OPTIMIZATION OF THE BIDDING AND MANAGEMENT PROCESS FOR ARCHITECTURAL WORKS WITH BLOCKCHAIN

Analysis of opportunity and implementation DF

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Problem

The physical and temporal scale of architectural projects makes it unfeasible to iterate the entire project at full scale, necessitating the use of simplified models of reality to design and execute them. Over time, these models and their representations have improved, focusing on construction systems, comfort optimization, management optimization, or spatial representation. However, the poetic and sculptural conception of architecture can sometimes lead to situations where technical and management solutions are perfectly implemented, but the project's intent is poorly received by users, potentially transforming the entire investment into a loss.

Examples of Problems

This problem exists in both public and private sectors, but it is crucial to improve this process in the public sector as it uses taxpayer money, and optimizing the use of these resources is paramount.

In the public sector, three scales are identified where this problem exists. At a small scale, for example, improving a room in a public space, the quick execution of such work makes opening a bid for multiple suppliers cumbersome, leading to simplified selection processes that result in non-transparent and suboptimal technical and financial choices. At a medium scale, notable processes at an urban level but not extending beyond an electoral cycle are considered, like the case in Uruguay where benches were built in Montevideo's historic district, leading to immediate complaints from residents after installation. The best example at a larger scale is the Odebrecht case, a multi-billion dollar scandal of incomplete works and lack of transparency that destabilized governments and halted regional development.

Hypothesis

We can create a system that implements 3D visualization and blockchain to improve the selection process for construction options, supplier selection, and project tracking.

Note: This document assumes that the 3D visualization platform is already implemented and functional. This aspect will not be covered here.

Background

The use of digital methods for architectural representation has been present for several decades. Relevant projects for this research include those that utilize digital methods for architectural representation, combining architecture, 3D design, and software development to advance from high-risk simulations to forensic applications. Adding a layer of blockchain technology can further enhance these systems.

Market Size

"The real estate investment will reach three billion dollars in 2022. There are two million square meters under construction or about to be constructed in Montevideo and Maldonado."
Source

"An investment of 905 million dollars in road works for 2022 has been announced, covering 7,622 kilometers of a national network of 8,833 kilometers. 81% of national routes will have works in progress during this period."
Source

These notes indicate a total estimated investment of 4 billion dollars for 2022, just for road works and real estate investment. Globally, the number increases exponentially, with an estimated global investment of 2.9 trillion dollars in 2023 for sectors such as energy, telecommunications, airports, seaports, railways, roads, and water infrastructure.

Value Proposition

The value proposition focuses on the implementation of blockchain over the visualization platform, without delving into the value proposition of the visualization platform itself.

1. Enable several users with technical capability to present design options via “Soulbound NFTs.”
2. Enable voting by users affected by the project via “Soulbound NFTs,” allowing both design and supplier selection.
3. Enable people to invest in the project through tokens, improving the project’s budget.
4. Keeping the design selection process on the blockchain increases transparency for future audits.
5. Repeat the process for supplier selection after design selection.
6. Smart contracts enable small-scale works to be open for bidding, and if no bids are received within a set timeframe, a specific supplier is chosen.
7. Blockchain payments improve transparency by tracking money movements at all times.
8. Once a supplier is chosen, project progress can be monitored on the blockchain for transparent and immutable tracking, allowing external auditors to follow the project step by step.

Justification of Technological Choice

Implementing blockchain allows direct connection between stakeholders, providing immutability at every step, extreme flexibility for case-by-case scenarios, and fast, secure transactions.

Competitor Analysis

	BimChain	**DigiBuild**	**Builderchain**
Industry	BIM Modeling	Construction Management	Construction Fintech
Opportunity Description	Centralizes legal contracts based on BIM models, offering a clear contrast with reality compared to traditional legal text.	Centralizes construction management processes.	Centralizes suppliers and enables automatic payments.
Blockchain Network	Not specified	Not specified	Not specified
Justification Description	Provides traceability and reduces the need for paper, centralizing all legal aspects within the BIM model.	Automates search, tracking, and management of materials and personnel, reducing hours spent on these tasks.	Facilitates participation of organizations of all sizes in the fourth industrial revolution.

Conclusion on Competitors

Neither DigiBuild nor Builderchain provides clear information for studying and comparing their solutions. However, DigiBuild is more prominent in the media and is part of the YCombinator platform, having secured 4 million dollars in investments in 2022. BimChain presents its information clearly and effectively, making DigiBuild the main competitor with a primary market in the USA.

Solution

This project aims to optimize design decisions for architectural or urban problems using state funds. The solution focuses on three key pillars:

1. **Increase the number of options presented for architectural or urban problems:** Allow anyone capable of generating a design to present their proposal, ensuring the viability of the proposal.
    - Implement a “Soulbound NFT” solution for involved parties with basic technical knowledge to enable them to generate a proposal. Interested parties can take a test and receive the “Soulbound NFT” (architects, students, etc.).
    - Implement a SmartContract with the minimum design proposal requirements.
    - Implement training for platform use (basic blockchain notions, wallet creation, withdrawal methods).
    - Implement a SmartContract with this stage’s behavior (time, quantities, etc.).
2. **Improve the quantity and quality of participation from those affected by the project:** Ensure that all interested parties can voice their opinions on state-funded projects, especially if directly affected.
    - Implement a “Soulbound NFT” solution for affected parties to enable them to voice their opinions and influence supplier selection. Interested parties can take a test and receive the “Soulbound NFT.”
    - Implement a SmartContract with the minimum feedback requirements for each design option.
    - Implement a SmartContract for voting.
    - Implement a SmartContract for adjudication.
3. **Increase transparency in the project execution process:** Allow all capable companies to present their budget proposals, ensuring that every design modification, payment, and decision is recorded on the blockchain.
    - Implement a “Soulbound NFT” solution for capable parties to present their budgets.
    - Implement a SmartContract for payments.
    - Implement a SmartContract for design modifications.

SWOT Analysis for the Solution

Strengths:

- Reliable and consolidated information source.
- Transparency of actors, materials, and costs.
- Possibility of feedback from affected parties.

Weaknesses:

- Dependence on individuals to register various events (asset receipt, etc.).
- Need for education of non-technologically fluent parties.
- Transaction costs may reduce interaction from project-affected parties (neighbors).
- Managing supplier selection when the voting result is not technically or financially viable.

Opportunities:

- Empower small producers by certifying their products.
- Reduce fraud in supplier selection.
- Reduce selection and payment times for executing parties.

Threats:

- Presence of solutions and competitors.

Comparative Technological Analysis

This work proposes using a public blockchain protocol to access an open and transparent network, allowing any construction industry actor (architect, neighbor, government entity, or builder) to offer their services and have a voice in the process.

The proposed protocol is Ethereum due to its extensive network, with transaction costs serving as a conscientious interaction method.

	Ethereum	**Solana**	**Hyperledger Besu**
Public	Yes	Yes	No
Private	Yes	No	Yes
Open source	Yes	Yes	Yes
Processing (tx)	15	50,000	-
Confirmations	5 min	75 sec	Instantaneous
Costs (USD)	10-50	0.00001	0