NirmaN: An Online Construction Management System (OCMS)

Pankaj Agrawal*

Department of Computer Science & Engineering, Parul Institute of Engineering Tech, India.

***Corresponding Author**
Pankaj Agrawal, Department of Computer Science & Engineering, Parul Institute of Engineering Tech, India.

Abstract
Construction industry is one of the major fields contributing to the nation's economy. So, it becomes vital to explore the ways of achieving it for betterment of this industry. The problems faced by the construction industry affects many individuals, communities, industries and government, including almost all the stakeholders of it. This paper presents an online construction management system (OCMS) as an e-platform for the construction industry. This system is designed to increase efficiency and transparency in the construction process and reduce the costs associated with the construction industry. It will enable contractors, material shops, and clients to collaborate and manage the entire construction process in a secure and efficient manner. This theory is supported by several researches, market trends and their problems. As it deals with the real time entities and their survival, the facts are summarized from the statistical results obtained from the survey conducted, which includes a questionnaire for the contractors, engineers, project managers, customers, material shops, etc. Based on the results obtained from the survey, The system will provide a secure and user-friendly interface for clients to monitor the progress of their projects. The paper will discuss the potential of the proposed system and the challenges associated with its implementation. It will also provide an overview of the current market trends in construction management systems. Finally, the paper will conclude by exploring the potential of the proposed system to revolutionize the construction industry.

Keywords: Construction Industry, Contractors, Material Shops, Clients, Supply Chain Management, E-Commerce Platform for Materials, Profile Management, Construction Cost Estimation, Market Trends, Transparency, Progress Monitoring, Time and Expense Tracker.

1. Introduction

Online construction management systems are the latest development in the construction industry. These systems have been designed to help make the process of construction management easier and more efficient. This paper will discuss the benefits of online construction management systems, the features of these systems, and how these systems can benefit construction projects. It will also explore the potential challenges that may arise from using an online construction management system.

The construction industry in India suffers from major time and budget increase. Data from government and industry reports suggest that the project suffers from 20 to 25 percentage in budget increase. Waste of Resources has also increased in past few years and demand for professionals and contractors are increased. The traditional method which is adopted by Indian construction industry will not be able to cope up dynamic environment due to inefficiencies. Innovative ways of procurement and project management can satisfy the concerns [1].

This is a web-based application that enables builders, contractors, and customers to communicate and manage their construction projects. It provides tools for communication, document sharing, tracking of project progress, budget management, and scheduling. It also provides reporting tools for tracking project progress and budget utilization. It also allows customers to provide feedback on projects and track the progress of their construction projects.

This is an online construction management system, which would connect all the stakeholders digitally on a platform where all of them are benefits. It will address the fundamental issues that crop up when something is done physically. In essence, it is establishing a new culture and method for carrying out all building activity in the near future [1].

2. Proposed System
2.1 Problem Statement
Since long the culture of construction have been the same in which the contractor and customer either connects directly or via any construction sites for any type of construction work. In this

structure the process of accomplishing the work either benefits the customer or contractor due to following main reasons:
• Improper guidance
• No time for daily visits to site
• Unaware of abilities of contractors
• Skillful contractors not getting enough work
• Materials and detailed quality of work is not assured
• More than half of the cost of a construction project is made up of the cost of the building materials. i.e., it makes up between 50 and 60 percent of the whole cost. So, how well they are managed affects how much the project will cost altogether [2].
• Moreover, determining the key elements influencing the material management of a building project is the first and most crucial phase [2].
• The factor "unclear description of roles and duties" is listed as the largest factor affecting material management out of all the factors found [2].
These are all daily life problems that can be solved by this system.

B. Proposed Solution
The solution for the above-mentioned problems can be given by:
• Formal/Informal chat with contractors and transparency.
• Daily updates of work using a tracker.
• Facilities to view ratings, reviews, previous projects and experiences of contractors.
• Advertisements and recommendations of the contractors in the trending section will give more opportunities to them.
• Customers can choose the material available in the list and ensure its quality.
• We must work on the interaction, collaboration, and communication between suppliers and contractors in order to improve the supply chain. The third-party logistics and delivery

system should also be improved [3].
• The supply chain management and e-business are discussed as ideal solutions in the study since they save money, speed up construction, and enhance quality [3].
• It offers strong support for both the supply of the material and its administration [3].

C. Stakeholders
The area is related to the construction field. Main entities using this project is:
• Contractors
• Architects
• Project Managers
• Site Managers
• Supervisor
• Material shops
• Customers

D. Major Advantages and Disadvantages of NirmaN
Advantages:
• Efficient usage
• Easily accessible
• Transparency in the Business
• Easy communication
• Full knowledge about the contractors to customers using their profiles
• Time wastage is avoided
• More work opportunities for contractors
• Quality of service increases
• customers and contractors network get expanded

Disadvantages:
• It will be a great change of modes for all the entities to accept.
• It will be hard to convince the stakeholders to use this as they are habituated to use the conventional mode of working.
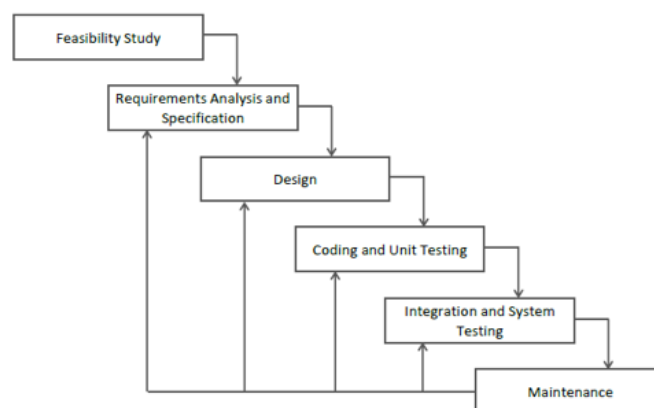
Project Flow

Figure 1: Iterative Waterfall Model

Iterative Waterfall Model
We will be using the iterative waterfall model for the development process as in case of some changes or modifications we need to repeat some steps as per requirement and in that case, we cannot afford to repeat the whole cycle like in classical waterfall model due to time and cost constraints. So, instead of performing all tasks we can repeat only those which are not giving the

satisfactory results. Like: if we are not sure that we have perform the testing phase properly then we can perform it again even after it is completed and without repeating the whole process.

Methodology
A. Requirement Gathering
We discovered that there is currently no such application

available on the market, thus we began our investigation on that problem statement. First, we attempted to determine whether or not this issue actually required a solution. Once we received a favorable response, we proceeded to the steps below to begin gathering requirements.

1. Recognize the needs of the many stakeholders, including customers, users, and business stakeholders. This is the first stage. This makes it more likely that the software solution will fulfil their needs and expectations.

2. Specify the project's scope: The second phase entails specifying the project's parameters, such as what the program should and should not be able to achieve. This makes it easier to maintain the project's direction and concentration.

3. Gather needs: The third step involves gathering requirements from a variety of sources, such as stakeholders, current systems, and market research. This aids in ensuring that all needs are noted and taken into account.

4. Evaluate the requirements: The requirements that have been gathered are then examined in order to find any overlaps, inconsistencies, or information gaps. This makes it easier to make sure that the specifications are thorough, correct, and consistent.

5. To find any information gaps, conflicts, or duplication. This makes it easier to make sure that the specifications are thorough,

correct, and consistent.

6. Document requirements: The last stage is to clearly and succinctly explain the requirements. This helps to make sure that the development process' requirements are clearly understood.

B. Designing Phase
Our design phase was broken in to six steps:
• System analysis: comprehending the needs and establishing the project's parameters.
• Architectural Design: Choosing the software's overarching framework and organizational scheme.
• Module Design: Dividing the system into more manageable, more compact parts.
• Interface Design: Outlining how various components interact with one another.
• Data Design: Specifying the format of the system's data.
• Designing the algorithm: Outlining the rationale and methods to be used in fixing the issue.

Flow Diagrams:
Flow Diagrams consists of three main diagrams:
1. Data Flow Diagram (DFD)
2. Entity Relationship Diagram (ER)
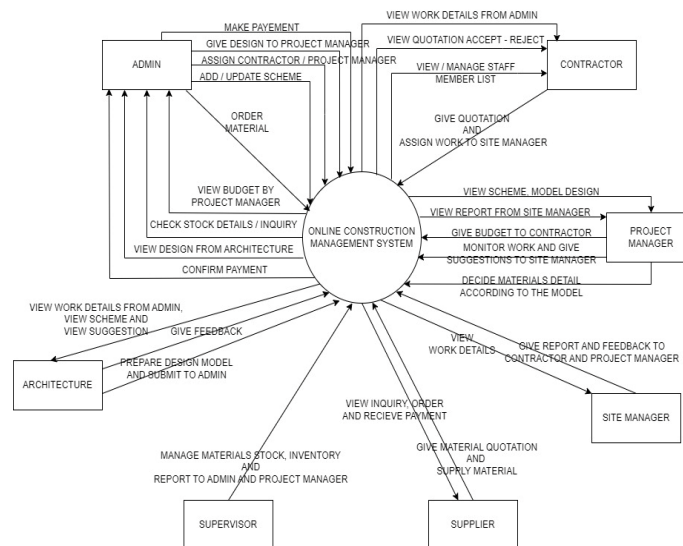3. Use Case Diagram
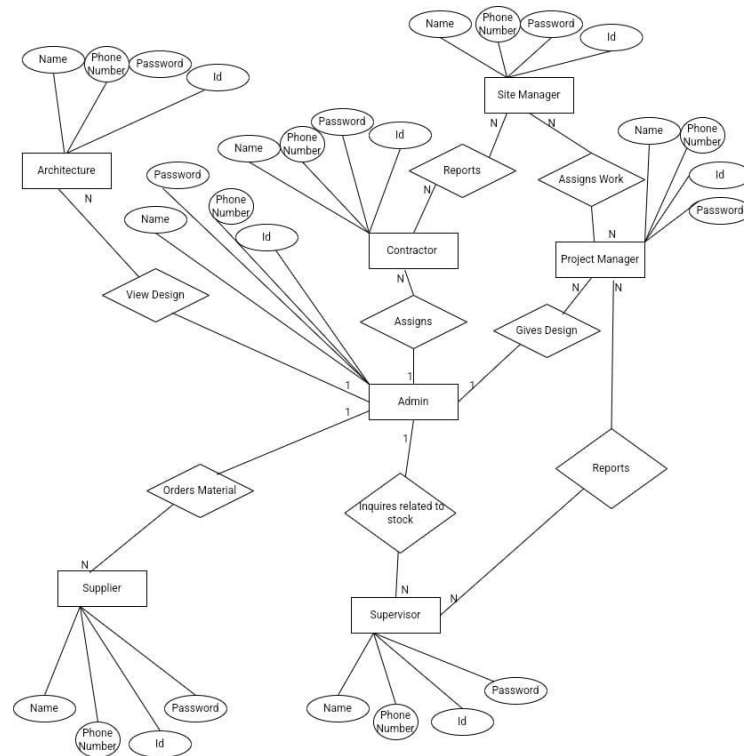

Figure 2: Data Flow Diagram (DFD)
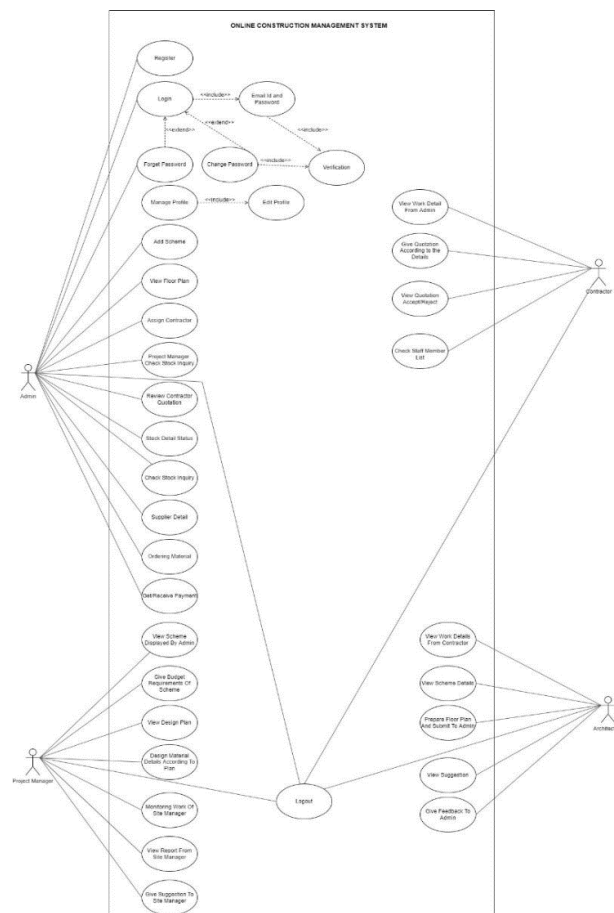
Figure 3: Entity Relationship

Figure 4: Use Case Diagram

C. Development Phase

By examining the triple constraint, which consists of scope, cost, and time, this project seeks to raise the success rate of building projects. To effectively manage the project, these restrictions must be addressed together with client satisfaction. Inability to adhere to these limitations may lead to project failure and disgruntled clients. The study is important since it offers knowledge about successfully managing projects and ensuring client satisfaction [4].

Worker safety, team management, schedule restraints, and workload are just a few of the difficulties faced by construction managers. In order to solve these issues, efficient planning and scheduling are required. Primavera software aids in project planning, scheduling, monitoring, and control while controlling costs and timelines. The software makes it possible to compare anticipated and actual progress, spot delays, and guarantee project success [5].

N ➤ Networking Platform for using several

I ➤ Integrated features in a

R ➤ Reliable, Rapid and Robust way for

M ➤ Managing & Monitoring of Construction tasks by

A ➤ Assigning, Analyzing and Tracking it, for on boarding

N ➤ New Clients, Projects, Construction Staff and Material Shops

Connect with us for Better, Faster, Trouble-Free & Effective Construc

Figure 4: What is NirmaN?

Nirman is Divided into 3 Parts:
i. Admin Panel
ii. Android Application
iii. Recommendation Model for recommending the best man for the job

Admin Panel

o The Admin Panel is built for handling the whole process of monitoring, Maintaining and assigning the tasks from admin side.

o This is a website which is built using technologies and tools like:

■ For Frontend – HTML, CSS, JavaScript, PHP

■ For Backend – PHP

■ For Building APIs – PHP

■ For creating databases – MySQL

■ For Developing Website – VS Code is used

■ For Validating APIs – Postman Tool is used

■ For maintaining the Database – phpMyAdmin tool is used

o This website helps the admin to handle the whole flow of processes taking place in the construction process like: assigning tasks to the architect, confirming the schemes, adding and updating the city, designation, team, profile and tracking the feedback, complain and the work submitted by each person.

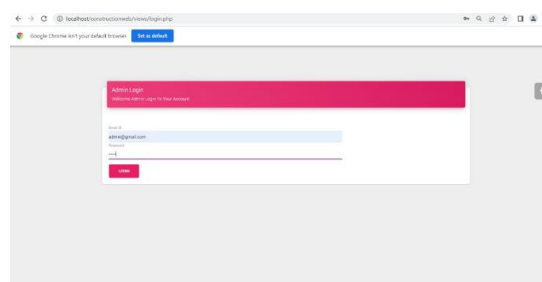o Some of the visuals of the admin panel are presented below:
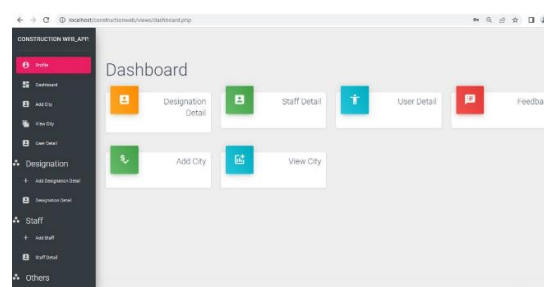

Figure 5: Admin Panel Login Screen

Figure 6: Admin Panel Dashboard

2. Android Application

o The Application is built for the all the stakeholders of NirmaN. As, majority of them are working on field so, a mobile application is a better fit for them to use easily and effectively.

o This mobile application is an Android application which is built using the tools and technologies like:

▪ For Frontend – XML ▪ For Backend – JAVA

▪ For Building APIs – PHP

▪ For creating databases – MySQL

▪ For Developing the application – Android Studio tool is used

▪ For Validating APIs – Postman Tool is used

▪ For maintaining the Database – phpMyAdmin tool is used

o This application is used for basic functionalities of the workers associated to it. They can use it to manage, assign, track and update the progress of the task. Also, they can view the available works, order Material from the application, generate quotation and much more.

o Some of the visuals of the Android

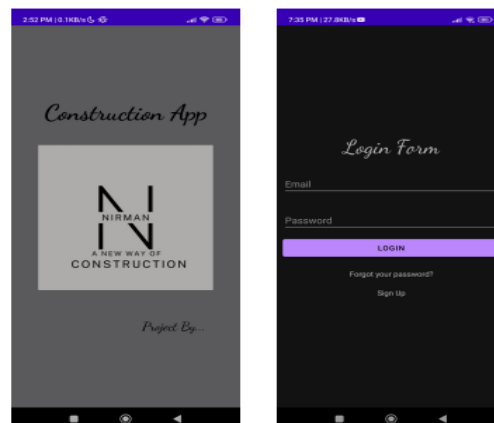Application are presented below:

Application are presented below:

Figure 6: NirmaN Login Screen

3. Construction Workers' Recommendation model

o The Recommendation Model is built mainly for the users who are looking for City best Architects, Contractors and Engineers for the Construction work.

o This model is build using Machine learning algorithm for recommending the best man for the job.

o This model is based on the Cosine Similarity algorithm which helps to check the closest similar value/entry to the required constraints. And due to this it increases the accuracy of the results generated. Thus, it becomes perfect fit for this model.

o For this model we have used a dummy dataset having 15 features and approximately 4000 entries. Of which the independent variables or the predictors used for this are: City, Ratings, Number of Projects previously done and Status.

o This recommendation model is built using tools and technologies like:

▪ For developing the model – Python Language and some standard Libraries like: Pandas, NumPy, Scikit-learn, Vectorizer etc.

▪ For developing the API for the model – Flask Rest API

▪ For developing the model – Google Collab tool is used

▪ For developing the API – PyCharm tool is used

o Some Visuals of the results obtain by the model are:

Figure 7: Results for Pune City

Figure 8: Results for Ahmedabad City

Also, we can calculate the cost for any construction project by predicting the cost of the project using a machine learning concept based on Ordinary least square method:

The essay examines how it can be challenging yet essential to predict construction costs precisely. In order to forecast future costs, the Ordinary Least Square (OLS) method, a kind of linear regression model, is suggested as a solution. OLS operates well on short datasets, and tests with this model indicate 91% to 97% prediction accuracy [6].

For enhancing the performance and reducing the latency in the working of the application we can use cloud as our deployment model. Using the cloud technologies we can improve the Critical real time client engagement and its maintenance. Also, using cloud we can improve the auto scaling of the resources allocated and smoothen out the work.

In order to investigate the impact of cloud computing on the construction sector, 92 peer-reviewed papers from 2009 to 2019 were analyzed. Emerging technologies including building information modelling, the Internet of Things, virtual reality, augmented reality, and big data analytics are discovered to be made possible by cloud computing in the construction sector. The study also examines methods for overcoming obstacles to the use of cloud computing in the construction industry [7].

D. Testing Phase
With this approach, we were able to make sure the developed product complies with the specifications and performs as planned. The primary objectives of testing were to find and fix any flaws or faults in the program and confirm that it complies with both functional and non-functional criteria. The following tasks are frequently included in our testing phase:
i. Test execution
ii. Test design
iii. Test planning
iv. Analysis of the Test Results
v. Correction of Defects

Features and Functionalities
A. Functionalities
1. E-Commerce Platform for Construction Materials
o The application will provide an E-Commerce platform specifically for construction materials.
o This will achieve by bringing all material shops online so that, their clients, contractors, engineers etc. can check for the availability and order it for the same.
o The rates of the materials will be updated daily and the site managers can order them according to the availability.
2. ERP
o The application will also provide an ERP mechanism, which helps the project managers and engineers to organize their work schedule, manpower, resources and materials.
o This can be achieved by using a mechanism like Gantt chart which helps them to do planning of the same.
o This helps them to put the right team and resources at right place. Also, to plan the week/month in advanced.

3. Profile Management
o The application will also keep record of the profiles of the contractors, project managers, engineers, architect, interior designer etc.

o So that all the members of this field can select the required member from the application based on his/her experience and qualification (like: LinkedIn).

o This will help the newly graduated students, experienced contractors etc. to get work as it will be seen by clients as well as site owners.

4. Cost Estimator, Time Estimator, Expenses Estimator
o The application will also provide a feature for calculating the cost and time of construction before starting the work. So, that the contractors can provide quotation to the clients based on their requirements easily. And, clients can compare rates with the others and find themselves the best rates.

o Also, after starting the work it will help to track daily expenses done on-site by the contractors for progressing the work.

5. Construction Workers' Recommendation Model
o One of the features of this system give the users' a privilege for looking for the best Contractors, Architects or Engineers of the city using some information like: Roles, City, Ratings, Number of projects previously done and his/her availability status. This model is build using Machine learning algorithm.

o We have used Cosine Similarity algorithm for recommending the best man for the job using various technologies like: Python, Flask and some standard python libraries.

B. Features
- Client/Staff Profiling
- Generate Quotation/Scheme
- Assign Tasks
- Monitor and Track Tasks
- Manage and Communicate with the Team
- Manage Inventory/Stock
- Track Time, Cost and Budget
- E-Commerce Platform for Construction Materials

VI. Implementation Challenges
As this type of applications are not freely available in the market with all the features as we are providing. So, there are no sources available which can be used as a reference. So, all the development part was little bit complicated. The main challenges faced by us due to that were:

• Lack of expertise
• Unclear Requirements
• Dependencies
• Resistance to changes
• Lack of Guidance for opting correct technologies and implementation ways
• Lack of knowledge for opting the ways of deploying this web-application
• Difficulty in searching and selecting the accurate dataset as, no information regarding construction is revealed by the organizations
• Difficulty in choosing the correct algorithm for making
• the recommendation model
• Connecting the model with the Web-App was the biggest challenge

• Interoperability issue while conducting several tests by using model over application or live server.

VII. Conclusion
• In conclusion, an online construction management system provides a valuable tool for managing construction projects. By using a centralized platform, project managers can streamline communication, track progress, and improve collaboration among project stakeholders. The benefits of an online construction management system include improved efficiency, increased transparency, and reduced errors.

• However, to fully realize the benefits of an online construction management system, it is important to carefully evaluate and choose the right system that fits the specific needs of the project and the organization. The system should be user-friendly, customizable, and scalable to accommodate changes in project scope and size.

• Furthermore, the success of an online construction management system depends on the willingness of project stakeholders to adopt and use the system. Training and support should be provided to ensure that all users are comfortable with the system and understand its features and capabilities.

• Overall, an online construction management system can greatly improve the management of construction projects, but it requires careful planning, evaluation, and implementation to be effective.

VIII. Future Work
• In this we have covered the first four features and have made Admin panel, Android Application and the recommendation model. So, as our Future work we will be performing the implementation work for last two functionalities and will make a marketing website which will give an acute turn to the project and this idea will be at a whole new and different level.

• Also, NirmaN has the capability to solve this realworld problem at a large scale by onboarding all the stakeholders from various locations. And for achieving this with no or negligible problems we need to deploy those features over cloud. So, by using Cloud technologies we can make the process run smoothly.

• So, we can consider using Cloud computing methods and adding some other features like: E-Commerce platform for Materials and Inventory management and a Marketing Website as our Future Works.

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