Artificial Intelligence, Cloud Computing and Blockchain Integration for Automation in Building Construction and Construction Procurement Process

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***Abstract*—The construction industry globally runs more manually even if the technology is advancing. There are many evolving technologies which can be used to bring revolution to the construction field.The proposed system replaces manual procurement workflows with Agentic AI which is used to ease the process of procurement, negotiation, managing contracts, weather forecast for material's safety, risk models and owner's settlement preferences, guidance in the fields like Plumbing, Carpentry and Electrical in place of Contractor and Sub-Contractor, Cloud Computing to store construction data which contains data like preference, site, estimate, works pending and accomplished and weather data along with Blockchain for transactions and barter system integration. AI Hub can be used to centralize information which will be provided to AI Agents to reduce conflict. This research advances automation in construction by the proposed Agentic AI–Blockchain–Cloud procurement model that reduces the remarkable time of procurement cycle compared to traditional methods and enables barter settlements without disputes. Unlike prior studies that uses AI, Blockchain, or cloud separately, this paper integrates them into a unified procurement ecosystem and introduces barter settlements as a novel payment mode in construction management.**

***Index Terms*—Agentic AI, AI Agents, Cloud Computing, Blockchain, Construction Automation**

I. INTRODUCTION

Construction field globally is suffering a lot due to the incompletion of a project on time and not finding a good deal in building materials. Builders/Project owners generally hire contractors for procurement of building materials still result closing a bad deal. Most of the work is dependent on contractors and sub-contractors due to which builders are facing difficulties, trust issues and bad quality building materials. It is quite challenging for them to manage all the things by themselves. They have to look after Contractors and Sub-Contractors even if there exist technologies which can perform the same work more efficiently and effectively and most importantly on time due to unavailability of application of such advanced technologies in this field. There are multiple sites under one Builder/Project Owner so for each site they have to assign workforce and managers and have to spend lot of money just to keep track of work and guide workers. In procurement also contractors' scams builders in multiple ways resulting in bad quality construction and reducing reputation of the company or Builder/Project Owner.

Retailers or Suppliers of Building Materials are also tired of delays in payments even after the delivery of materials on time. They have to wait for months and in some cases even years to get the payment resulting in debt as they have no capital remained for the business. There are also cases of no payment for long time intentionally and then suppliers have to take legal actions against them. This problem can also be solved using advanced technologies like Blockchain which provides smart contracts which can also be used for Barter system. Barter system means the builder/supplier will give house or shops in return to the payment of Building materials. They can also negotiate with the builders easily as the mediators will be removed with the evolving technologies.

II. LITERATURE REVIEW

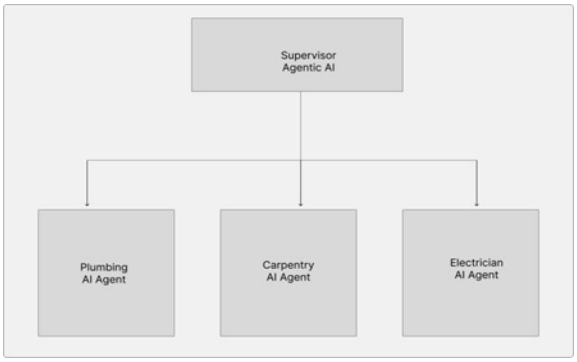
Many previous research works are done before for integrating multiple technologies including AI, Cloud Computing and Blockchain to do advancement in the construction and procurement process but the novelty of this paper is the integration of all the technologies and build a unified platform which will fulfill all the requirements of the Builders/Project Owners in the

best way possible.Artificial Intelligence (AI) in construction project management is revolutionizing the industry; offering innovative solutions to enhance efficiency, reduce costs, and improve decision making. This structured literature review explored the current applications, benefits, challenges, and future trends of AI in construction project management. [1] The primary focus of current AI research in this field centers on safety monitoring and control, as well as process management. Key technologies such as machine learning, computer vision, and natural language processing are prominent, with significant attention given to the development of smart construction sites. [2] The construction sector is confronted with significant challenges, such as reduced productivity, high injury rates, and labor deficits, driving research into autonomous robotics as a viable solution. A comprehensive overview of recent technological advancements, providing valuable guidance to researchers and practitioners on the design, implementation strategies, and adaptation concerns of autonomous construction robotics, thus fostering further innovation and practical applications.[3] Special concerns have been put on six hot research topics that amply the advantage of AI in CEM, including (i) knowledge representation and reasoning, (ii) information fusion, (iii) computer vision, (iv) natural language processing, (v) intelligence optimization, and (vi) process mining. The goal of these topics is to model, predict, and optimize issues in a data-driven manner throughout the whole life cycle of the actual complex project. [4] Artificial Intelligence (AI) has emerged as a catalytic force, poised to redefine every phase of the construction life-cycle—from conceptual design and planning to on-site execution, project management, and post-construction facility optimization. While existing literature has explored discrete AI applications in construction, such as robotic automation or predictive analytics, few studies provide a holistic synthesis of AI's transformative potential across the industry's interconnected domains.[5] Although the construction industry is well placed to leverage these technologies for competitive and operational advantage, the diffusion of the technologies in the industry follows a steep curve.[6] A cross-sectional survey of 72 professionals from various construction firms was performed, and data were analyzed using t-test, exploratory factor analysis (EFA), and partial least squares-structural equation modelling. PLS-SEM) and artificial neural networks (ANN).The results highlight that addressing data security, technical capacity, and cost-related constraints is important to improving CC incorporation and advancing sustainability goals in Saudi Arabia's construction industry.[7] The application of specific engineering examples is verified to realize the integration, sharing and service of the information model of water conservancy and Hydro-power Engineering in each stage. The research results show that the scheme can realize the transmission and sharing of BIM data of all participants in the project in the distributed environment based on cloud computing, which provides the ownership management.[8] A key highlight of the findings is that cloud computing is an innovation delivery enabler for other emerging technologies (building information modelling, internet of things, virtual reality, augmented reality, big data analytics) in the construction industry.[9] Blockchain Technology (BT) enhances transparency, efficiency, and trust in information sharing through its decentralized, encrypted ledger system.[10] Building services are a major element in construction projects, and the adoption of technology in the procurement and management of building services systems is critical. There is limited research in this area hence it creates a knowledge gap on how digital technologies can solve issues related to P&M of building services. [11] Changes propagate fast and are updated in seconds or minutes in the distributed ledger, making ledger tracking easy. This is because there are no involvements of intermediaries in the Blockchain. [12] The data blocks cannot be changed or deleted by a single actor upon gathering in a chain. No single party or intermediary manages the data, and all parties can see the entire data infrastructure. Each transaction is "permission-less" within the public Blockchain, and users can remain anonymous.[13] DLT will affect business models within organizations and organizational structures will change as viable alternatives to traditional methods of practice become available.[14] Builders can register their sites adding required list of materials and that construction site will get pinned on map which Retailers can view. Retailers can provide estimates in PDF format navigating nearby sites on map with real-time email service. Builders can add or remove sites whenever required and similarly Retailers can add or remove Estimate

Data.Findings highlight the potential to connect Builders directly with Retailers which will streamline the procurement process and it will result into best quality construction and will improve Builder-Retailer relationship. [15]

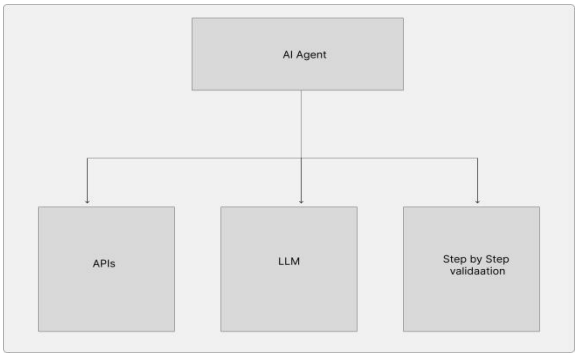
III. RESEARCH METHODOLOGY

Agentic AI for Construction Sites in place of Contractors can manage multiple tasks more easily and efficiently including negotiating and procurement. It is basically a group of Ai Agents which will work together to make process easier, manageable and efficient. All the agents communicate with each other validating and understanding the situation step by step and providing proper information or suggestions also (Figure: Agentic AI).



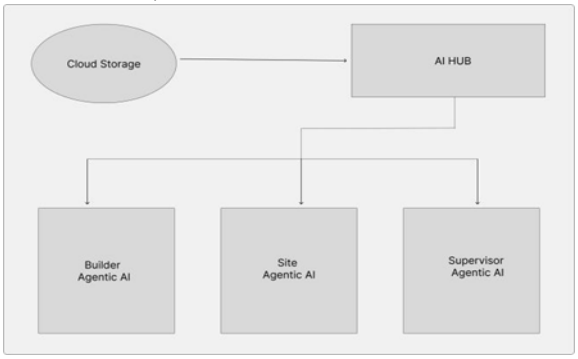
Construction Site Agentic AI will negotiate with the Suppliers/Retailers about the pricing using the current rates going on in the market, analysing the other estimates received by the suppliers, reputation of the specific retailer/supplier and may other parameters to close the deal at the best price and best quality of building materials. It will be open to the dynamic environment that means the builder can provide instruction to the AI to make conversation or negotiation more effective.

A Builder Agentic AI which will work as a Builder/Project Owner's personal assistant which keeps all the details about the site, estimates, finalized list of materials, payment method, workforce details, work completed, work pending, remainders, and all the necessary data. It will save a remarkable time of builder as information will be fetched by a simple prompt. It will analyse all the data by itself and providede information and instructions to the builders/project owners. Ex. If materials are going to be received on a particular site, then it will automatically check the weather and will update builder about the rain prediction if the rainfall is predicted so that necessary arrangements can be made or delivery will be delayed which will save building materials from getting damaged. (Figure: AI Agents)



A dashboard will be provided where all the data will be analyzed by AI and shown in graphical format which will improve builder's decision-making capability. A Field Agentic AI will be provided to provide assistance to the workers and supervisor in specialized tasks like plumbing, carpentry and electrician work. Dashboard will show all the data with site filters so that builder will get updates about each and every activity going on at a same place in an effective way. Supervisor profile is included to keep track of field work going on and managing the workforce and taking attendance.

All the data will be stored in Cloud using cloud computing as the amount of data will be in large quantity and will require adequate amount of memory to store. It will act as a data warehouse. AI Hub can pool a required amount of data needed to feed Agents of Agentic AI to produce appropriate and meaningful output during conversation using LLM and API data by step-by-step evaluation. It will act as a centralized data center for all the Agentic AIs. (Figure: Centralization).



Blockchain will play an important role in procurement process during transaction phase. Blockchain is a

decentralized distributed ledger which will help to perform transaction in Cryptocurrency and smart contracts which makes it faster, efficient and more secure using hashing technique and consensus algorithm. It is also used to do hybrid payments like half crypto and half using barter or other payments like this. Supervisor plays an important role in smart contracts to fulfil the conditions like all the building materials are received and there is no damage or faulty product to perform transaction automatically via Blockchain.

Component	Role	Functions	Integration
Agentic AI	Acts as intelligent personal assistant for builders and supervisors	1. Negotiates with suppliers 2. Assists Builders 3. Supports field tasks 4. Provides Dashboards	AI Hub, pulls data from Clou data warehouse
Cloud-Computing	Acts as data warehouse	Stores all the data of the sites, estimates and all the data of the Agentic AI.	Supplies necessary data to the AI Hub so that it can centralize data between all the Agentic AIs.
Blockchain	Secures transactions and payments	1. Smart Contracts 2. Hybrid Payments 3. (Crypto + Barter) 4. No intermediaries	Supervisor confirmation for smart contracts otherwise Builder or Builder's Agentic AI.

IV. CONCLUSION

It will automate the whole Building Construction and Construction Procurement process. Agentic AI, Cloud-Computing and Blockchain are the technologies which will be integrated to automate the whole process which reduces human intervention. There are many research papers available based on AI-only, Cloud-only or Blockchain-only advancements but we must need to integrate all these technologies to get better outcomes. In a nutshell, using such evolving technologies, we can bring revolution to the construction field as it enables autonomous decision-making and enhances real-time responsiveness via AI Agents.

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