

BuildXchange: An AI-Enabled Marketplace for Sustainable Construction Material Exchange and Circular Resource Management

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Abstract - The construction industry generates a large amount of unused or surplus material such as cement bags, bricks, sand, steel rods, tiles, and pipes that often ends up as waste, under low-value scrap, or idle storage. At the same time, nearby construction sites may face shortages, high procurement costs, and logistics overheads. This paper proposes an AI-oriented conceptual framework for a digital marketplace that connects sellers of surplus construction materials with local buyers, reducing waste and optimizing resource utilization. Using AI-based techniques such as demand forecasting, clustering, and recommendation, the system can match surplus inventory with nearby construction sites, estimate fair prices, and prioritize materials with high reuse potential. The work emphasizes the research and algorithmic aspects, rather than system level implementation details, and aligns with sustainable construction and circular-economy goals.

Keywords - Construction waste, surplus building materials, AI-based marketplace, material reuse, sustainability, recommendation system.

1. INTRODUCTION

The construction industry is a major consumer of raw materials and a significant source of solid waste, as project modifications and phase completions often leave behind partially used materials such as cement, bricks, steel, tiles, and pipes. These surplus resources are frequently discarded, stored without use, or sold at low prices, while nearby projects simultaneously face shortages and increased procurement and transportation costs. This mismatch indicates the absence of a localized, intelligent system to connect supply with demand. With advancements in artificial intelligence (AI), it is now possible to develop data-driven solutions that analyze construction patterns, predict material requirements, and facilitate efficient exchange of surplus resources. Unlike conventional e-commerce platforms, an AI-enabled marketplace tailored to construction materials can incorporate quality assessment and location-based logistics

to minimize waste and promote sustainable, circular practices. This study proposes a research-focused framework that leverages AI for identifying, valuing, and matching surplus construction materials, addressing the issue from technological, economic, and environmental perspectives rather than presenting a complete software implementation.

2. PROBLEM STATEMENT

Many construction projects generate surplus materials that remain in good condition but are often discarded or left unused, resulting in inefficient use of resources and unnecessary environmental impact. At the same time, contractors face difficulties in obtaining both reclaimed and new construction materials because supplier information is scattered, prices vary, stock availability is uncertain, and transportation costs can be high. These challenges increase project costs and may delay construction activities. Furthermore, there is no integrated AI-based platform that can recommend suitable reusable materials, identify nearby suppliers for new materials, compare pricing and availability, and support cost-effective procurement decisions.

3. OBJECTIVES AND SCOPE

1. To design and develop an AI-powered e-commerce platform that facilitates the buying and selling of construction materials through a secure and user-friendly interface.
2. To reduce construction material wastage by enabling the exchange and reuse of surplus materials between construction projects.
3. To improve the efficiency of material distribution by connecting nearby buyers and sellers, thereby reducing transportation time and associated costs.
4. To optimize construction expenses through intelligent planning of material procurement, storage, and logistics.
5. To incorporate artificial intelligence techniques that provide personalized recommendations for material selection, pricing, and availability based on user requirements and market trends.

6. To establish a transparent and trustworthy digital marketplace that connects buyers, sellers, and transport service providers on a single platform.
7. To promote sustainable construction practices by encouraging the reuse of materials, minimizing waste generation, and reducing the environmental impact of construction activities.

Scope:

The scope of this project includes the design and development of a web-based platform that facilitates the trading of both new and surplus construction materials. It covers features such as product listing, searching, filtering, order management, and delivery tracking. The system.

integrates AI-based recommendation mechanisms to assist users in making cost-effective and efficient decisions. It also supports location-based services to identify nearby suppliers and reduce transportation efforts. Future enhancements may include mobile application development, advanced AI models for demand prediction and pricing analysis, and integration with logistics and payment systems. The platform has potential applications in real-world construction projects by improving resource utilization, reducing costs, and promoting sustainability in the construction industry.

4. LITERATURE REVIEW

^[1] *A TRUSTWORTHY DIGITAL MARKETPLACE FOR SECOND-HAND CONSTRUCTION MATERIALS 2023*, This study introduces a blockchain-enabled digital marketplace designed for trading pre-owned construction materials. The system ensures transparency, security, and trust among users by leveraging blockchain technology. The research demonstrates that such a platform is technically feasible and can effectively support the reuse of construction materials.

^[2] *Digital Technologies for Sustainable Construction Supply Chains 2024*, This research focuses on the role of digital technologies in enhancing construction supply chains. It explains how online platforms, location-based services, and digital trading systems can streamline procurement processes, lower costs, and improve material availability, ultimately contributing to more sustainable construction practices.

4. PROPOSED METHODOLOGY

The proposed system presents an AI-based e-commerce platform for the buying, selling, and exchange of construction materials. The process begins with user registration, where contractors, suppliers, buyers, and transport providers access the platform based on their roles. Suppliers upload material details such as type, quantity, price, condition, and location, while buyers search and filter materials according to their requirements.

An AI-based recommendation module analyzes material availability, user preferences, location, and pricing

information to suggest suitable materials. The system gives priority to nearby reusable materials; if unavailable, it recommends new materials from the nearest suppliers to reduce transportation cost and delivery time.

The platform includes an order management module for order placement, payment processing, and order tracking, along with a logistics module that assigns transport providers and monitors deliveries. A storage planning module assists users in estimating material requirements to minimize excess inventory and reduce wastage.

All user, material, transaction, and logistics data are securely maintained in a centralized database. By integrating artificial intelligence with digital commerce, the proposed methodology improves material utilization, reduces project costs, and promotes sustainable construction practices.

6. SYSTEM ARCHITECTURE

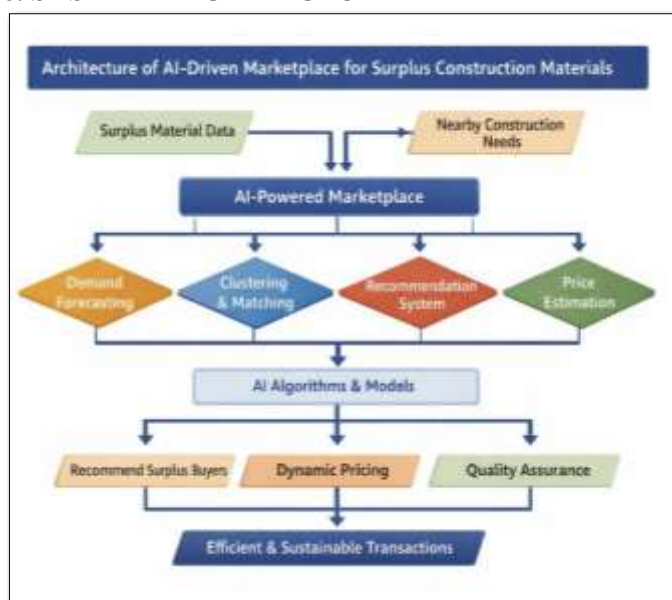


Fig -1: System Architecture

Table -1: Main Features consider for final result

Parameter	Description	Example 1	Example 2	Data Type	Source
Material Type	Construction material requested	Cement	Steel	Categorical	Seller
Quantity	Quantity required	100 Bags	5 Tones	Numeric	Buyer
Distance (km)	Buyer-Seller distance	18 km	20 km	Numeric	Google Maps API
Transport Vehicle	Delivery vehicle	Mini Truck	Trailer	Categorical	Logistics
Material Price (₹)	Price quoted by supplier	₹350/Bag	₹62,000/Tn	Numeric	Seller

Delivery Charge (₹)	Calculated using distance	₹400	₹12,000	Numeric	AI System
Estimated Cost Savings (₹)	Savings compared with other available suppliers	₹2,350	₹5,800	Numeric	AI Recommend Engine
AI Recommendation Score	Final ranking score	94%	91%	Numeric	AI Model

Create your account

Takes less than 2 minutes

1 Basic info

2 Location

3 Details

4 Verify

Buyer Buy materials

Seller Sell new stock

Site Manager Sell surplus

Transporter Deliver goods

Full Name * Ketan Bhujbal Phone * 8328420646

Email Address * ketanbhujal54@gmail.com

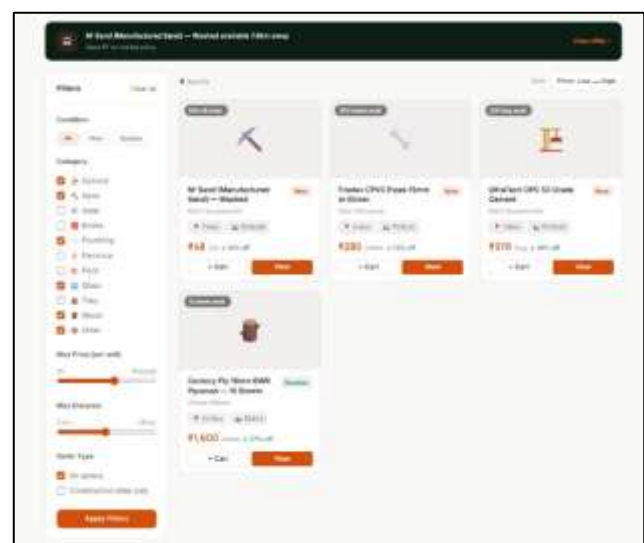
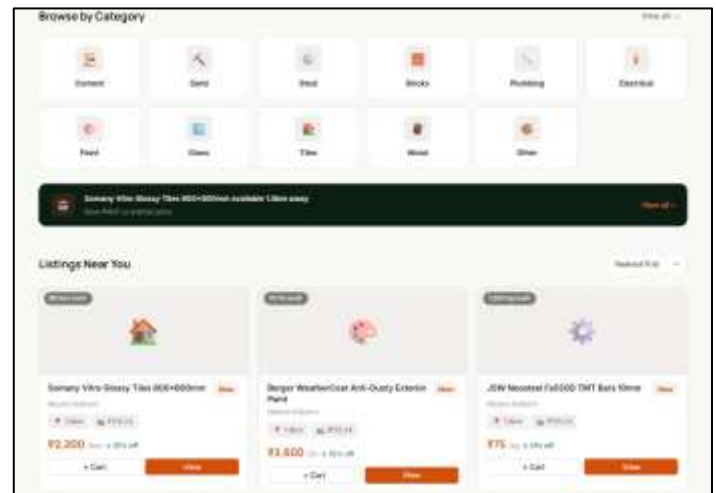
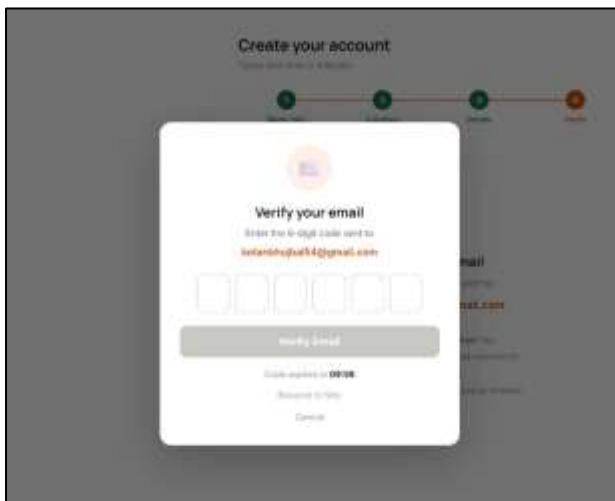
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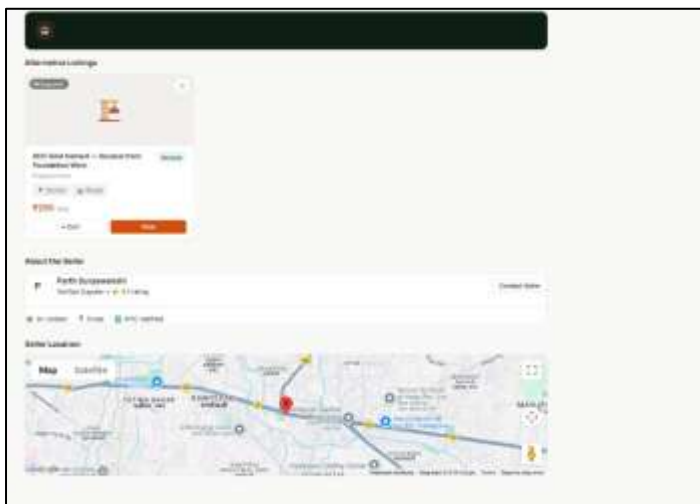
Password * Confirm Password *

Strong

Continue →

7. IMPLEMENTATION





tools and online platforms improve efficiency and sustainability in construction supply chains.

3. IEEE, IEEE Xplore Digital Library. Available: <https://ieeexplore.ieee.org>, Source for research papers and technical studies related to AI, IoT, and digital systems.

4. Google Scholar. Available: <https://scholar.google.com>, Used for exploring academic papers and related research work.

8. FUTURE SCOPE

The proposed platform can be enhanced by integrating advanced AI models for demand forecasting, dynamic pricing, and material quality assessment. Future developments may include mobile application support, blockchain-based transaction verification, and IoT integration for real-time inventory tracking. The system can also be expanded to support large-scale construction projects and smart city initiatives, further promoting sustainable and efficient resource management in the construction industry.

8. CONCLUSIONS

The proposed system provides a smart solution for construction material management using an AI-based e-commerce platform. It helps reduce material wastage, lower costs, and improve procurement efficiency. By promoting reuse and enabling intelligent decision-making, the system supports sustainable and efficient construction practices, with strong potential for future enhancements.

9. ACKNOWLEDGEMENT

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10. REFERENCES

1. "A Trustworthy Digital Marketplace for Second-Hand Construction Materials," 2023, This work discusses the use of blockchain technology to create secure and transparent platforms for trading reused construction materials.
2. "Digital Technologies for Sustainable Construction Supply Chains," 2024, This paper explains how digital