation of employees and optimization are essential in the field of construction project management to guarantee project success. Numerous software applications are available to help with project management tasks, including BuildTrend, Procore, Primavera P6, Alice Technologies, and PlanGrid. These systems frequently lack integrated methods, nevertheless, which would incorporate personnel requirement prediction, KPI-based manpower allocation, and optimum allocation strategies. To bridge these gaps, Project Pulse is a web application tailored to the needs of construction projects that offers a complete solution that makes use of data-driven insights to improve project efficiency and labor allocation. Project Pulse intends to overcome the shortcomings of current solutions and provide a more targeted and efficient method of managing construction resources by integrating cutting-edge features like KPI-based allocation and employee prediction [6]- [7].

✓ - This symbol indicates that a particular feature or functionality is present in the application.

✗ -This symbol signifies that the application does not possess the specific feature or functionality.

Table 1: Research gap with similar applications

Application Reference	Web application	Applicable for construction projects	User Focused Dashboards	Employee requirement prediction	Employee allocation and optimization
Procore	✓	✓	✓	✗	✗
Primavera P6	✗	✓	✓	✗	✗
BuildTrend	✓	✓	✓	✗	✗
Alice Technologies	✓	✓	✓	✓	✗
PlanGrid	✓	✓	✓	✓	✗
Project Pulse	✓	✓	✓	✓	✓

1.4 Research Problem

“How can employee allocation by project managers, which is often based on experience, be improved to reduce inefficiencies and address employee management issues? "

Project managers' traditional practice of allocating employees based only on experience and subjective assessment frequently results in inefficiencies and problems with employee management. This traditional method may ignore important elements like unique skill sets, project specifications, and performance indicators, which could lead to an inadequate staffing assignment and possible delays.

2. Objectives

2.1 Main Objective

The development of a web application that can automate the construction industry's process of allocating manpower through performance analysis and project classification is the solution proposed. Categorizing the details of the upcoming projects, generating a KPI value for each employee through performance and CV analysis, and then optimally assigning the employees to the projects based on the project category outcomes and KPI values. Through the analysis of previous project specifics, this program also aids in predicting the number of laborers needed for the project based on its classification. When a project is initiated, its progress can be used to estimate its cost and timeline for completion.

2.2 Sub Objectives

To overcome the overall main objective there are main 4 objectives to be achieved.

1. Project Categorization - Develop and implement a classification system for construction projects that categorizes them based on complexity, scope, and resource requirements
2. KPI Generation by CV analysis and Performance analysis - Design an automated system for generating Key Performance Indicators (KPIs) by analyzing employee CVs and past performance data, with a goal to enhance decision-making in employee allocation
3. Employee allocation and Optimization - Create an optimized employee allocation system that matches staff to projects, based on their KPIs and project categorization results to reduce allocation errors.
4. Labor, Timeline and Cost prediction - Implement a predictive analytics tool for forecasting labor needs, project timelines, and costs.

2.3 Specific Objective

This component's primary objective is to develop a systematic approach for allocating employees to categorized construction projects using Key Performance Indicators (KPIs) to improve project efficiency and outcomes, with a target to enhance project completion rates by 20% and reduce resource allocation errors by 15% within the first year of implementation.

2.4 Specific Sub Objectives

To achieve the main objective mentioned above in section 2.3, the following are the sub objectives required.

- Gather outcomes of component 1 (Project Categorization) and component 2 (KPI Value generation by performance analysis and CV analysis) such as project categorization result and generated KPI.
- Develop a model for matching employees to projects using the identified KPIs.
- Optimize the outcome of this component
- Validate the model with historical data and real-world scenarios.

3. Methodology

3.1 System Overview Diagram

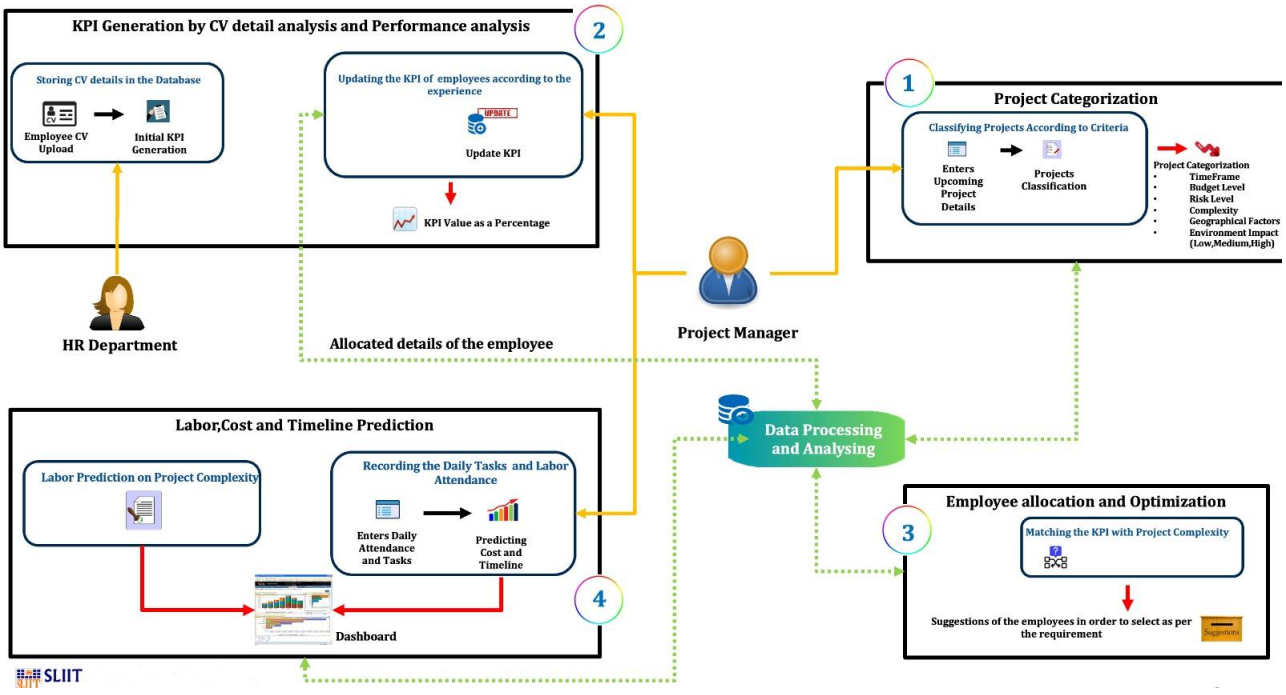

Figure 1: Overall System Diagram

We are about to develop a web application named “Project Pulse”. This application is used by the project manager to select the most suitable human resources for their vacant or upcoming project. When a project is taken by the company, the assigned project manager enters the project details (Location, required staff and their qualifications, cost), then that project is categorized and the complexity is measured as high, medium, or low. When an employee is recruited for the company that employee’s CV details are stored in the database. Once the CV details are entered KPIs are generated according to the CV. The recruited employees should be able to update their experiences according to that KPIs are updated.

According to the KPI values and according to the complexity the staff members under Management, Engineering & Construction, Technical Support, Quantity Surveying and costing, Finance, Administration, Procurement, Inventory and Security personnel categories as required for the project are allocated using allocation and optimization algorithms. Then according to the complexity of the project the required labor count is predicted based on the past project labor details and created labor histogram for the project. And the project manager

can record the daily attendance of the labors and according to the attendance the cost, timeline will be predicted through the dashboard.

3.2 Component Overview Diagram

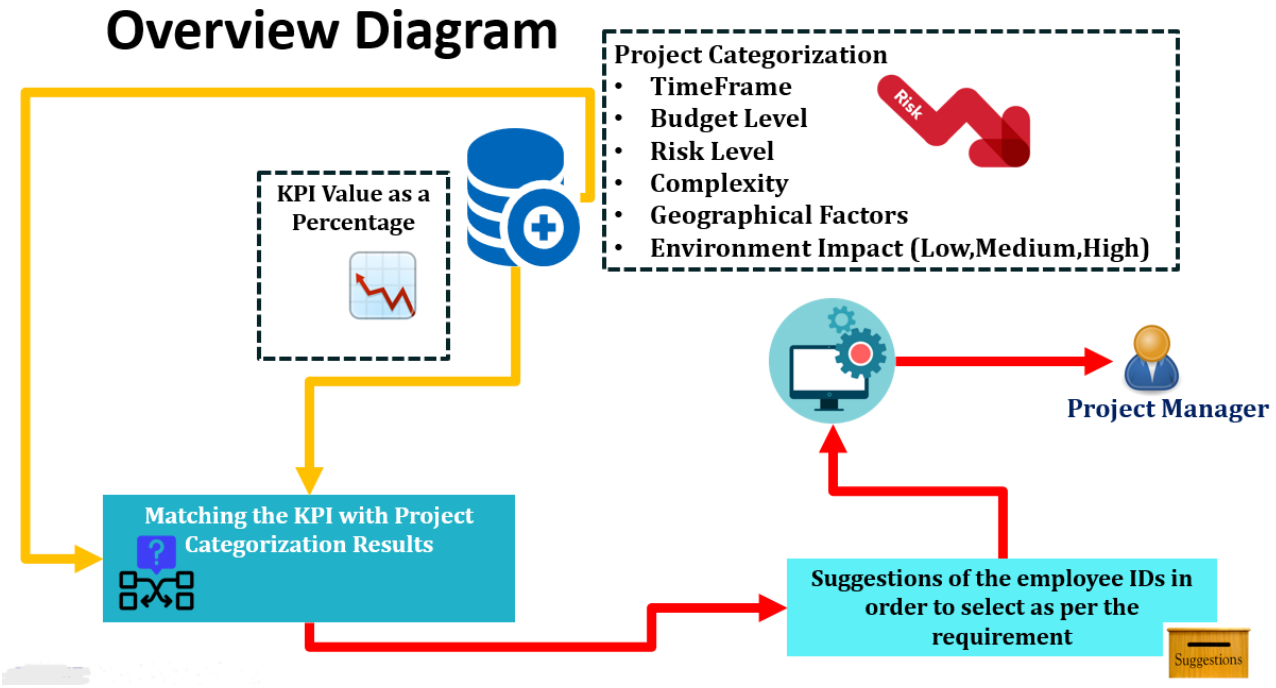

Figure 2 : Component overview diagram

The entire project will move through the previously mentioned sub objectives, with an emphasis on "employee allocation and optimization" in order to enhance decision-making and employee management in comparison to prior research.

Data collection is the initial stage of the development process. Data from our field visit to MAGA Engineering Pvt Ltd will be gathered by field. The relevant dataset ought to have information on every building construction project.

The dataset has to be refined after it is gathered. Data normalization, data conversion into a common format, and data grouping for model training, testing, and validation are all steps in the data refining process. Incomplete and inconsistent data are removed. The collect information and data such as.

- Number of employees worked on certain projects.

- employee categories required for the projects.

Based on the data collected, a matching model will be developed to align the generated KPIs with project categorization results. This model will utilize the outcomes from Component 1 (Project Categorization) and Component 2 (KPI Value Generation through performance and CV analysis) as inputs. The model will then suggest appropriate employees for each project based on their employee ID. Additionally, project managers will have the ability to refine these suggestions by incorporating their own experience and insights. They can provide feedback and make adjustments to the employee recommendations displayed on their dashboard, ensuring that the final allocation reflects both data-driven insights and practical management expertise.

3.3 Gantt Chart

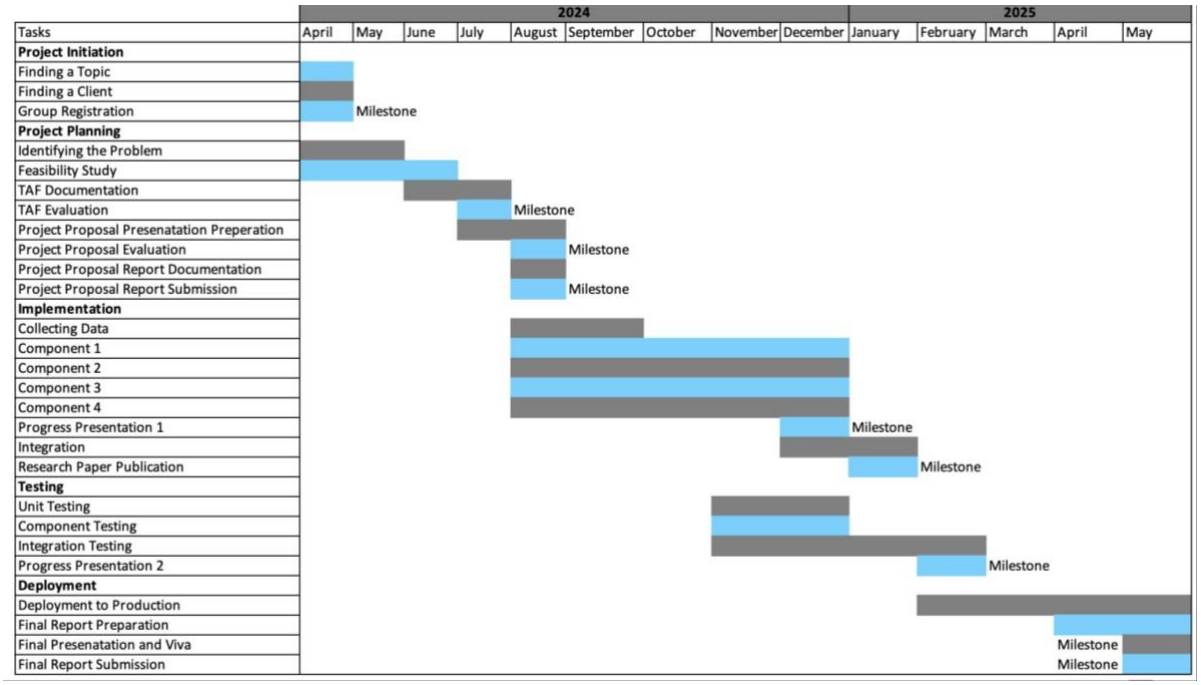

Figure 3: Gannt Chart

The Gantt chart illustrates the research project's stages, milestones, and timeline from April 2024 to May 2025, highlighting tasks like planning, execution, testing, and deployment.

3.4 Work Breakdown Structure

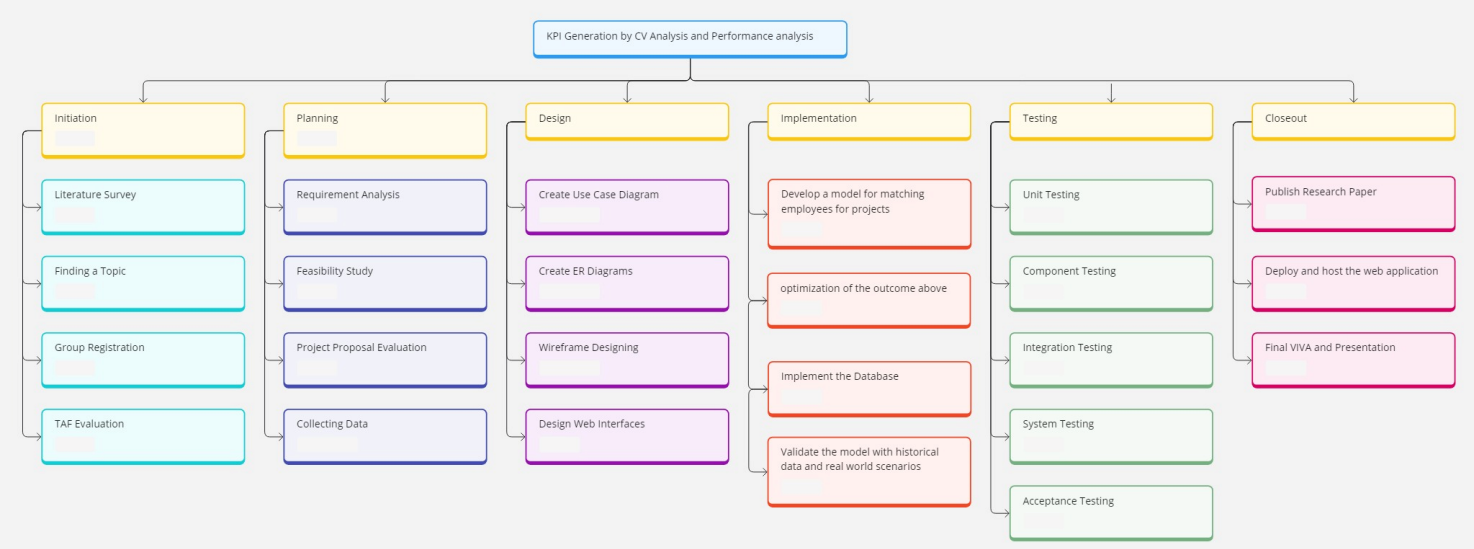

Figure 4:Work Breakdown Structure

The feasibility study and literature review for the research project "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects" have been finished. Planning and design are currently underway on the project, testing and execution will follow. The project will be finished when the research paper is published, the online application is put into use, and the final VIVA and presentation are made.

4. Project Requirements

The following functional, non-functional, and system requirements will be only focusing on the component “Employee allocation and optimization”.

4.1 Functional Requirements

Table 2:Functional requirements 1

FR1:	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.

Table 3:Functional requirements 2

FR2:	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

Table 4:Functional requirements 3

FR3:	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.

4.2 Non-Functional Requirements

Table 5:NON-Functional requirements 1

NFR1:	User-Friendly Interface
Description:	The application should have an intuitive and easy-to-navigate interface that allows users to interact with the system effortlessly.

Table 6:NON-Functional requirements 2

NFR2:	Application Reliability
Description:	The application must be dependable and consistently perform as expected without crashes or errors, ensuring continuous availability to users.

Table 7:NON-Functional requirements 3

NFR3:	Higher Accuracy of Results
Description:	The system should produce highly accurate outcomes based on the data provided, minimizing errors in predictions and analysis.

Table 8:NON-Functional requirements 4

NFR4:	Efficient Results

Description:	The application should deliver results quickly and with minimal resource usage, optimizing the efficiency of the overall process.

Table 9:NON-Functional requirements 5

NFR5:	Flexibility to Include Project Managers' Input
Description:	The system should allow for the integration of project managers' insights and inputs, adapting to their specific needs and preferences.

Table 10:NON-Functional requirements 6

NFR6:	Easy Operability
Description:	The system should be simple to operate, requiring minimal training for users to perform tasks effectively and efficiently.

4.3 System Requirements

- Laptop
- Internet connection
-

4.4 Software & Technology Requirements

- Python
- Visual Code
- MYSQL
- HTML
- CSS
- Tensor Flow

4.5 Data requirements

Our main data source is MAGA Engineering Pvt Ltd. The data requirements for my component are,

1. Number of employees worked on certain projects.
2. employee categories required for the projects.

5. Description of Personal and Facilities

Table 11: Description of Personal and Facilities

Registration Number	Name	Task Description
IT21069840	Devashika R.P.P.A.	• predicting the number of employees required for the project. • Suggest the employees for the project

6. Commercialization

The finished product of this project will be a web application which any of the construction company can be used by paying a one-time fee or a subscription fee. This application provides so many advantages than the existing systems. Some of them are.

- Employee allocation for projects on the basis of KPIs.
- Employee allocation optimization.
- Tracking and management of project progress.
- Project categorization mainly by risk and complexity.

This product will exist as two types of models,

- Common Version
- Premium Version

The facilities provided by above 2 versions are as below,

Table 12 :Features of two versions

Common Version	Premium Version
• Initial KPI generation by CV Upload. • Updating the performance of employees. • Project categorization on Time Frame and Geographical factors.	• Updated KPI Values. • Project Categorization on risk and complexity. • Most appropriate employee suggestions. • Labor, Cost, and timeline predictions.

This (ProjectPulse) can be used by the construction companies as a project management tool.

The main end-users and their tasks are.

- HR Department - Uploads the CV when an employee is recruited for the company.
- Employee - Update the Project details assigned with start and end dates of the project.
- Project Manager - Enters the upcoming project details for categorization.

  Records the daily attendance and completed tasks.

7. Budget and Budget Justification

Table 13 : Budget

Resource Type	**Amount (Rs.)**	**Total (Rs.)**
Internet Connection	**10000.00**	**10000.00**
Travelling Cost	**15000.00**	**15000.00**
Documentation Cost		
Paper Cost	7000.00	
Research Paper Publication per person	60,000.00	
Total	**67,000.00**	**67,000.00**
Implementation Cost		
Software version Charges	45,000.00	**45,000.00**
Total Cost		**137,000.00**

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Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)

Project ID-2024-25J-018

Component: KPI Generation by CV analysis and Performance analysis.

Project Proposal Report

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August 2024

Declaration

We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning, and to the best of our knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

IT Number	Name	Signature
IT21276750	Isuranga K.M.S	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Name of supervisor: Ms. Buddhima Attanayake

Name of co-supervisor: Ms. Narmada Gamage

.....
Signature of the supervisor:
(Mrs. Buddhima Attanayake)

20/08/2024
Date

.....
Signature of the co-supervisor:
(Ms. Narmada Gamage)

20/08/2024
Date

Abstract

The objective of the project proposal named "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)" is to create a web application that maximizes the allocation of labor in the construction sector, with a focus on MAGA Engineering Pvt Ltd. Based on the users' resumes and past performance, the program will classify projects and produce Key Performance Indicators (KPIs) for staff members. Then, considering the intricacy of the project and these KPIs, it will efficiently assign personnel. Additionally, the system will forecast labor needs, project budgets, and schedules, which will enhance decision-making and resource management in building projects. The proposal covers the technique, system requirements, and commercialization strategy for the proposed application. It also contains a thorough evaluation of the literature and identifies research needs.

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1. Introduction

At MAGA Construction, we're dedicated to keeping our staff focused on producing high-quality work while also maximizing our operational efficiency. We have put in place a reliable system for creating Key Performance Indicators (KPIs), automating CV uploads, and updating KPIs to support this goal. Our efforts in personnel development, talent acquisition, and performance management will be more efficiently handled by these procedures. [1]

By measuring personnel and project performance objectively and coordinating their results with our strategic objectives, KPI generation enables us to effectively manage both. We can guarantee that KPIs are created reliably and consistently by automating this process, which will also provide us with important insights into areas that require improvement.

The automation of CV uploads is an essential component of our hiring process that helps us handle candidate data swiftly and effectively. By minimizing errors, cutting down on human data entry, and shortening the hiring process, our technology makes sure that we draw in the best candidates in the business.

The KPI Update process enables us to continuously evaluate and modify our KPIs to better represent the ever-changing nature of our sector. We guarantee that our performance measures are up to date by automating KPI changes, giving us the real-time information, we need to make wise decisions.

When taken as a whole, these automated procedures are revolutionizing the way MAGA Construction oversees its employees and projects, fostering ongoing development and preserving our standing as a pioneer in the sector.

1.1 Background Study

Ensuring excellent outputs, achieving project deadlines, and maintaining productivity in the construction business are contingent upon the implementation of efficient performance management and recruitment procedures. Manually managing these procedures grows more difficult and error prone as businesses expand and projects get more complicated. Automation technologies that can greatly improve accuracy and efficiency have been adopted as a result[2].

In the construction sector, Key Performance Indicators (KPIs) have long been used to assess and gauge the effectiveness of several project components, including quality, safety, cost, and schedule management. KPIs were traditionally created and tracked through manual data gathering and analysis, which might be laborious and prone to human error. The necessity for increasingly advanced and automated KPI management techniques has grown along with the industry. Construction businesses can detect problems early and make informed decisions that enhance project results by utilizing automation in KPI development, which facilitates real-time tracking and reporting.

In a similar vein, hiring practices in the construction industry play a crucial role in guaranteeing that projects are filled with qualified personnel. The conventional method of gathering and organizing resumes for candidates can be labor-intensive, and HR departments are frequently overloaded with applications, particularly in times of significant growth. This problem has given rise to CV Upload Automation, which provides an effective method of managing massive amounts of candidate data. HR staff labor is greatly reduced when using automated tools to process and classify resumes, extract pertinent data, and integrate it into the organization's talent management systems.

In addition, KPI updates are necessary to guarantee that a construction company's performance measurements continue to be pertinent to its present operating objectives. Project development and emerging problems necessitate an evolution of success metrics. By automating updates, KPIs can be examined and modified regularly to reflect changes in the organization's goals, industry norms, and project scope.

Acknowledging the significance of these procedures, MAGA Construction has made investments in automation technologies to optimize its business processes. Through the implementation of automated KPI production, CV upload, and KPI updates, MAGA Construction hopes to improve its capacity to oversee intricate projects, draw in top personnel, and uphold a high caliber of performance in all its operations. This tactical choice puts the business in a competitive position in a field that values precision, speed, and flexibility.

1.2 Literature Survey

Several studies have looked into the use of machine learning for workforce allocation and KPI generation in the construction industry. In one well-known study, numerous project factors were analyzed to produce predictive insights, and the results were used to build a machine learning-based model for cost prediction in building projects. This study showed how machine learning can manage complicated, multi-dimensional data in building projects, even though its main objective was cost prediction. However, the study left a vacuum in the research for this particular application by not expanding its investigation to incorporate the creation of KPIs using CV and performance data[2].

A different study looked into the qualifications needed for project managers in the construction industry, highlighting the significance of managerial expertise and experience for project success. The study demonstrated how machine learning might be used to improve managerial competency assessments, which could then be converted into KPI values. However, this study's relevance to automated manpower allocation systems that demand thorough KPI development across all roles is limited because it largely focused on the capabilities of project managers rather than a wider spectrum of construction people [3].

Improved resource allocation and real-time performance monitoring are two important elements influencing worker efficiency, according to additional research on increasing productivity in labor-intensive construction projects. According to the study, labor allocation might be greatly enhanced by automated systems that can produce KPIs based on continuous performance analysis. Nevertheless, neither the implementation details of such systems nor the difficulties in combining CV analysis with performance data to produce precise KPI values were covered in this study [2] [4].

Indra and Humiras' (2020) systematic literature study offers a thorough overview of the application of KPIs at various project management levels. They stress that in order to enable more uniform performance measurement across projects, there needs to be a systematic methodology to the selection and application of KPIs [5].

1.3 Research Gap

The research on the automated allocation of labor based on comprehensive performance analysis and CV evaluation is conspicuously lacking, in spite of the advances in machine learning and KPI-based performance analysis. Current systems frequently use static or partially automated processes that underutilize the vast amounts of data that may be obtained from CVs, employee performance reviews, and previous project experiences. Personalized performance measures are often overlooked by these systems, which results in less-than-ideal resource allocation choices.

The following table is a comparison between existing technologies and the proposed solution.

Table 1: Research Gap with similar systems

Application Reference	Applicable for construction projects	Performance Update	CV Upload	Real Time Integration with performance	KPI Generation
Procore [6]	✓	✗	✓	✗	✓
Alice Technologies [7]	✓	✗	✓	✗	✓
nPlan [8]	✓	✗	✓	✗	✓

Labour Chart [9]	✓	✗	✓	✗	✓
PlanGrid [10]	✓	✗	✓	✗	✓
Project Pulse	✓	✓	✓	✓	✓

1.4 Research Problem

How can the challenges of managing physical CVs and using outdated KPIs be addressed to improve decision-making in employee management? The challenges associated with managing physical copies of employee CVs, along with the use of inaccurate and outdated Key Performance Indicators (KPIs), result in wrong decision-making.

2. Objective

2.1 Main Objective

This proposed solution is to develop a web application which can automate the manpower allocation by performance analysis and project categorization for construction industry.
Categorizing the upcoming project details and generating a KPI Value to the employees by CV analysis and performance analysis and then allocating the employees for the upcoming projects based on the project categorization results and KPI values in an optimized way. This application also helps to predict the number of labors required to the project based on the project categorization by analyzing past project details. When the project is started, according to the progress this can predict the cost and timeline of the project.

2.2 Sub Objectives

To overcome the overall main objective there are 4 main objectives to be achieved.

1. Project Categorization
2. KPI Generation by CV analysis and Performance analysis
3. Employee allocation and Optimization
4. Labor, Timeline and Cost prediction.

2.3 Specific Objective

To improve decision-making, staff management, and alignment with current corporate goals, implement a digital CV management system, generate key performance indicators (KPIs) and update KPIs with involved project details. The goal is to generate accurate KPIs based on predefined criteria (Performance, Competencies, Additional Criteria) and provide real-time KPI results for better decision-making.

2.4 Specific Sub Objectives

To achieve the above-mentioned main objective the following specific objectives will be achieved in advance.

- Developing an upload portal to upload CVs.
- Generating KPIs for the employee
- Developing a portal to update employees' project work.
- Developing to calculate KPI percentage for generated KPI and given project details.

3. Methodology

1. Research Design:

Type: A mixed-approaches strategy will be used for this project, integrating quantitative and qualitative research methods. This strategy will guarantee thorough data gathering and analysis, meeting the needs of the implementation's technical and human components.

Scope: A mid-sized construction company's adoption of a digital CV management system and the creation of new KPIs will be the main subjects of the study. The project will cover all departments involved in performance reviews, staff management, and decision-making.

2. Data collection methods:

Literature review: Review the body of research on digital CV management systems, staff management best practices, and KPI formulation in the construction sector. Examine case studies from comparable businesses that have effectively updated KPIs and deployed digital management systems.

Document Analysis: Examine recent resumes, performance reviews, and KPIs to establish baselines and pinpoint areas in need of development.

3. System Design and Development:

Software Selection: Determine the demands of the organization and choose a digital CV management system that is user-friendly, scalable, and scalable. Think at alternatives such as off-the-shelf or custom software.

System Customization: Add fields and features that are unique to the construction sector to the digital CV management system you have chosen, such as the ability to track certifications, project experience, and skill evaluations.
Integration: To facilitate real-time data sharing and analysis, make sure that the current HR and project management systems integrate seamlessly.

4. KPI Development and Updating:

Current KPI Review: Evaluate current KPIs to determine their applicability, efficiency, and congruence with current business objectives.

Stakeholder Workshops: Lead meetings with important parties to establish new KPIs, such as employee happiness, productivity rates, project delivery schedules, and safety compliance, that more accurately reflect the company's strategic goals.

KPI Testing & Validation: Test the new KPIs in a chosen project or department to determine their efficacy and make any required modifications.

Continuous Improvement: Create a procedure for routinely reviewing and revising KPIs to make sure they stay in line with changing company objectives.

5. Implementation:

Phased Rollout: Begin with a trial project or department and expand the digital CV management system from there. This will enable testing, gathering input, and modifications before rollout throughout the organization.

Training and Change Management: To guarantee a seamless implementation, create and implement extensive training programs for managers, employees, and HR staff. To overcome opposition, highlight the advantages of the new system, and guarantee buy-in from all stakeholders, implement a change management plan.

Support and Monitoring: Create a structure for continuous technical support and monitoring system performance, user happiness, and the effect on personnel management and decision-making.

6. Data Analysis Techniques:

Quantitative Analysis: Focus on metrics like time saved, decision accuracy, and staff performance improvements when applying statistical tools to examine data gathered from surveys and the digital CV management system.

Qualitative Analysis: To find recurring themes, difficulties, and recommendations pertaining to the implementation process, use thematic analysis to data from focus groups and interviews.

KPI Monitoring: Keep a close eye on the updated KPIs to evaluate how well they're helping to improve decision-making and align with company objectives.

7. Ethical Considerations:

Confidentiality: Assure the utmost secrecy and adherence to data protection laws in the handling of all employee data, including resumes and performance reviews.

Informed Consent: Get the informed consent of every person taking part in focus groups, questionnaires, and interviews.

Minimizing Disruption: Take steps to reduce the amount of time that regular business activities are disrupted when the new system is being implemented and research data is being gathered.

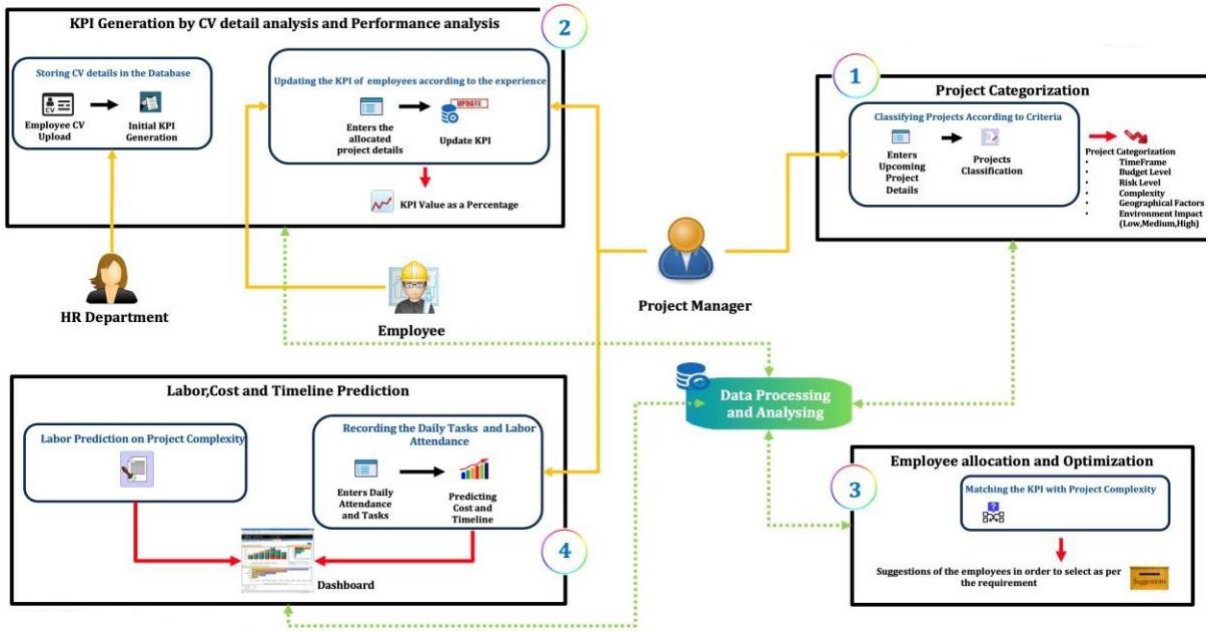
8. Reporting and Continuous Improvement

Final Report: Write a thorough report that details every step of the process, including data analysis results, system implementation outcomes, and suggestions for additional enhancements.

Feedback Loop: To guarantee continual improvement of the digital CV management system and KPIs, establish a continuous feedback loop with all stakeholders. Long-term monitoring: Establish a framework for long-term monitoring and assessment to monitor the modifications' ongoing effects on personnel management, decision-making, and alignment with company objectives.

3.1 System Overview Diagram

Figure 1:Overall System Diagram



We are about to develop a web application named “Project Pulse”. This application is used by the project manager to select the most suitable human resources for their vacant or upcoming project. When a project is taken by the company, the assigned project manager enters the project details (Location, required staff and their qualifications, cost), then that project is categorized and the complexity is measured as high, medium, or low. When an employee is recruited for the company that employee’s CV details are stored in the database. Once the CV details are entered KPIs are generated according to the CV. The recruited employees should be able to update their experiences according to that KPIs are updated.

According to the KPI values and according to the complexity the staff members under Management, Engineering & Construction, Technical Support, Quantity Surveying and costing, Finance, Administration, Procurement, Inventory and Security personnel categories as required for the project are allocated using allocation and optimization algorithms. Then according to the complexity of the project the required labor count is predicted based on the past project labor details and created labor histogram for the project. And the project manager can record the daily attendance of the labors and according to the attendance the cost, timeline will be predicted through the dashboard.

3.2 Component Overview Diagram

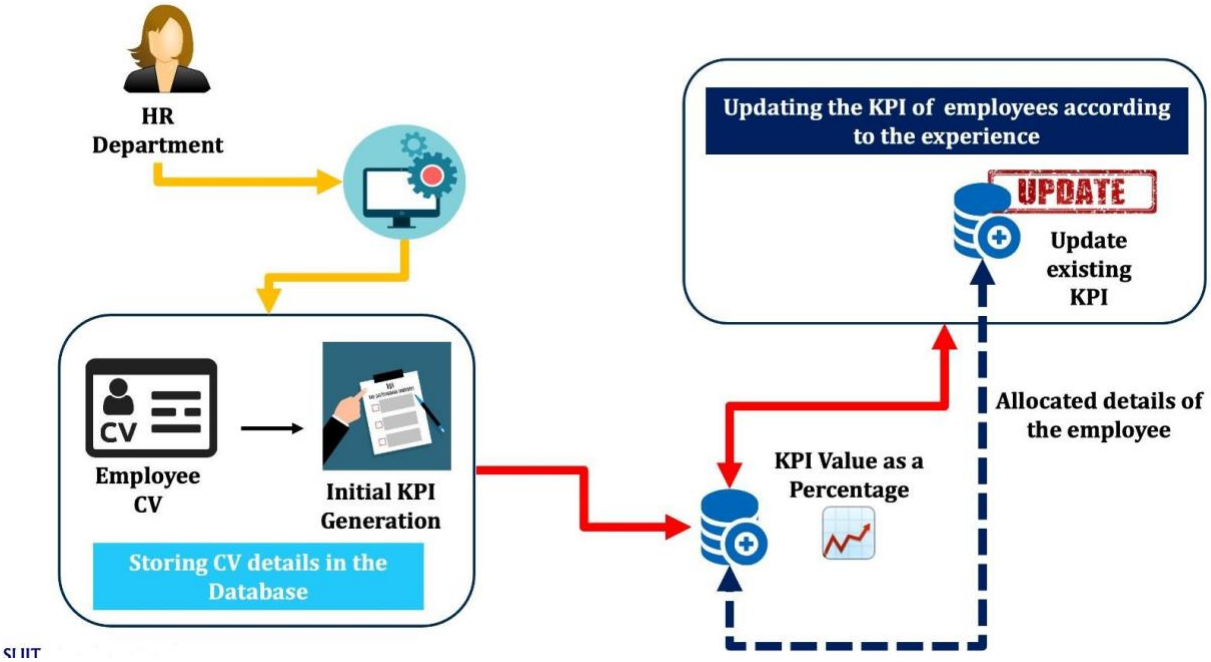


Figure 2: Component System Diagram

The process flow diagram for KPI generation, CV upload, and KPI changes at MAGA Construction is shown.

CV Upload & Storage: Employee resumes are uploaded by the HR department and kept in the business database. To guarantee that employee data is handled and stored efficiently, this procedure is automated.

First KPI Generation: A first set of Key Performance Indicators (KPIs) for the employee is automatically generated based on the data in the CV. These KPIs are specific to the experience and position of the employee in the organization.

KPI Update: The current KPIs are modified when an employee obtains more experience or when the needs of the project alter. Allocating updated employee information and modifying the KPI values are steps in this procedure.

KPI Value Management: Performance evaluation and subsequent decision-making processes can access the updated KPI values, which are kept in the database.

With the help of this automated system, employee performance measures are kept up to date and pertinent, resulting in more accurate performance evaluations and improved alignment with organizational objectives.

3.3 Gantt Chart

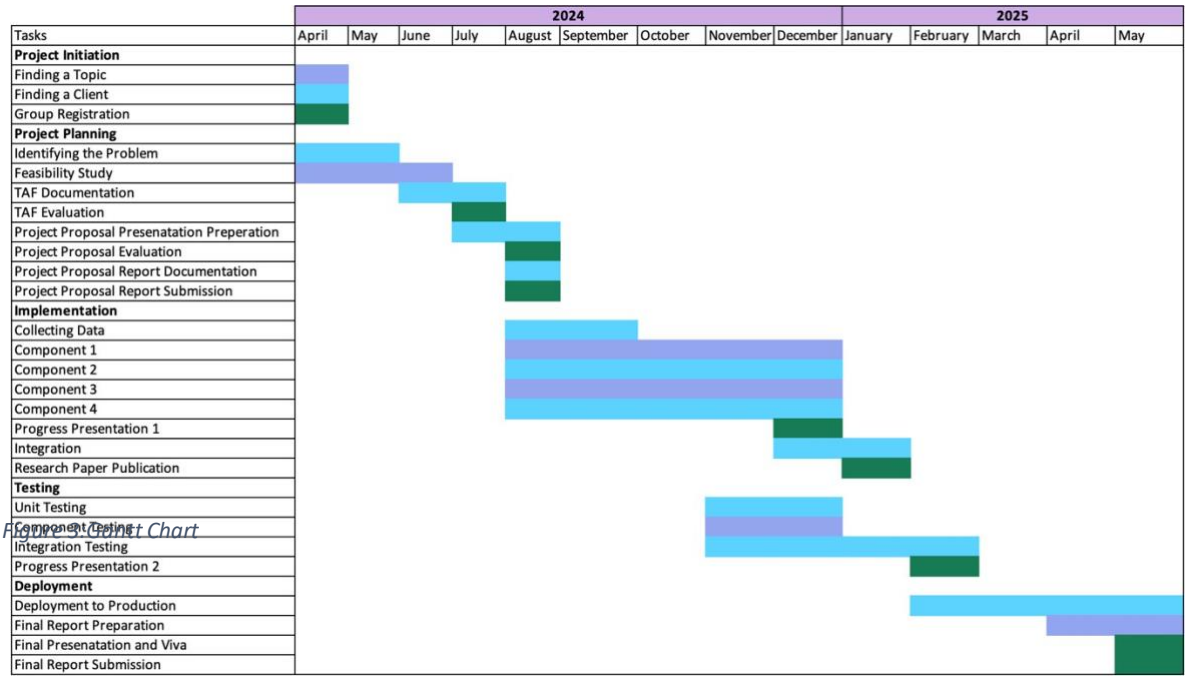


Figure 3: Gantt Chart

The Gantt chart illustrates the research project's stages, milestones, and timeline from April 2024 to May 2025, highlighting tasks like planning, execution, testing, and deployment.

3.4 Work Breakdown Structure

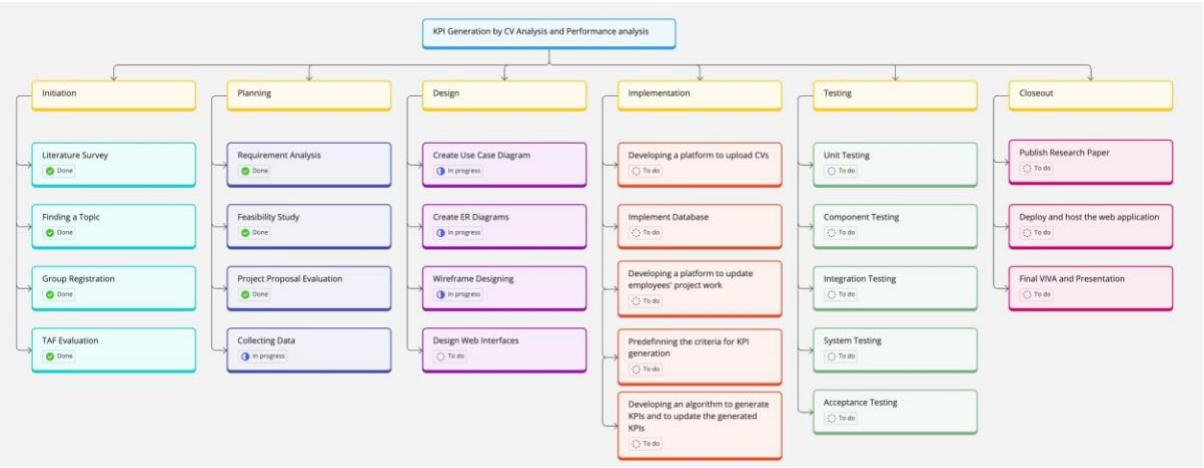


Figure 4:Work Breakdown Structure

The research project "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects" has completed its feasibility study and literature review. The project is now in its planning and design stages, with testing and implementation next. The publication of the research paper, the implementation of the web application, and the final VIVA and presentation will mark the project's completion.

4. Project Requirements

The following functional, non-functional, and system requirements will be only focusing on the component " KPI Generation by CV analysis and performance analysis".

4.1 Functional Requirements

- 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

- Should calculate KPI values after entering the worked project details by the employees.

Input	Project Details
Process	Updating KPI values
Output	KPI value percentage

- 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

- 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

4.2 Non-Functional Requirements

- System should have a user-Friendly interface
- Application should be reliable
- System should have a higher accuracy of results
- Results should be more efficient

4.3 System Requirements

- A Computer
- Internet Connection

5. Description of Personal and Facilities

Table 2:Description of personnels and Facilities

Registration Number	Name	Task Description
IT21276750	Isuranga K.M.S.	• Developing an upload portal to upload CVs. • Generating KPIs for the employee • Developing to calculate KPI percentage for generated KPI and given project details.

6. Commercialization

The finished product of this project will be a web application which any of the construction company can be used by paying a one-time fee or a subscription fee. This application provides so many advantages than the existing systems. Some of them are.

- Employee allocation for projects on the basis of KPIs.
- Employee allocation optimization.
- Tracking and management of project progress.
- Project categorization mainly by risk and complexity.

This product will exist as two types of models,

- Common Version
- Premium Version

The facilities provided by above 2 versions are as below,

Table 3:Features of two versions

Common Version	Premium Version
• Initial KPI generation by CV Upload. • Updating the performance of employees. • Project categorization on Time Frame and Geographical factors.	• Updated KPI Values. • Project Categorization on risk and complexity. • Most appropriate employee suggestions. • Labor, Cost and timeline predictions.

This (ProjectPulse) can be used by the construction companies as a project management tool. The main end-users and their tasks are;

- HR Department - Uploads the CV when an employee is recruited for the company.
- Employee - Update the Project details assigned with start and end dates of the project.
- Project Manager - Enters the upcoming project details for categorization.
  Records the daily attendance and completed tasks.

7. Budget and Budget Justification

Table 4:Budget

Resource Type	**Amount (Rs.)**	**Total (Rs.)**
Internet Connection	**10000.00**	**10000.00**
Travelling Cost	**15000.00**	**15000.00**
Documentation Cost		
Paper Cost	7000.00	
Research Paper Publication per person	60,000.00	
Total	**67,000.00**	**67,000.00**
Implementation Cost		
Software version Charges	45,000.00	**45,000.00**
Total Cost		**137,000.00**

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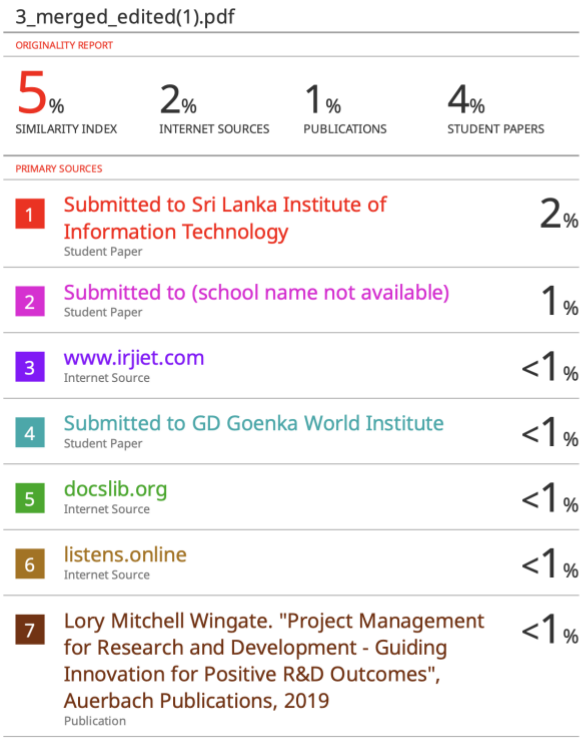
Appendices



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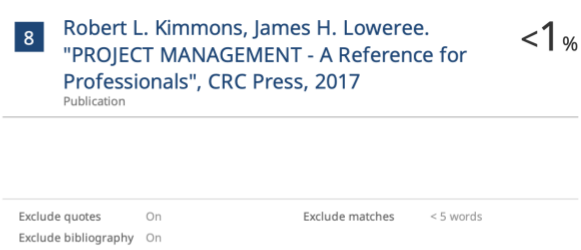

8	Robert L. Kimmons, James H. Loweree. "PROJECT MANAGEMENT - A Reference for Professionals", CRC Press, 2017 Publication	<1%

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Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)

Project ID-2024-25J-018

Project Proposal Report

Perera K.M – IT21087660

BSc. (Hons) in Information Technology specialized in Information Systems Engineering

Department of Computer Systems Engineering

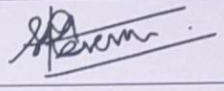
Faculty of Computing

Sri Lanka Institute of Information Technology
Sri Lanka

August 2024

Declaration

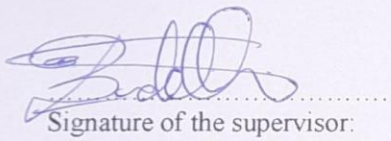
We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning, and to the best of our knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

IT Number	Name	Signature
IT21087660	Perera K.M	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

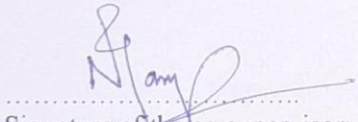
Name of supervisor: Ms. Buddhima Attanayake

Name of co-supervisor: Ms. Narmada Gamage



Signature of the supervisor:
(Mrs. Buddhima Attanayake)

16/08/2024
Date



Signature of the co-supervisor:
(Ms. Narmada Gamage)

16/08/2024
Date

Abstract

"Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)" is a project proposal whose goal is to develop a web application that optimizes labor allocation in the construction industry, with a particular emphasis on MAGA Engineering Pvt Ltd. The tool will categorize projects and provide Key Performance Indicators (KPIs) for staff members based on user resumes and prior performance. Then, it will effectively assign staff, considering the complexity of the project and these KPIs. The technology will also predict labor requirements, project costs, and timelines, which will improve resource management and decision-making in construction projects. The method, system specifications, and commercialization plan for the suggested application are all covered in the proposal. It also includes a comprehensive assessment of the literature and identifies research needs.

Table of Contents

1. Introduction

1.1 Background Study

One important sector that makes a major contribution to global economic development is the construction industry. Effectively allocating labor, however, continues to be a difficult task for many construction companies [1]. Given the wide diversity and complexity of construction projects from residential buildings to massive infrastructure expansions like highways, bridges, and irrigation systems this issue is especially pressing. The effective use of resources, particularly human resources, is critical to the success of these undertakings. Poor staffing management can result in a number of problems, such as project delays, cost overruns, and lowered quality [2].

In the construction sector, project categorization plays a crucial role in helping understanding of the needs and characteristics of different projects [1]. Construction businesses may customize their resource allocation methods to fit unique project needs by classifying projects into multiple categories, such as residential, commercial, industrial, institutional, and infrastructure projects. For example, a residential project might need different resources and expertise than a huge infrastructure project like a bridge or highway [2]. When classifying projects, other elements that need to be taken into account are risk levels, project complexity, budget, timeline, geographic location, and environmental impact. Each of these elements has an impact on the method used to decide how to allocate labor [3].

The businesses struggle to match suitable staff members with the correct projects. The standard approach, which depends on the project manager's skills, has led to inefficiencies. These include staffing projects either too or insufficiently, assigning unqualified personnel to specialized tasks, and eventually causing delays and cost overruns [4].

In order to overcome these challenges, our research focuses on creating a methodical project classification system that will simplify its personnel allocation procedures. In order to establish a more effective and efficient resource management system, we want to collect detailed project information such as scope, objectives, budget, timeframe, and location. We also plan to classify projects according to type, risk level, complexity, and other pertinent aspects. In addition to being advantageous to MAGA Engineering, this method will also serve as a model for the larger construction sector [5].

1.2 Literature Survey

In order to manage the many different and complicated nature of construction projects in an organized manner, project categorization is an essential part of construction project management. A number of approaches and frameworks for project classification are available in the literature now under publication, all of which seek to enhance project scheduling, resource allocation, and risk management [5]. The Project Management Body of Knowledge (PMBOK), published by the Project Management Institute (PMI), is one of the fundamental foundations for project classification. As part of the project initiation phase, PMBOK stresses the significance of establishing the project's scope, objectives, and limitations. Using this framework, projects can be categorized according to their size, goals, and level of complexity [6].

Though the PMBOK offers a broad framework for project classification, it is devoid of explicit instructions for incorporating risk considerations into the process, especially when it comes to building projects.Within the construction sector, the classification of projects is frequently based on the kind of construction, including infrastructural, commercial, industrial, and residential projects. Choudhry and Iqbal's (2013) research indicate that construction projects are generally classified according to their degree of complexity and risk [4]. Their research emphasizes the need for a more complex classification scheme that takes into account variables including the location of the project, its influence on the environment, and the availability of resources. However, they do not go into great detail about the integration of risk prediction models, instead concentrating on high-level categorization in their research[7].

Pinto and Patanakul (2015) presented the notion of dynamic project categorization in a more recent study. This approach adjusts to the evolving circumstances of a project. This methodology holds special significance in the construction sector, because projects may undergo modifications as a result of unanticipated obstacles like shifts in regulations or environmental conditions. According to Pinto and Patanakul's methodology, it's critical to regularly review project categories to make sure they appropriately represent the project's current status. Nevertheless, a thorough technique for classifying projects according to particular construction-related risks is absent from the study [8].

1.3 Research Gap

The construction sector is characterized by the complexity and diversity of its projects, which range from big infrastructural improvements to residential buildings. Still, there's a big hole in the standardized project classification process. There is frequently a lack of a systematic approach in current procedures for categorizing projects according to all the important information, including risk level, complexity, geographical considerations, budget level, and time frame, as well as kind, scope, objectives, location, budget [5].

The inefficiencies in project management, especially in resource allocation and risk management, are caused by this gap in project categorization, which is troublesome. Project managers could find it difficult to decide how much manpower to assign without a set framework, which could result in problems like under- or overstaffing, delays, and cost overruns. Project planning and execution are further complicated by the difficulty in predicting potential hazards associated with various project types due to the absence of a systematic categorization system [6].

Current approaches mostly concentrate on classifying projects according to fundamental criteria such as project type or budget. But they frequently forget how crucial it is to include risk prediction in the classification procedure. For example, certain dangers like landslides or unstable foundations are not often sufficiently taken into consideration in projects situated in geographically difficult areas, such mountain regions. This omission could have a major negative impact on the project's success during the building phase [7].

Consequently, the research gap is the requirement for a strong and well-standardized project categorization system that takes into account risk prediction based on the particular characteristics of the project in addition to basic project facts. This gap needs to be closed in order to enhance project planning, resource allocation, and risk management. This would benefit the construction sector by enabling more effective project execution and better results[6].

Application Reference	Automatic Classification	Applicable for construction projects	Risk Level Assessment	Complexity Analysis	Location/ Environmental Impact Assessment	Budget Analysis	Time Frame
Procore	✗	✓	✗	✗	✗	✓	✗
Microsoft Project	✗	✓	✗	✓	✗	✓	✓
Smartsheet	✗	✓	✗	✓	✗	✓	✓
nPlan	✗	✓	✗	✗	✗	✗	✓
Trello	✗	✓	✗	✗	✗	✗	✗
Project Pulse	✓	✓	✓	✓	✓	✓	✓

Table 1.3 Research Gap

✓ Tick Mark: This indicates that the feature or characteristic is present or applicable for that specific application.

✗ Cross Mark: This indicates that the feature or characteristic is absent or not applicable for that specific application.

1.4 Research Problem

There isn't a thorough project classification system in the construction business that combines important risk variables with in-depth project data. There is currently no standard system in place that makes it possible to classify projects according to their kind, scope, objectives, location, budget, and duration while also taking into account important variables like risk level, complexity, geographic circumstances, budget level, and time frame [4].

This lack of systematic methodology creates a number of difficulties. Initially, project managers encounter challenges in precisely determining the amount of labor and resources needed for a project in the absence of a strong classification system. This may result in inefficiencies like understaffing, which pushes back project deadlines, or overstaffing, which raises expenses. Furthermore, in the lack of a thorough classification system, possible risks related to particular project types and locales are not sufficiently taken into account during the planning stage. Building a hotel in a hilly area, for example, has special risks like landslides or unstable foundations, which are frequently overlooked in conventional project planning techniques [5].

Therefore, the research challenge is to create a project classification approach that incorporates risk prediction into the classification process in addition to classifying projects according to traditional parameters like type, scope, and budget. Project managers will be able to make better decisions about resource allocation, risk management, and project execution with the help of this classification system, which takes into account risk levels, project complexity, geographical variables, and other pertinent information [6].

By developing a standard project categorization framework that can be used for a variety of construction projects, this research seeks to close the current gap in the literature. The ultimate objective is to increase the construction industry's project management's efficacy and efficiency while lowering the danger of delays, cost overruns, and other typical problems brought on by insufficient project classification and risk management [7].

2. Objectives

2.1 Main Objective

This proposed solution is to develop a web application which can automate the manpower allocation by performance analysis and project categorization for construction industry. Categorizing the upcoming project details and generating a KPI Value to the employees by CV analysis and performance analysis and then allocating the employees for the upcoming projects based on the project categorization results and KPI values in an optimized way. This application also helps to predict the number of labors required to the project based on the project categorization by analyzing past project details. When the project is started, according to the progress this can predict about the cost and timeline of the project.

2.2 Sub Objectives

To overcome the overall main objective there are main 4 objectives to be achieved.

1. Project Categorization

Classifying construction projects into different groups according to predetermined standards, including project type, risk level, complexity, budget, schedule, geographic considerations, and environmental impact, is known as project categorization. This classification aids in comprehending the nature of the undertaking, its particular requirements, and any possible obstacles. By combining related projects, it facilitates the application of pertinent management techniques and the efficient allocation of resources, laying the groundwork for successful planning and resource allocation.

2. KPI Generation by CV Analysis and Performance Analysis

Using a CV analysis, KPI (Key Performance Indicator) generation is determining an employee's credentials, skills, and historical performance in order to provide performance measurements. The system may create KPIs that measure an employee's performance over time and represent their capabilities by evaluating CVs. By identifying areas of strength and improvement, this analysis helps to improve project outcomes overall by ensuring that the correct people are assigned to jobs where they can perform to their full potential.

3. Employee Allocation and Optimization

Matching workers to projects in accordance with the classification and KPI analysis is known as staff allocation and optimization. By using this procedure, it is made sure that workers

with the best qualifications and fit are paired with projects that complement their expertise and experience. In order to deploy resources effectively and lower the chance of delays, cost overruns, and other inefficiencies, optimization also takes into account variables like project complexity, risk levels, and timetables.

4. Labor, Timeline, and Cost Prediction

In order to project the number of laborers required, the anticipated time frame for project completion, and the predicted expenses, this component uses historical data and predictive algorithms. The method can assist project managers in making more precise plans, allocating resources wisely, and foreseeing possible problems by forecasting these variables. By using a predictive strategy, risks are reduced, expenses are managed, and projects are finished on schedule and within budget.

2.3 Specific Objective

The primary goal of this project is to develop a standardized method for categorizing various construction projects. This method will consider a wide range of factors that are crucial to the success and management of any project. These factors include:

- Project Type: The nature of the project, such as whether it is residential, commercial, industrial, or infrastructural.
- Risk Level: The potential risks associated with the project, ranging from low to high.
- Complexity: The overall complexity of the project, considering factors like design intricacy,
- technological requirements, and coordination among various teams.
- Location/Geographical Factors: The physical location of the project and the specific geographical challenges or advantages associated with that location, such as urban, rural, or remote settings.
- Budget Level: The financial scope of the project, categorized into small, medium, and large budgets.
- Time Frame: The duration of the project, categorized into short-term, medium-term, or long-term projects

2.4 Specific Sub Objectives

- Gathering Project Information:

Before starting to develop a standard classification method, first we must gather detailed project information. This include gathering information about the project's objectives, timeline, budget, and the location. The gathered data will provide the basis for additional examination and classification.

- Define Specific Criteria for Categorizing Projects:

Once the project information is gathered, the next step is to define clear and specific criteria for categorizing the projects. This involves identifying key parameters that influence the project’s nature and complexity. Criteria such as project type, risk level, complexity, geographical factors, budget, and time frame will be carefully defined to ensure that the categorization is accurate and meaningful.

- Predict the Risks According to Project Type Under the Risk Category:

The last goal is to forecast potential risks related to each type of project after the projects have been categorized. Risks that could happen during the project's execution can be predicted by knowing the project's nature and its unique drawbacks. These risks may be of the following types: financial, technical, environmental, or project management related. The project's chances of success can be increased by predicting these risks and developing suitable mitigation techniques earlier.

3. Methodology

3.1 System Overview Diagram

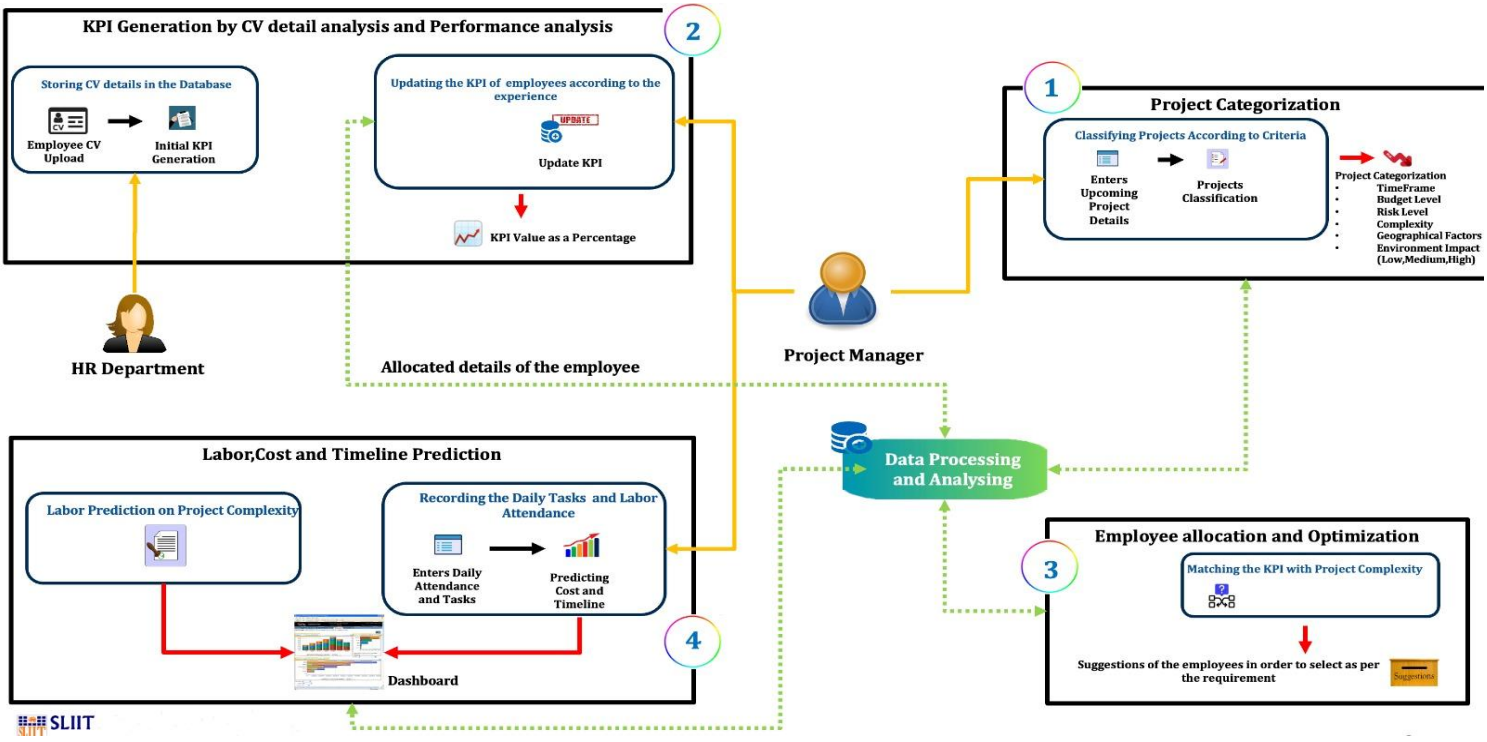


Figure 3.1 System Overview Diagram

Our company is going to develop a web application called "Project Pulse," which will help project managers choose the best human resources for open positions or upcoming projects. When a project is accepted by the organization, the assigned project manager enters the project details (location, required staff and their qualifications, cost), after which the project is categorized and its complexity is measured as high, medium, or low. An employee's resume is then stored in the database, and KPIs are generated based on the resume. Recruited employees should be able to update their experiences in accordance with the KPIs are updated. Allocation and optimization algorithms are utilized to assign the staff members under the following personnel categories: Management, Engineering & Construction, Technical Support, Quantity Surveying and costing, Finance, Administration, Procurement, Inventory, and Security, based on the complexity and KPI values. Next, a labor histogram for the project is developed and historical project labor information are used to estimate the required labor count based on the complexity of the project. The laborers' daily attendance may also be recorded by the project manager 10, and the dashboard will forecast the cost and timetable based on the attendance.

3.2 Component Overview Diagram

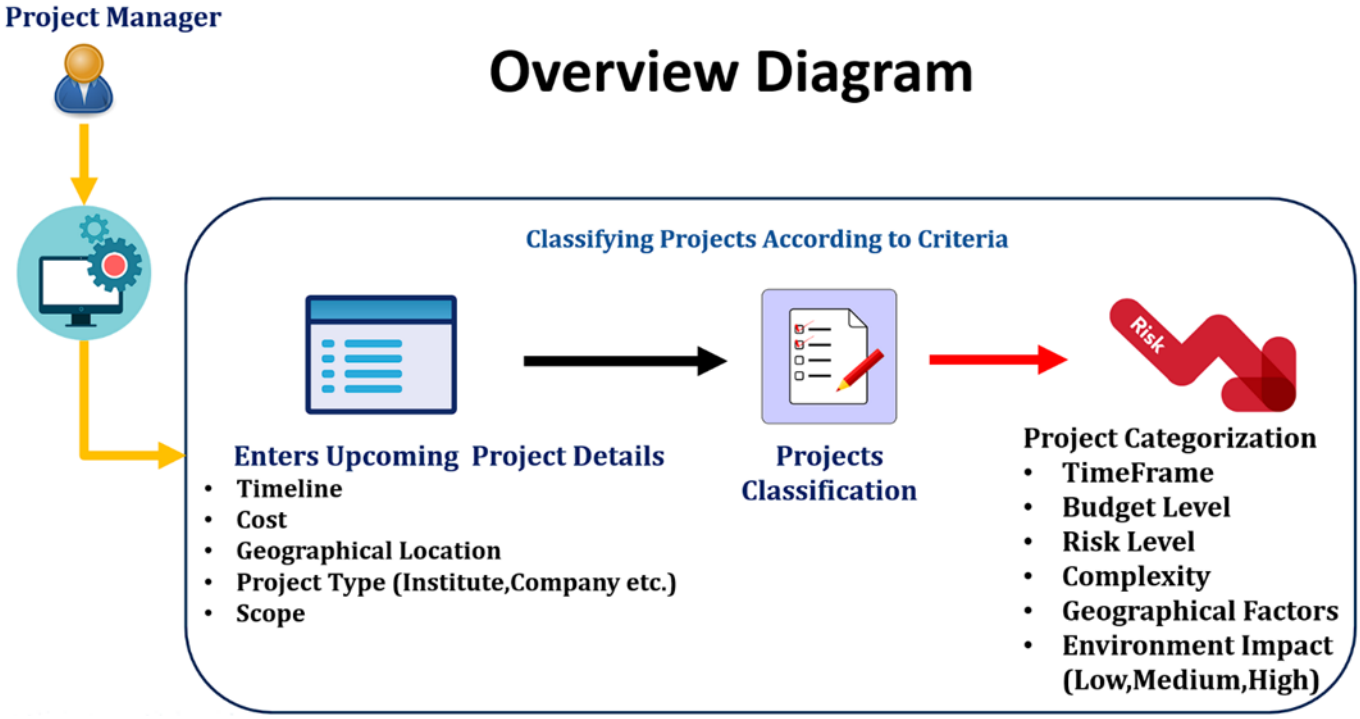


Figure 3.2 Component Overview Diagram

When it comes to my component the project manager first inputs all project information, such as the type, scope, objectives, cost, and duration, into the system. After analyzing these specifics, the system classifies the project according to a number of important criteria. These variables mainly include the project's risk level, complexity, budget, time frame, and location. The system assists in ensuring that the project is managed more successfully and that any possible risks or issues are addressed early on by arranging the project based on these criteria. A successful project's execution and improved planning depend on this category.

3.3 Gantt Chart

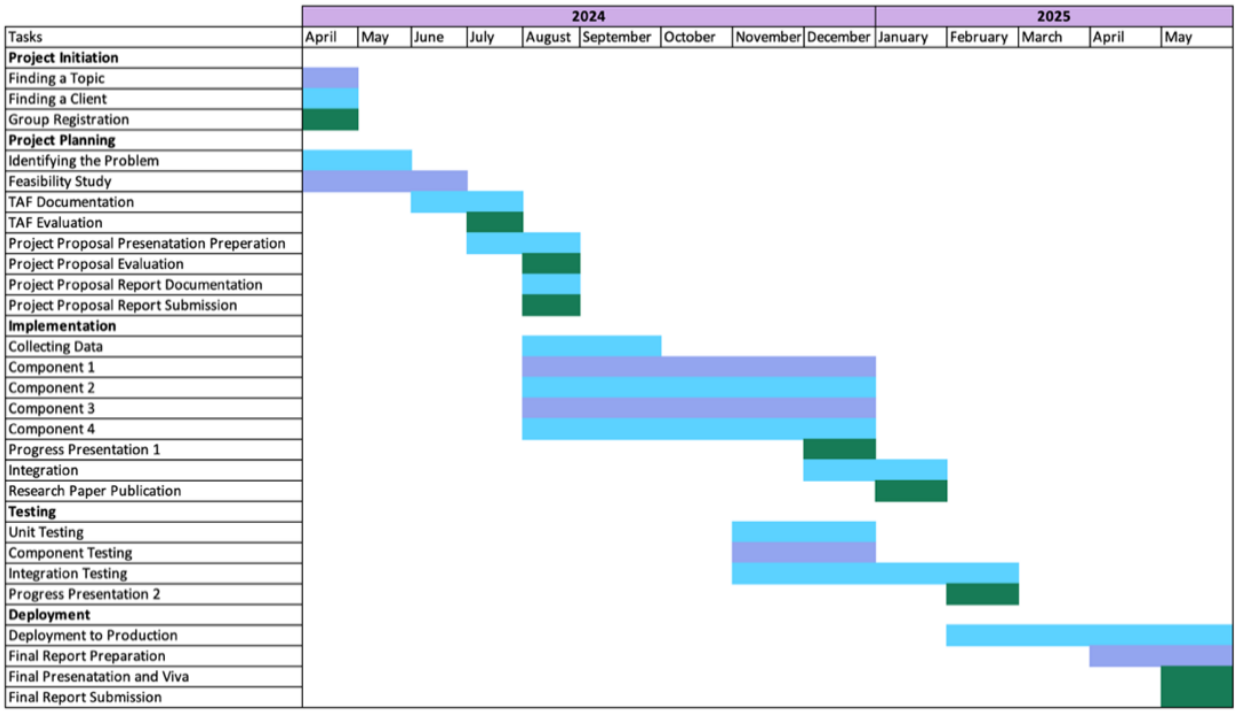


Figure 3.3 Gantt Chart

Gantt charts, which display the various tasks that make up a project's timeline. It shows the start and end dates of each task for the months of April 2024 through May 2025. Phases including Project Initiation, Planning, Implementation, Testing, and Deployment are separated out on the chart. Certain duties, such as selecting a topic, registering as a group, and doing component testing, are part of each step. The overall project timetable and dependencies are made easier to see by using color bars in the chart to indicate the length of each activity.

3.4 Work Breakdown Structure

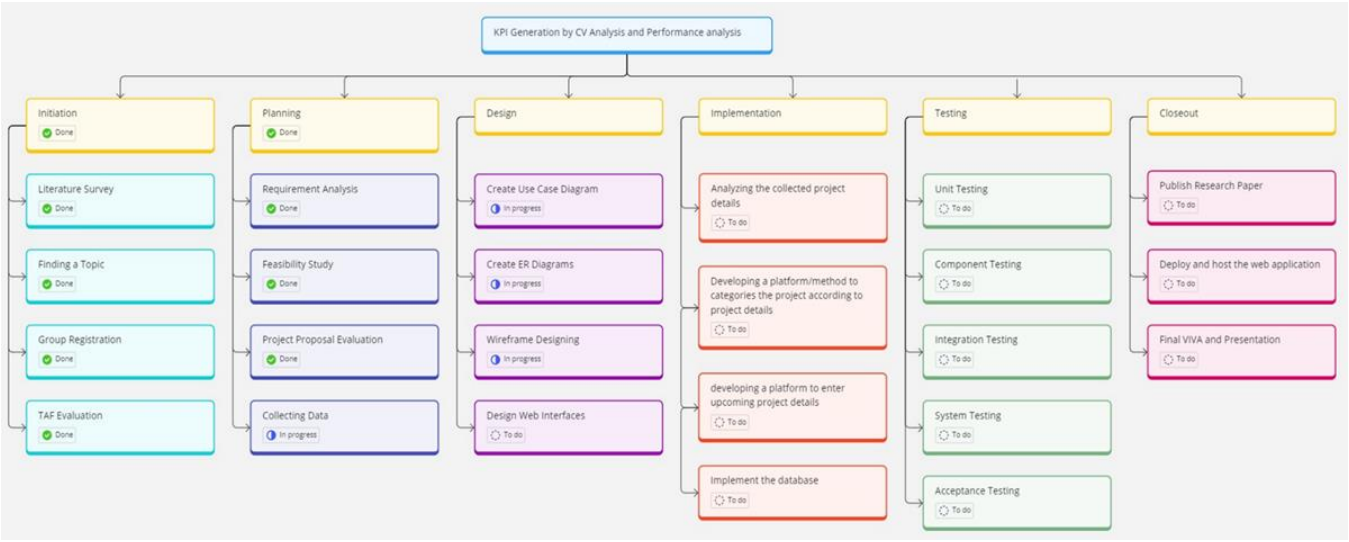


Figure 3.4 Work Breakdown Structure

This diagram divides the project into smaller, easier-to-manage activities or portions. Initiation, Planning, Design, Implementation, Testing, and Closeout are the six primary phases that make up the WBS. Each phase is further broken down into tasks like system testing, database installation, use case diagram generation, and requirement analysis. It is simpler to manage and monitor progress when all project components are accounted for and arranged according to this framework.

4. Project Requirements

The following functional, non-functional, and system requirements will be only focusing on the component "**Project Categorization**".

4.1 Functional Requirements

FR1:	Should be able to input the project details
Input:	Project details such as scope, objectives, budget, duration, project type, location
Processing:	The system stores the project details in the database for further categorization and analysis.
Output:	Confirmation of successful input and storage of project details.
Definition:	The system should allow to input and save all relevant project details, ensuring that these details are accurately stored and available for subsequent processes.

FR2:	Should be able to categorize the project, based on project type, risk level, complexity, location wise/geographical factors, budget level, time frame
Input:	Project information including project type, risk level, complexity, location, budget level, and time frame.
Processing:	The system analyzes the input data and categorizes the project based on the defined parameters.
Output:	Display of categorized project information.
Definition:	The system should categorize the project by evaluating different aspects such as type, risk, complexity, and other factors

	to ensure that projects are organized and managed efficiently.

FR3:	Should be able to predict the risk according to project type
Input:	Project type and other related factors (e.g., complexity, budget, time frame).
Processing:	The system analyzes the input data and uses predictive models to estimate the risk level associated with the project.
Output:	A report or score indicating the predicted risk level.
Definition:	The system should provide a risk prediction feature that uses input data to calculate and present the potential risks associated with a project, enabling better planning and decision-making.

4.2 Non-Functional Requirements

Non-Functional Requirement 1 (NFR 1):	Interfaces should be User-friendly
Description:	An application's user interface should be simple to use and intuitive so that users with different levels of technical experience can interact with the system without difficulty.

Non-Functional Requirement 2 (NFR 2):	The application should be reliable
Description:	To facilitate efficient decision-making, the system should produce remarkably precise findings, especially when it comes to risk assessments and project classification.

Non-Functional Requirement 3 (NFR 3):	Higher accuracy of results
Description:	The system should provide highly accurate results, particularly in risk predictions and project categorization, to support effective decision-making.

Non-Functional Requirement 4 (NFR 4):	Results should be more efficient.
Description:	To increase user productivity, the application should complete all tasks quickly and minimize the amount of time needed for data input, processing, and output production.

Non-Functional Requirement 5 (NFR 5):	The system should be easy to maintain and update
Description:	It should be straightforward and rapid to introduce enhancements, problem corrections, and adjustments to the system in response to evolving project management requirements.

4.3 System Requirements

- Laptop (8GB RAM, 1TB Storage)
- Internet connection

4.4 Software & Technology Requirements

- Python
- Visual Code
- MYSQL
- HTML

5. Description of Personal and Facilities

Table 5.1 Description of Personnels & Facilities

Registration Number	Name	Task Description
IT21087660	Perera K.M	• Gathering the project details • Define Specific Criteria for Categorizing Projects • Categorizing the project according to project details • Predicting the risks according to the risk level under risk category.

6. Commercialization

This project will result in a web application that any construction company can utilize for a one-time cost or a monthly membership fee. Comparing this application to the current systems, there are a ton of advantages. A few of them consist of,

- Employee allocation for projects on the basis of KPIs.
- Employee allocation optimization.
- Tracking and management of project progress.
- Project categorization mainly by risk and complexity.

This product will exist as two types of models,

- Common Version
- Premium Version

The facilities provided by above 2 versions are as below,

Common Version	Premium Version
• Initial KPI generation by CV Upload. • Updating the performance of employees. • Project categorization on Time Frame and Geographical factors.	• Updated KPI Values. • Project Categorization on risk and complexity. • Most appropriate employee suggestions. • Labour,Cost and timeline predictions.

This (ProjectPulse) can be used by the construction companies as a project management tool. The main end-users and their tasks are;

- HR Department - Uploads the CV when an employee is recruited for the company.
- Employee - Update the Project details assigned with start and end dates of the project.
- Project Manager - Enters the upcoming project details for categorization.
  Records the daily attendance and completed tasks.

7. Budget and Budget Justification

Resource Type	Amount (Rs.)	Total (Rs.)
Internet Connection	**2500.00**	**2500.00**
Travelling Cost	**3750.00**	**3750.00**
Documentation Cost		
Paper Cost	1750.00	
Research Paper Publication per person	15,000.00	
Total	**16,750.00**	**16,750.00**
Total Cost		**23,000.00**

8. References

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[4] "A KPI-based Methodology for Assessing the Success of Construction Projects," MDPI, vol. 14, no. 2, p. 553, 2024. Available: https://www.mdpi.com/2075-5309/14/2/553, [Accessed: Jun. 19, 2024].

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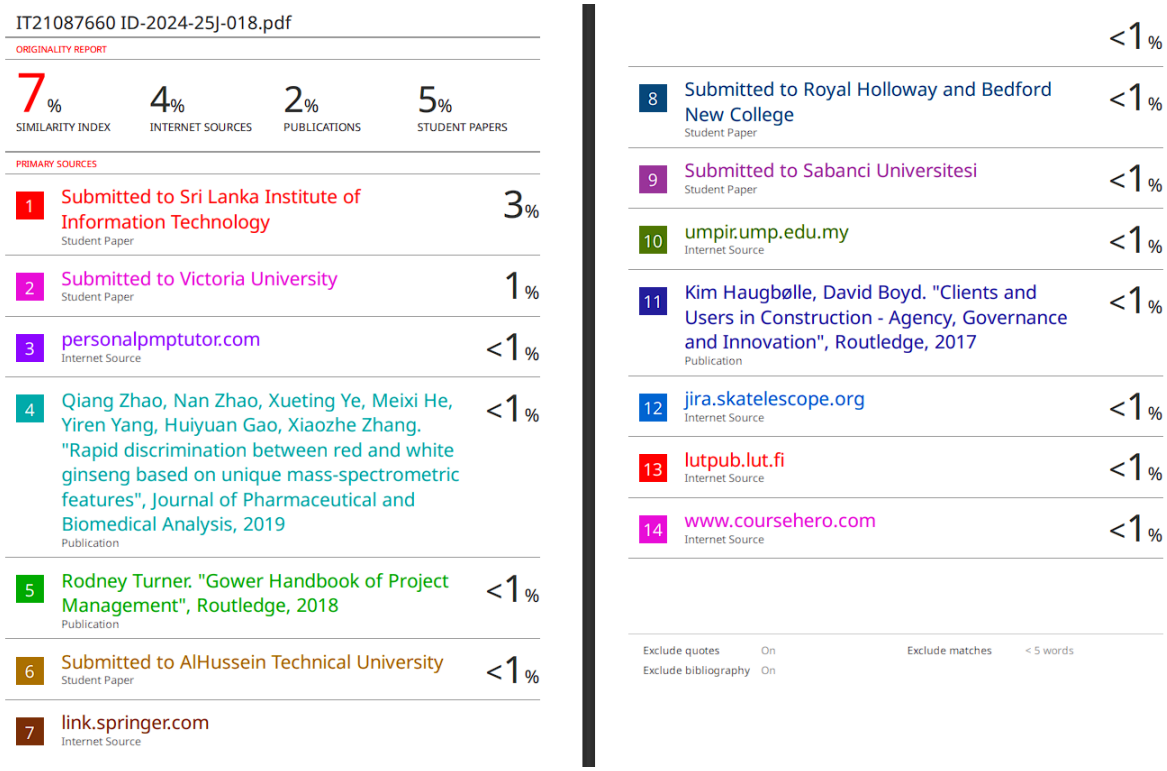
[8] J. Kim, S. Lee, and K. Lee, "Predictive analytics for effective manpower allocation in construction," *Automation in Construction*, vol. 94, pp. 252-260, 2018, [Accessed: Jun. 20, 2024].

Appendices



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Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects (ProjectPulse)

Project ID-2024-25J-018

Component: Labor, Cost & Timeline Prediction.

Project Proposal Report

IT21270956 - Munagama M.K.H

BSc. (Hons) in Information Technology specialized in Information Systems Engineering

Department of Computer Systems Engineering

Faculty of Computing

Sri Lanka Institute of Information Technology
Sri Lanka

August 2024

Declaration

We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or institute of higher learning, and to the best of our knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

IT Number	Name	Signature
IT21270956	Munagama M.K.H	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Name of supervisor: Ms. Buddhima Attanayake

Name of co-supervisor: Ms. Narmada Gamage

.....

Signature of the supervisor:
(Mrs. Buddhima Attanayake)

16/08/24

Date

.....

Signature of the co-supervisor:
(Ms. Narmada Gamage)

16/08/24

Date

Abstract

The objective of the project proposal named "Automated Manpower Allocation by Performance Analysis and Project Categorisation for Construction Projects (ProjectPulse)" is to create a web application that maximises the allocation of labour in the construction sector, with a focus on MAGA Engineering Pvt Ltd. Based on the users' resumes and past performance, the program will classify projects and produce Key Performance Indicators (KPIs) for staff members. Then, taking into account the intricacy of the project and these KPIs, it will efficiently assign personnel. Additionally, the system will forecast labour needs, project budgets, and schedules, which will enhance decision-making and resource management in building projects. The proposal covers the technique, system requirements, and commercialisation strategy for the proposed application. It also contains a thorough evaluation of the literature and identifies research needs.

Table of Contents

Table of Figures

1. Introduction

In this project we are considering about 2 types of manpower as, employees working in the company and the laborers working in the sites. Since we are doing our research for construction projects, we are considering MAGA Engineering Pvt Ltd for our project. Among different construction projects we are considering “building projects” for our research project [1].

1.1 Background Study

Manpower allocation in construction projects has historically relied on manual decision-making processes based on the experience and judgment of project managers. However, with the growing complexity of projects and the increasing availability of data, there is a significant shift towards automating these processes using advanced technologies like machine learning and data analytics. The construction industry is highly complex, involving various stakeholders, processes, and resources. Effective manpower allocation is crucial for the successful execution of construction projects.

Predicting labor requirements and project timelines accurately is critical for project success. Incorrect predictions can lead to cost overruns, delays, and resource wastage. Recent advancements in machine learning have enabled the development of predictive models that can analyze historical data and forecast future needs. These models can consider various factors such as project type, complexity, past performance, and resource availability to make accurate predictions. The integration of such models into project management practices can enhance decision-making, improve resource utilization, and ensure timely project completion [2] [3].

1.2 Literature Survey

The use of machine learning in construction project management has been the subject of numerous research, with a focus on resource allocation and cost prediction. For example, Sadeghi (2024) used an Artificial Neural Network (ANN) optimized with Particle Swarm Optimization (PSO) to construct a cost prediction model. When compared to conventional techniques, the model showed considerable gains in cost prediction accuracy, underscoring the potential of machine learning to improve project management procedures. But the study's narrow focus on cost prediction—which ignored other important variables like labor allocation and project timelines—limited its applicability [4].

The managerial skills necessary for effective construction project management were examined in a different study. In order to enhance project performance, the study underlined the significance of combining management skills and machine learning techniques. Core competencies—knowledge, abilities, and attitude—were found to be essential for successful project management in the study, especially when it came to labor-intensive construction projects. Despite offering insightful information about the function of management abilities, this study ignored the requirement for automated technologies to assist these competencies in making decisions in real time [5] [6].

Furthermore, studies on increasing productivity in labor-intensive construction projects have found a number of variables that affect labor efficiency, including the availability of skilled workers, the caliber of materials, and the difficulty of the project's tasks. These results imply that better project outcomes and more effective labor allocation may result from a greater comprehension of these variables combined with sophisticated predictive models [7].

1.3 Research Gap

While existing studies have made significant contributions to the application of ML in construction project management, several gaps remain. One of the primary gaps is the need for a comprehensive model that integrates project categorization with labor allocation and cost prediction. Most studies focus on either cost prediction or labor allocation independently, without considering the interdependencies between these factors. Additionally, there is limited

research on the use of ML models to predict labor requirements based on project categorization results, which is crucial for optimizing resource allocation in construction projects.
The following table is a comparison between existing technologies and the proposed solution.

Table 1:Research Gap with similar systems

Application Reference	Applicable for construction projects	User Focused Dashboards	Labor requirement prediction	Predict timeline and budget variations	Tracking daily logs and attendance
Procore [8]	✓	✓	✗	✗	✓
Alice Technologies [9]	✓	✓	✓	✗	✗
nPlan [10]	✓	✓	✗	✓	✗
Labour Chart [11]	✓	✓	✗	✗	✗
PlanGrid [12]	✓	✓	✗	✗	✓
Project Pulse	✓	✓	✓	✓	✓

✓ - Included in the systems ✗ - Not in the systems

1.4 Research Problem

How can the inefficiencies in labor allocation, irregular attendance affects the cost and timeline in construction projects? Determining the number of laborers for a project based on the project manager's experience leads to inefficiencies like overstaffing and understaffing, irregular labor

attendance causes projects to deviate from plans, and there is no precise method to determine the timeline and cost with labor attendance as the project progresses.

2. Objectives

2.1 Main Objective

This proposed solution is to develop a web application which can automate the manpower allocation by performance analysis and project categorization for construction industry.
Categorizing the upcoming project details and generating a KPI Value to the employees by CV analysis and performance analysis and then allocating the employees for the upcoming projects based on the project categorization results and KPI values in an optimized way. This application also helps to predict the number of labors required to the project based on the project categorization by analyzing past project details. When the project is started, according to the progress this can predict about the cost and timeline of the project.

2.2 Sub Objectives

To overcome the overall main objective there are main 4 objectives to be achieved.

1. Categorizing the projects according to the geographical location, time frame, budget, risk, and complexity as High, Low, Medium.
2. Generating a KPI value as a percentage by analyzing the CVs of the employees and Performance analysis.
3. Displaying the suggestions of the employees whose KPI values are matched with the project categorization results in an optimized way.
4. Predicting the number of labors required for the project according to the project categorization results and predicting the cost and the timeline of the project according to the daily attendance of the labors and the completed tasks through a dashboard.

2.3 Specific Objective

The main motivation in this component is to predict the labor count required for upcoming projects based on project categorization result and to forecast the project timeline and cost during the project's progression.

2.4 Specific Sub Objectives

To achieve the main objective mentioned above in section 2.3, following are the sub objectives required.

- Analyzing past project details.
- Training the system according to the past project details.
- Creating a platform to update the daily labor count and completed tasks.
- Predicting the realtime status of the projects.

3. Methodology

3.1 System Overview Diagram

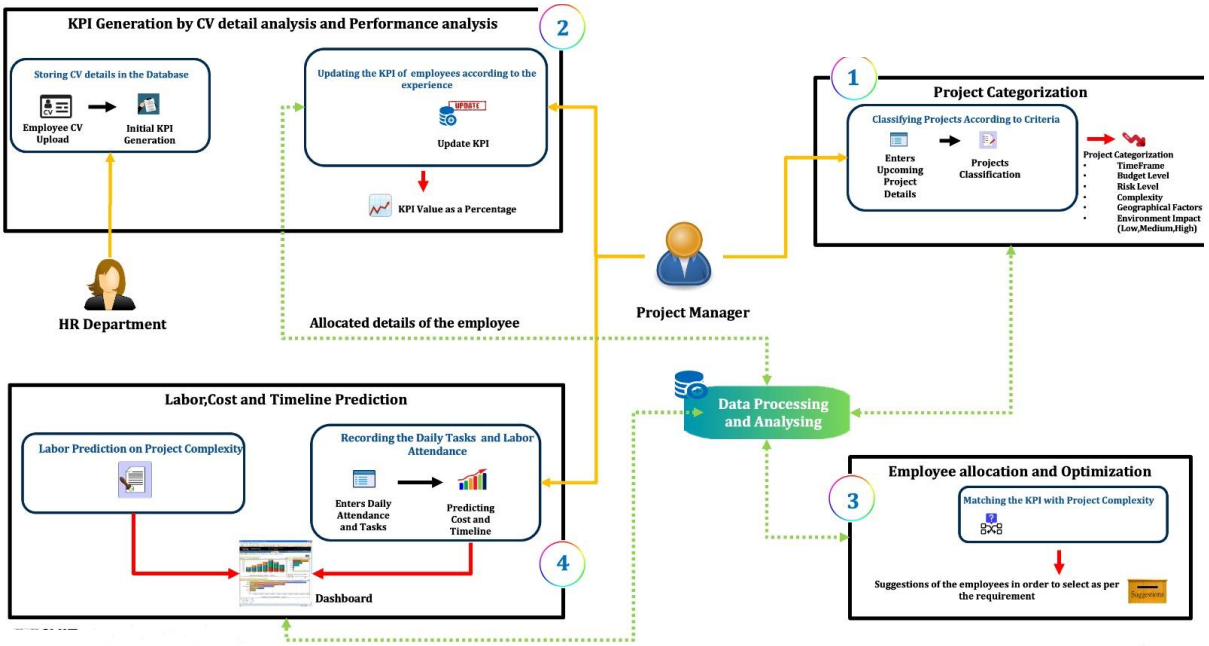

Figure 1:Overall System Diagram

We are about to develop a web application named “Project Pulse”. This application is used by the project manager to select the most suitable human resources for their vacant or upcoming project. When a project is taken by the company, the assigned project manager enters the project details (Location, required staff and their qualifications, cost), then that project is categorized and the complexity is measured as high, medium, or low. When an employee is recruited for the company that employee’s CV details are stored in the database. Once the CV details are entered KPIs are generated according to the CV. The recruited employees should be able to update their experiences according to that KPIs are updated.

According to the KPI values and according to the complexity the staff members under Management, Engineering & Construction, Technical Support, Quantity Surveying and costing, Finance, Administration, Procurement, Inventory and Security personnel categories as required for the project are allocated using allocation and optimization algorithms. Then according to the complexity of the project the required labor count is predicted based on the past project labor details and created labor histogram for the project. And the project manager

can record the daily attendance of the labors and according to the attendance the cost, timeline will be predicted through the dashboard.

3.2 Component Overview Diagram

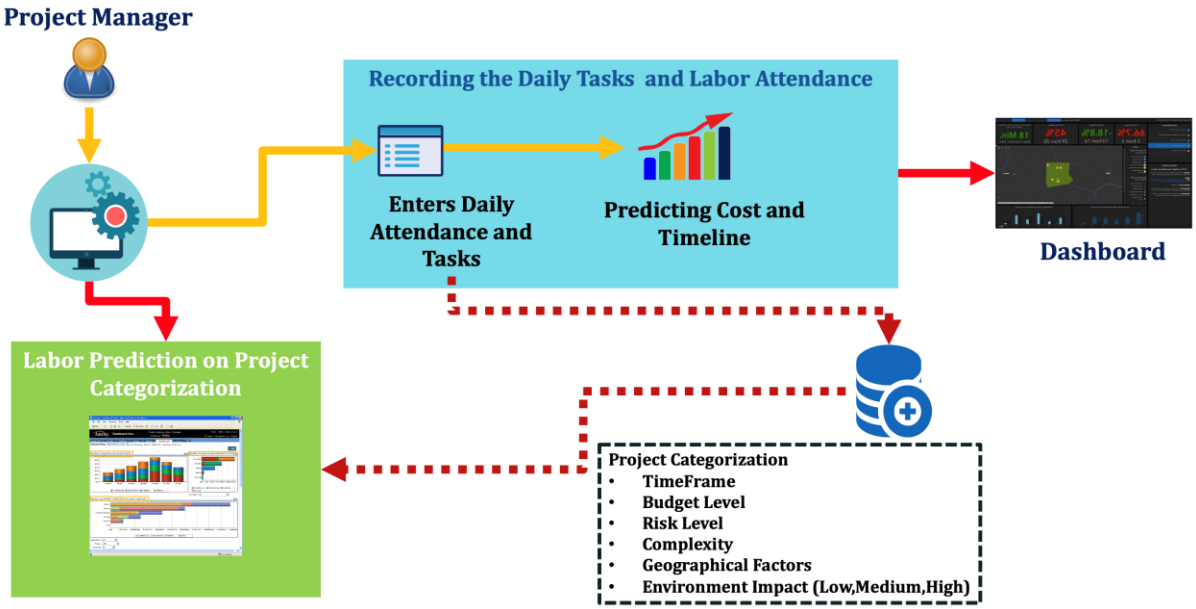

Figure 2:Component System Diagram

The overall project will proceed through the above sub objectives with a specific focus on the "Labor, Cost and Timeline prediction" aiming to improve the predictions compared to previous researches by providing real time data integration.

The first step of the development process is data collection. The data will be collected from our field visit to MAGA Engineering Pvt Ltd by field. The relevant dataset should contain data regarding all building construction projects.

Once the dataset is collected, it should be refined. The refining process of data includes removing the incomplete and inconsistent data, normalization, converting the data into a same format and grouping the data for model training, testing and validation. Then the gathered data such as,

- Budget, timeline, and number of employees worked in the projects
- Past Project Categorization Results of the particular projects
- Types of labors required for the buildings

are used to train the neural network model using TensorFlow according to the project categorization results. Then the model is compiled using optimizer, loss function and evaluation metrics. Then the model is trained and evaluated by test cases.

Then to predict the real-time status of the project cost and timeline of the project DAX formula of PowerBI is used and also with integration of python in PowerBI, the results predicted using linear regression and timeseries will be visualized by the dashboard.

Also, to mark the attendance and the completed tasks I will be developing a platform to upload the labor histogram prepared by the project manager using MS project and to mark the attendance by each labor type. Then the accuracy of the results will be evaluated.

3.3 Gantt Chart

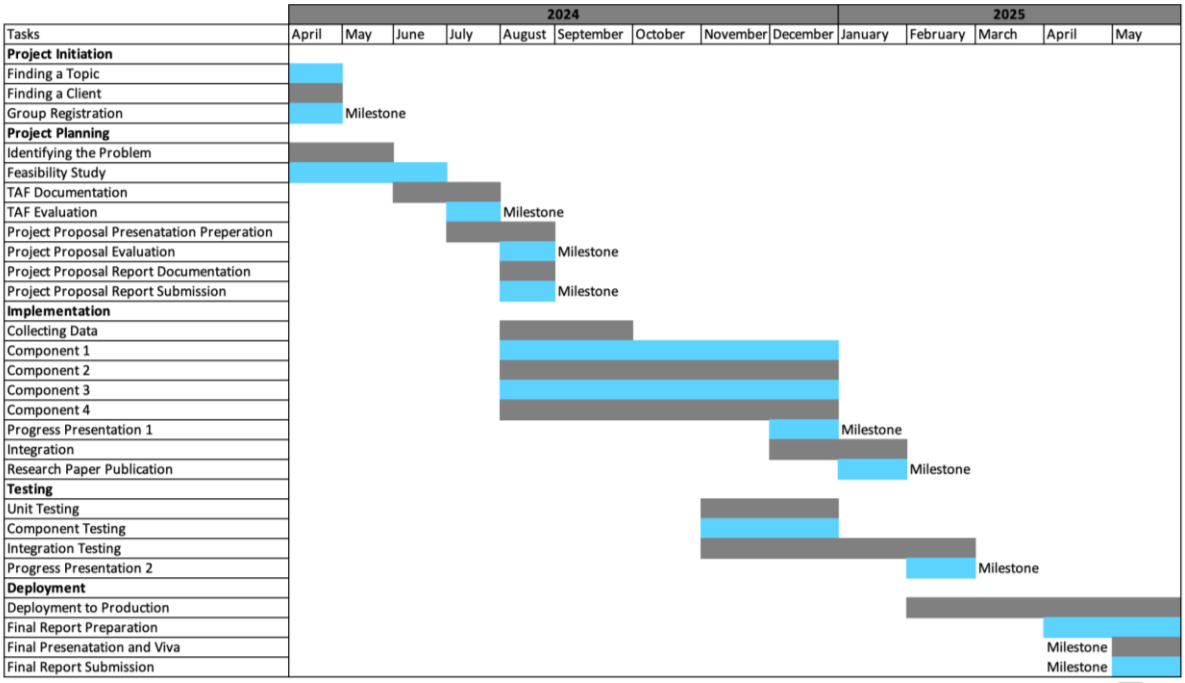

Figure 3 : Gannt Chart

The Gantt chart illustrates the research project's stages, milestones, and timeline from April 2024 to May 2025, highlighting tasks like planning, execution, testing, and deployment.

3.4 Work Breakdown Structure

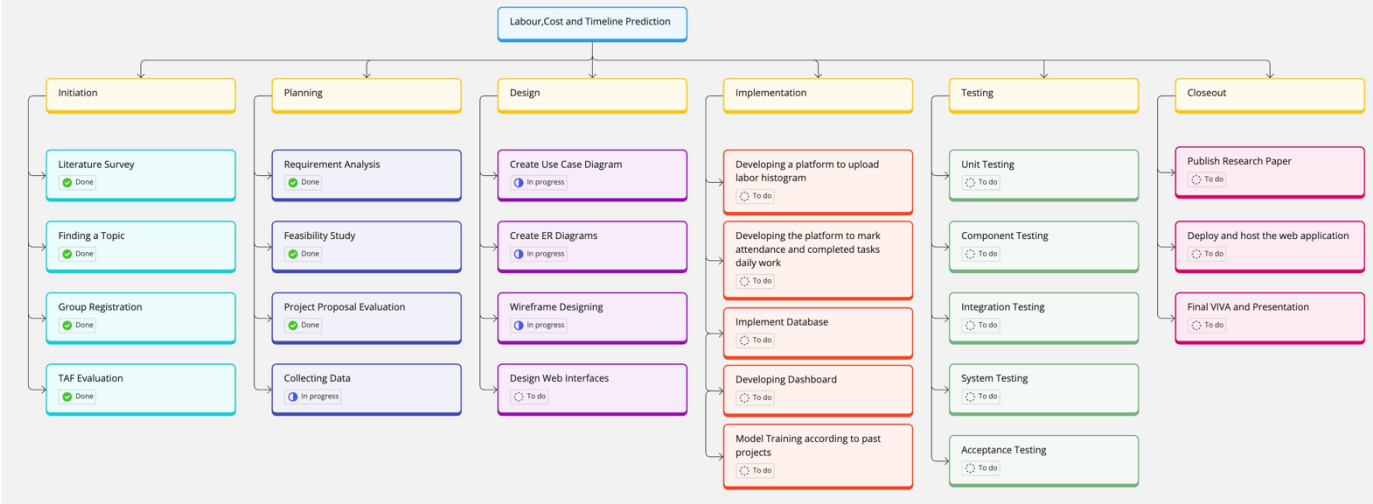

Figure 4:Work Breakdown Structure

The research project "Automated Manpower Allocation by Performance Analysis and Project Categorization for Construction Projects" has completed its feasibility study and literature review. The project is now in its planning and design stages, with testing and implementation next. The publication of the research paper, the implementation of the web application, and the final VIVA and presentation will mark the project's completion.

4. Project Requirements

The following functional, non-functional, and system requirements will be only focusing on the component “Labor, cost and timeline prediction”.

4.1 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.

4.2 Non-Functional Requirements

Non-Functional Requirement (NFR1)	Interfaces should be User-friendly
Description	User should be able to access the content easily.

Non-Functional Requirement (NFR2)	Performance
Description	It should take less than 30 seconds for perform a task.

Non-Functional Requirement (NFR3)	Higher accuracy of results
Description	The predicting results should be accurate.

Non-Functional Requirement (NFR4)	Security of the system.
Description	Only the authorized parties should make changes.

Non-Functional Requirement (NFR5)	The system should be easy to maintain and update.
Description	It should be easy to navigate within the system.

4.3 System Requirements

- Laptop
- Internet connection

4.4 Software & Technology Requirements

- Python
- Visual Code
- PowerBi
- MYSQL
- HTML
- CSS
- Tensor Flow

4.5 Data requirements

Our main data source is MAGA Engineering Pvt Ltd. The data requirements for my component are,

1. Budget ,Timeline and Number of labours worked at the past project.
2. Labor categories required for the projects.
3. Labor histogram details of each project.

5. Description of Personal and Facilities

Table 2:Description of personnel and facilities

Registration Number	Name	Task Description
IT21270956	Munagama M.K.H	• Predicting the number of labors required for the project. • Recording the daily attendance and the completed tasks of the labors. • Predicting the timeline and budget of the project while the progression. • Testing and Documentation.

6. Commercialization

The finished product of this project will be a web application which any of the construction company can be used by paying a one-time fee or a subscription fee. This application provides so many advantages than the existing systems. Some of them are;

- Employee allocation for projects on the basis of KPIs.
- Employee allocation optimization.
- Tracking and management of project progress.
- Project categorization mainly by risk and complexity.

This product will exist as two types of models,

- Common Version
- Premium Version

The facilities provided by above 2 versions are as below,

Table 3:Features of two versions

Common Version	Premium Version
• Initial KPI generation by CV Upload. • Updating the performance of employees. • Project categorization on Time Frame and Geographical factors.	• Updated KPI Values. • Project Categorization on risk and complexity. • Most appropriate employee suggestions. • Labour,Cost and timeline predictions.

This (ProjectPulse) can be used by the construction companies as a project management tool. The main end-users and their tasks are;

- HR Department - Uploads the CV when an employee is recruited for the company.
- Employee - Update the Project details assigned with start and end dates of the project.
- Project Manager - Enters the upcoming project details for categorization.
  Records the daily attendance and completed tasks.

7. Budget and Budget Justification

Table 4:Budget

Resource Type	**Amount (Rs.)**	**Total (Rs.)**
Internet Connection	**10000.00**	**10000.00**
Travelling Cost	**15000.00**	**15000.00**
Documentation Cost		
Paper Cost	7000.00	
Research Paper Publication per person	60,000.00	
Total	**67,000.00**	**67,000.00**
Implementation Cost		
Software version Charges	45,000.00	**45,000.00**
Total Cost		**137,000.00**

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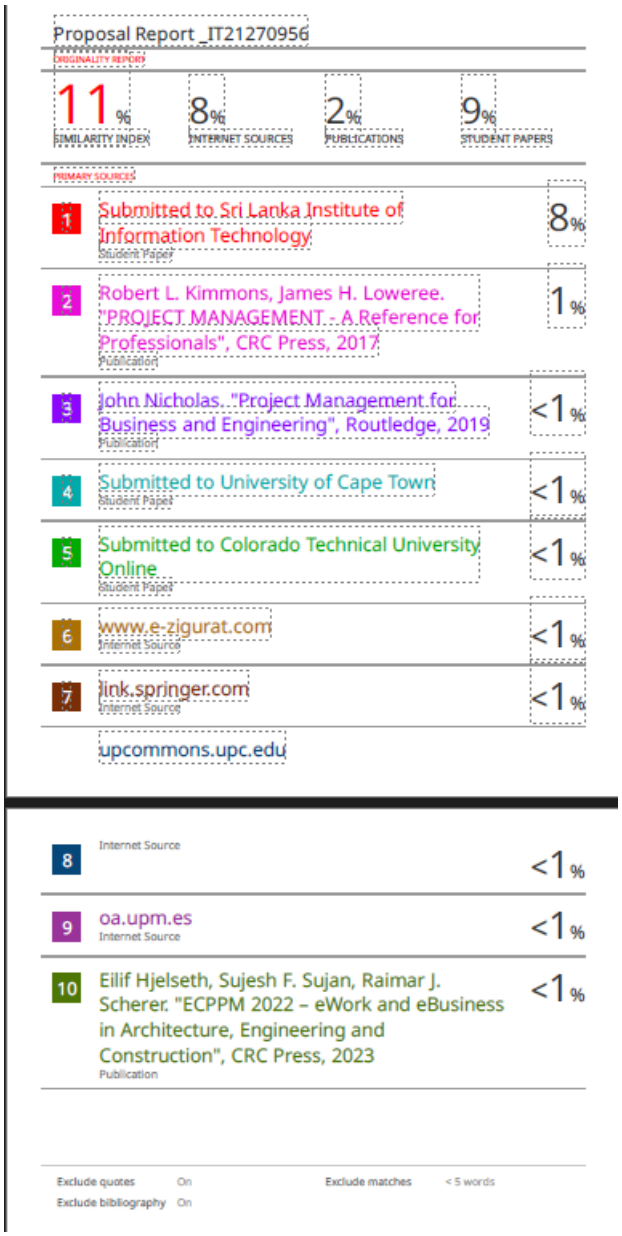
Appendices



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