

AI- DRIVEN RAW MATERIAL COST OPTIMIZATION AND PROCUREMENT INTELLIGENCE PLATFORM

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ABSTRACT

The AI-Driven Raw Material Cost Optimization Platform is a web-based system designed to help industries make efficient procurement decisions amid fluctuating raw material prices. In sectors such as construction, textiles, manufacturing, and energy, material costs vary due to factors like market demand, seasonal changes, and supply chain disruptions. Traditional procurement methods often rely on manual analysis, leading to less effective decisions and higher costs. To overcome this, the platform uses machine learning and real-time data to analyze historical and current prices and forecast future trends. It provides decision-support recommendations such as BUY NOW, BUY LATER, or HOLD based on predicted price movements and inventory needs. The system also includes dashboards to visualize price trends and cost comparisons, and can be customized for different industries, making it an effective solution for cost optimization.

Keywords

Cost Optimization, Procurement Optimization, Raw Material Price Analysis, Market Trend Analysis, Smart Purchasing System and Business Intelligence.

I. INTRODUCTION

In today's competitive business environment, industries aim to reduce costs and improve efficiency. A major challenge faced by sectors like manufacturing, construction, textiles, and energy is the fluctuation in raw material prices. Materials such as steel, cement, cotton, and fuel frequently change in price due to demand, economic conditions, and other external factors. These fluctuations make procurement decisions difficult and can increase costs. Traditionally, procurement relies on historical data and manual analysis. However, these methods are limited in handling large data and predicting future trends, often leading to missed opportunities or unfavorable purchasing decisions. To address this, the AI-Driven Raw Material Cost Optimization Platform uses machine learning and data analytics to predict price trends. It analyzes data using forecasting techniques to support better decision-making.

The platform provides simple recommendations such as BUY NOW, BUY LATER, or HOLD, helping businesses act quickly. It also evaluates suppliers based on reliability and performance, improving overall procurement efficiency. Additionally, the system supports real-time data monitoring, enabling businesses to stay updated with market changes. It improves risk management by identifying potential price fluctuations in advance.

The platform also enhances transparency in procurement processes, allowing better tracking and control of purchasing activities. Overall, the system reduces manual effort, improves decision-making, and helps organizations manage costs more effectively.

II. LITERATURE REVIEW

[2.1] Zhifeng Tan; Zheng Zhang; Liqing Hu; Shan Chen; "Engineering Material Management Platform for Nuclear Power Plant", 2013.

The materials are the basis of the nuclear power plant construction. Effective nuclear power engineering material management can accelerate the construction and reduce project cost of the nuclear power plant. In order to put the design of the source data into engineering material management, regulate the process of material procurement management and provide material procurement data and design drawings data in real-time for site management, this paper proposed the solution of the engineering material EPC (engineering, procurement, construction) based on VPRM system and SAP system and finally realized it.

[2.2] Yan Dong; "Optimization and Analysis of Raw Material Supply Chain Based on Computational Intelligence", MOBILE INFORMATION SYSTEMS, 2022.

With the rapid economic growth and increasingly fierce market competition, the traditional manufacturing advantages have become a thing of the past. There are problems such as inaccurate procurement plans, large quantities of inventory sold out, chaotic procurement processes, and unclear inventory policies. Optimizing the procurement of basic raw materials will help reduce raw material costs.

[2.3] Shahrkh Khalid; "Optimization of Pharmaceutical Processes Using Artificial Intelligence", CLINICAL MEDICINE AND HEALTH RESEARCH JOURNAL, 2025.

The pharmaceutical industry plays a crucial role in global healthcare by developing and manufacturing life-saving medications. However, the industry faces several critical challenges that hinder its efficiency and sustainability. One of the foremost challenges is high production costs, which stem from the extensive research, clinical trials, and regulatory approvals required for drug development.

[2.4] Olorunshogo Benjamin; Olorunshogo Benjamin Ogundipe; Azubuike Chukwudi Okwandu; SanniAyindeAbdulwaheed; "Optimizing Construction Supply Chains Through AI: Streamlining Material Procurement and Logistics for Project Success", GSC ADVANCED RESEARCH AND REVIEWS, 2024.

The construction industry faces numerous challenges in achieving efficient supply chains, particularly in material procurement and logistics. This paper explores the transformative potential of Artificial Intelligence (AI) in addressing these challenges and enhancing project success implementation.

[2.5] M. N. Shamma; K. Shawki; H. Bassioni; "Optimization of Construction Logistics Planning Cost in Egypt Using Genetic Algorithms", JOURNAL OF INFORMATION TECHNOLOGY & SOFTWARE ENGINEERING, 2017.

The effective and efficient management of construction resources is the core of success for any construction project. Traditionally, researchers and industry professionals identify the five main construction resources to include, time, capital, labor, equipment and material.

III. METHODOLOGY

3.1 EXISTING SYSTEM

The existing procurement systems used by many businesses are largely manual and lack advanced technological support, making the process time-consuming and inefficient. Organizations often depend on spreadsheets and basic tools to track raw material prices and manage purchases, which increases the chances of errors, duplication, and inconsistencies in data handling. There are no accurate price prediction mechanisms, forcing decision-makers to rely heavily on past experience or guesswork rather than data-driven insights, which can lead to poor purchasing decisions. Supplier evaluation and comparison are also performed manually, leading to limited analysis, bias, and suboptimal vendor selection. Additionally, the absence of a centralized system makes it difficult to track procurement activities effectively, resulting in poor visibility and lack of control over operations.

Most importantly, existing systems do not incorporate artificial intelligence or automated recommendations, resulting in missed opportunities for cost optimization and strategic decision-making. Furthermore, these systems lack real-time data updates, making it difficult to respond quickly to market fluctuations, and they do not provide alert or notification features for price changes, causing businesses to miss optimal purchasing opportunities.

They also lack integration with external data sources such as global market trends, weather conditions, supply chain disruptions, and economic indicators, which significantly reduces forecasting accuracy and planning efficiency.

Transparency in procurement processes is often limited, making it difficult to monitor supplier performance, pricing history, and procurement decisions. Many systems do not maintain proper historical data analysis, which restricts long-term planning and trend identification. In addition, these systems are not scalable, making it challenging for growing organizations to handle large volumes of procurement data and increasing operational complexity. The absence of automated approval workflows leads to unnecessary delays in procurement cycles, reducing overall productivity and responsiveness.

3.2 PROPOSED SYSTEM

The proposed system is an AI-driven procurement intelligence platform designed to enhance and automate the decision-making process in raw material purchasing. It integrates advanced features such as real-time raw material price tracking, machine learning-based price prediction, and a smart procurement recommendation engine that suggests actions like BUY NOW, BUY LATER, or HOLD. The system also includes supplier intelligence ranking to evaluate vendors based on performance, pricing consistency, and reliability, ensuring better supplier selection. Additionally, it provides interactive analytics dashboards for clear visualization of price trends, forecasts, and procurement insights. The platform supports real-time alerts and notifications for price changes, centralized data management for easy tracking of procurement activities, and scalability to handle large datasets and multiple users. It can also be integrated with existing enterprise systems such as ERP and supply chain tools, improving overall workflow automation.

By combining these capabilities, the system enables businesses to make accurate, data-driven purchasing decisions, reduce costs, minimize risks, and improve overall efficiency in supply chain management.



FIG 3.3 FLOW DIAGRAM

IV SYSTEM SPECIFICATION

4.1 SOFTWARE REQUIREMENTS

- MERN Stack
Frontend : React.js, Tailwind CSS, JavaScript
Backend : Django REST Framework, Python

4.2 SOFTWARE DESCRIPTION

4.2.1 MERN STACK

The MERN Stack is a popular set of technologies used to build full-stack web applications. It includes MongoDB, Express.js, React.js, and Node.js. MongoDB serves as the database.

Express.js and Node.js handle the backend/server-side logic, while React.js manages the frontend/user interface. All components use JavaScript, which allows for smooth integration and a unified development experience across the entire application stack. The MERN Stack is widely used for developing scalable, dynamic, and high-performance web applications. The MERN Stack is widely used for developing scalable, dynamic, and high-performance web applications. It offers an end-to-end JavaScript environment, improving development efficiency and consistency. And also it has strong community support and a wide range of libraries, making it ideal for modern web development.

4.2.2 REACT.JS

React.js is a popular JavaScript library developed by Facebook for building user interfaces, particularly single-page applications where real-time updates and dynamic content are crucial. It uses a component-based architecture that allows developers to create reusable UI components, enhancing code modularity and maintainability.

4.2.3 TAILWIND CSS

Tailwind CSS is a modern utility-first CSS framework that enables developers to build custom user interfaces quickly and efficiently. Unlike traditional CSS frameworks that provide pre-designed components, Tailwind offers low-level utility classes that can be composed to create any design directly in the markup.

4.2.4 JAVASCRIPT

JavaScript is a widely used programming language that enables interactive and dynamic behavior in web applications. It runs in the browser and is primarily used to manipulate web page content, handle user events, validate data, and communicate with servers through APIs.

As a core technology of the web alongside HTML and CSS, JavaScript powers modern frontend frameworks like React and also supports backend development through environments like Node.js. Its flexibility, asynchronous capabilities, and vast ecosystem make it essential for building responsive, real-time, and full-stack web applications.

4.2.5 DJANGO REST FRAMEWORK

Django REST Framework is a powerful toolkit built on top of Django that is used to create robust and scalable web APIs. It enables developers to easily convert database models into JSON format, handle HTTP requests (GET, POST, PUT, DELETE), and build RESTful services efficiently. It provides built-in features like serializers for data conversion, view sets for handling logic, and routers for automatic URL routing, reducing development effort. Additionally, it supports authentication methods such as token-based and session-based authentication, along with role-based permissions for security.

4.2.6 PYTHON

Python is a high-level, interpreted programming language known for its simplicity, readability, and versatility. It is widely used in various domains such as web development, data science, artificial intelligence, automation, and scripting. Python supports multiple programming paradigms, including object-oriented, procedural, and functional programming, making it flexible for different types of projects. Its easy-to-understand syntax and powerful capabilities make Python a popular choice for beginners as well as professionals in building scalable and efficient applications.

V EXPERIMENTAL RESULT

5.1 TEST CASE 1:



5.2 TEST CASE 2:



5.3 TEST CASE 3:



5.4 TEST CASE 4:



Material	Supplier	Unit	Unit Price	Status
Aluminum	Aluminum	kg	150	✓
Steel	Steel	kg	120	✓
Copper	Copper	kg	180	✓
Iron	Iron	kg	100	✓
Plastic	Plastic	kg	80	✓
Concrete	Concrete	kg	110	✓
Wood	Wood	kg	90	✓

5.5 TEST CASE 5:



VI RESULTS AND DISCUSSION

The AI-Driven Raw Material Cost Optimization Platform successfully demonstrates how advanced technologies like machine learning and data analytics can transform traditional procurement processes into intelligent and efficient systems. The platform effectively collects and analyzes both historical and real-time data to predict raw material price trends with improved accuracy, enabling businesses to make timely and cost-effective purchasing decisions. By generating clear recommendations such as BUY NOW, BUY LATER, or HOLD, the system simplifies complex data into actionable insights, reducing dependency on manual analysis and guesswork. The inclusion of supplier intelligence ranking enhances vendor selection by evaluating performance, reliability, and pricing patterns, thereby strengthening supply chain efficiency.

The interactive dashboards and visualizations provide a clear understanding of market trends, while real-time alerts ensure users can respond quickly to price fluctuations. The system also minimizes manual effort, reduces errors, and centralizes procurement data for better tracking and management. Testing results indicate that the platform significantly improves decision-making accuracy, reduces procurement costs, and minimizes risks associated with market volatility.

Overall, the project achieves its goal of providing a scalable, secure, and user-friendly solution that enhances procurement efficiency, supports strategic planning, and offers a competitive advantage to businesses operating in dynamic market environments.

VII CONCLUSION AND FUTURE WORK

7.1 CONCLUSION

The AI-Driven Raw Material Cost Optimization Platform represents a significant advancement in the field of procurement and supply chain management by integrating modern technologies such as artificial intelligence, machine learning, and data analytics into a unified system. Throughout the development and implementation of this project, it has been clearly demonstrated that traditional procurement methods, which heavily depend on manual processes and human intuition, can be effectively transformed into intelligent, automated, and data-driven solutions. The platform successfully addresses the critical challenge of raw material price volatility, which has long been a major concern for industries such as manufacturing, construction, textiles, and energy. One of the key achievements of this system is its ability to analyze both historical and real-time data to generate accurate predictions of raw material price trends. By utilizing machine learning techniques, the platform provides meaningful insights that enable businesses to anticipate market fluctuations and plan their procurement strategies accordingly. The introduction of a recommendation engine that suggests actions such as BUY NOW, BUY LATER, or HOLD simplifies complex analytical outputs into easy-to-understand decisions.

version is also a valuable future extension.

7.2 FUTURE SCOPE

The AI-Driven Raw Material Cost Optimization Platform presents a strong foundation for intelligent procurement; however, there are several opportunities for future enhancements that can further improve its performance, scalability, and real-world applicability. As technology continues to evolve, incorporating advanced features and emerging innovations can significantly enhance the system's capabilities and provide even more accurate and reliable decision support. One of the major areas for future improvement is the integration of deep learning-based price prediction models. While the current system utilizes traditional machine learning algorithms for forecasting, advanced techniques such as Long Short-Term Memory, Recurrent Neural Networks (RNN), and Transformer-based models can be implemented to capture complex patterns and long-term dependencies in time-series data. These models can significantly improve prediction accuracy, especially in highly volatile markets where traditional methods may struggle to adapt. By continuously training these models with large-scale datasets, the system can evolve into a more robust and intelligent forecasting tool. Another important enhancement is the integration of real-time commodity market APIs. Although the current system supports data collection, incorporating multiple reliable and live data sources such as global commodity exchanges and financial data providers will improve the accuracy and timeliness of predictions. Real-time data streaming can enable the system to respond instantly to market fluctuations, providing users with up-to-date insights and recommendations. This will make the platform more dynamic and suitable for industries where price changes occur rapidly. The development of a mobile application

VIII REFERENCES

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