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APPLICATION OF SOULBOUND TOKENS FOR DECENTRALISED AUTONOMOUS ORGANIZATIONS IN ARCHITECTURE

Mariia Deinega[1], Theodoros Dounas[2, 3], Daniel Hall[1], Hico McDonald[3]
Simon Prokop[3, 4], and Jiri Vele[3, 4]
[1]Technical University of Delft, Delft, Netherlands
[2]Heriot Watt University, Edinburgh, Scotland
[3]Architecture Decentralised Autonomous Organisation, ArchiDAO
[4]Czech Technical University of Prague, Czech Republic

Abstract

Decentralized project delivery in architecture faces challenges related to transparency, accountability, and role definition. This paper explores the application of Soulbound Tokens (SBTs) as a governance and record-keeping mechanism within decentralized autonomous organizations (DAOs). Using a systematic review of practice, the paper identifies five opportunities for SBTs, proposes an operating framework for SBTs with respect to record-keeping (e.g., skills, contributions) and project governance (e.g, voting power, reputation), and describes one case of technical implementation of SBTs. Future research can improve this technical implementation or develop additional decentralised applications for SBT skills verification and governance mechanisms.

Introduction

When project organizations in architecture, engineering and construction take on a highly distributed form, such as the case with decentralized project delivery (DPD) models, they can face significant challenges in maintaining trust (Hunhevicz, 2024; Papathanasiou, 2024). The lack of consistent information about team members and the variability in standards of contribution can undermine confidence, hinder collaboration, and compromise the quality of decision-making processes.

This is a problem because effective decision-making in project delivery processes involving multiple stakeholders relies on several critical factors, including defined roles, transparency, and accountability for members' skills. Clearly stated roles and responsibilities not only improve the efficiency of collaboration but also ensure accountability within project teams, fostering a structured and goal-oriented approach to task management (Kirytopoulos et al., 2010). Moreover, reliable and trustworthy data about members' skills enables tasks to be allocated to the most qualified individuals, leading to more informed decisions and superior project outcomes. Transparency in information sharing plays a pivotal role in building trust within teams, as it aligns expectations and reinforces mutual confidence in members' contributions. This trust extends beyond transactional relationships, encompassing personal beliefs and shared commitments that strengthen team cohesion.

Against this backdrop, architectural designers are currently experimenting with implementation of decentralized models and web3. One of the examples is the formation of the Architecture Decentralised Autonomous Organisation (ArchiDAO), which is an architecture studio which runs via smart contracts on the Ethereum blockchain (Dounas, 2022). Recent observations within the ArchiDAO project highlight the necessity of clearly defined roles and responsibilities, as well as the need for enhanced transparency and accountability among members (Papathanasiou, 2024).

To address these challenges, Soulbound Tokens (SBTs), offer a potential solution by providing immutable and verifiable records of skills, contributions, and roles. Such systems enhance transparency and trust within decentralized teams, creating a robust framework for effective and equitable decision-making (Pirani et al., 2023) within decentralized governance systems.

While research has explored the integration of SBTs in other fields, there remains a significant gap in practical guidelines for their application in a team project delivery with a complex workflow such as the architectural design process. The aim of this paper is to propose a comprehensive framework for integrating SBTs into decentralized architecture projects.

To do this, the paper conducts a systematic review of practice, develops an operating framework for SBTs, and describes the case of one technical implementation from ArchiDAO. Although the primary context is the field of architecture, the proposed approach is adaptable and can be generalized for application in other engineering or design sectors with similar workflow dynamics.

Background

Decentralised Autonomous Organisation (DAO)

DAO is a blockchain-powered organisation that can run on its own without any central authority or management hierarchy (Wang et al., 2019). DAOs aim to decentralize project management and foster collaboration through blockchain technology.

Key aspects of a DAO include (Pohl, et al., 2022):

- Governance: Democratic decision-making mechanisms.
- Task management: Distributed and task-based structures.
- Collaboration: Transparent, community-driven workflows.

In the field of architecture, there have been attempts at using DAOs to coordinate design projects. However, these attempts suffer from several challenges, such as a lack of reliable systems for skill verification, difficulty in tracking contributions and assigning credit fairly, limited tools for fostering long-term member engagement, and limited tooling for developing and operating the DAOs themselves (Papathanasiou, 2024).

SBT

Soulbound Tokens (SBTs) are permanent, non-transferable digital assets that represent credentials, skills, and achievements. Unlike non-fungible tokens (NFTs) (Dounas, 2021), SBTs serve as immutable records tied to an individual's identity (wallet or so called 'Souls'), and can not be bought, sold or traded. SBTs can represent different parts of an individual's life, for instance, work experience or medical records. Meanwhile, SBTs can also be issued by other Souls as part of a relationship between them: a university could issue SBTs to its graduates, reflecting their educational achievements and credentials (Ohlhaver et al., 2022).

There are three key characteristics of SBTs:

1. **Permanence.** SBTs are immutable and tied to the user's wallet.
2. **Non-Transferability**. SBTs cannot be sold or traded, ensuring authenticity.
3. **Versatility.** SBTs can represent affiliations, commitments or other personal attributes or characteristics of the wallet holder.

Despite their potential, SBTs face challenges such as legal ambiguities, privacy challenges, scalability concerns, and limited adoption in real-world applications.

Methodology

This study is done in three parts. First, a systematic review of practice analyzes the strengths and weaknesses for current applications of SBTs in DAOs. Based on a systematic overview of available DAO Tooling (Alchemy, 2025), the researchers categorized the purposes of such tools into categories. The results of the assessment can be found online (Arlav, 2025). The following five categories of tools needed to build DAOs were identified (see Table 1):

1. Tools that provide incentives,
2. Tools that track identity,
3. Tools for workflow/project management,
4. Tools for governance,
5. Tools for additional functionality (e.x. funds, dispute resolution.

Table 1: Overview of DAO Tools

Incentives	33 tools
Identity	25 tools
Workflow/Project Management	34 tools
Governance	29 tools
Additional Functionality	26 tools

To illustrate the implementation of each of these tooling categories, and their relationship to SBTs in decentralised workflows, the findings present five exemplary DAO tools (Coordinape, Proof of Humanity, Snapshot, Fabric and Injunctive), one representing each of the categories. These use cases were not specific to the context of the built environment. The selection aimed to explore different functional roles of SBTs beyond the built environment, providing transferable insights for their integration into Architecture DAOs. Each case study presents a unique perspective on how SBTs contribute to trust-building, decision-making, and verification processes, which are key challenges in decentralized project delivery. The review of practice assessed each SBT and its specific features, strengths, and limitations.

Second, from this review and in consideration of the unique characteristics of the built environment, the paper conceptualizes the approach needed for SBTs in architecture. First, the specific identified opportunities for SBTs are identified from the systematic review. Then, these are combined into a conceptual operating framework in consideration of the timeline and workflow associated with SBT implementation and requirements for use in architecture DAOs.

Third, the paper describes the implementation of SBTs in the case of ArchiDAO, including the technical setup and preliminary observations from the implementation. ArchiDAO was first created in December 2022, by a group of architects and engineers which were active in researching and developing blockchain smart contracts for use in AEC. The core group then consisted of nice people who had various roles in the organisation, from developing its strategy to developing its social media presence.

Findings

Review of practice

Incentives category: Coordinape is a DAO tool that enables efficient task assignment and rewards distribution among DAO contributors by allowing them to autonomously allocate funds to each other based on perceived contribution value. This method fosters a collaborative environment where all members have a say in resource distribution (Coordinape, 2025).

- Strengths: Promotes equitable distribution of rewards and enhances peer-to-peer collaboration within DAOs.
- Weaknesses: Relies heavily on the collective judgment of community members, which can introduce biases or unequal recognition of contributions.

Identity category: Proof of Humanity (PoH) is a decentralized protocol that verifies the uniqueness of identities for use in DAOs and other blockchain ecosystems. It creates a Soulbounded ID of unique human participants using peer verification and video submissions. This tool belongs to the second group that helps to track identity.

- Strengths:The use of SBTs as immutable fraud markers enhances transparency and decentralized compliance, discouraging further misuse. It is particularly important nowadays, as it helps to distinguish humans from Artificial Intelligence.
- Weaknesses: The effectiveness relies on widespread recognition and adoption by exchanges and other stakeholders.

Snapshot Voting Power is a DAO governance tool that uses SBTs to allocate voting power based on contributions. This ensures that only active participants influence decision-making processes. This tool represents a governance group (Snapshot, 2025).

- Strengths: Encourages equitable governance by tying voting power to contributions.
- Weaknesses: Requires robust token issuance systems and clear criteria for contribution measurement.

Colony is a comprehensive no-code toolkit for building DAOs, enabling users to create and manage decentralized autonomous organizations without programming knowledge. It simplifies the setup and governance of DAOs, integrating token management and overseeing governance operations seamlessly (Alchemy, 2025). This tool represents the fourth category which helps to create and manage DAO.

- Strengths: Facilitates the quick setup and management of DAOs without coding expertise; streamlines governance and token management processes.
- Weaknesses: Potential limitations in customization due to the no-code environment, possibly restricting unique DAO functionalities.

Fabric is a crowdfunding protocol that operates on blockchain, allowing creators to deploy crowdfunding contracts for pooling capital. If funding goals are met, recipients can withdraw the funds, and if not, contributors can reclaim their deposits. The protocol also permits recipients to reinvest yield back into the contract, which contributors can then withdraw proportionally (Alchemy, 2025). This tool belongs to the category of additional functionality.

- Strengths: Enables verifiable and decentralized crowdfunding, providing flexibility and security for both project creators and contributors.
- Weaknesses: Relies on the achievement of set funding goals for successful disbursement, which may limit funding opportunities for projects with variable capital requirements.

Injunctive is a landmark use case from 2023 where Intelligent Sanctuary (iSanctuary), a London-based financial investigation firm, assisted a businessman defrauded of over $3 million in crypto-assets. Through a swift on-chain investigation, the stolen assets were traced to cold wallets and centralized crypto exchanges (CEXs). The CEXs were immediately notified to prevent dissipation of funds while a freezing order was obtained. The Singapore High Court approved the freezing order and authorized its service via a Soulbound Token (SBT), tokenized by Mintology, an NFT-minting provider. SBT, while not preventing transactions, permanently flagged the wallets associated with fraud, warning counterparties and exchanges of potential legal breaches (Adams, 2024). This "mark of shame" significantly deterred further transactions and served as a compliance mechanism. This case demonstrates how SBTs can enhance legal enforcement in decentralized environments by acting as immutable, visible deterrents to fraudulent activities (Cryptopolitan, 2023).

- Strengths: Effectively reduces sybil attacks in DAOs.
- Weaknesses: High barriers to entry due to the labor-intensive verification process and privacy concerns.

Review of practice

The analysis of these use cases offers several practical insights which Architecture DAOs can apply to the design and implementation of Soulbound Tokens:

1. Fostering transparency and accountability: Use case Snapshot highlights the potential of SBTs to provide a transparent, immutable record of contributions. Architecture DAOs can implement SBTs to create verifiable participation logs, ensuring accountability in project collaboration and governance.
2. Strengthening governance through reputation-based mechanisms: Snapshot demonstrates the utility of reputation-weighted voting systems. Architecture DAOs can adopt similar mechanisms where voting power correlates with verified contributions, promoting fairer decision-making processes.
3. Facilitating identity verification: protocols like Proof of Humanity (PoH) underscore the importance of verified identities in decentralized ecosystems. Architecture DAOs can integrate

SBTs to verify member credentials and prevent sybil attacks, enhancing trust within the organization.

4. Enhancing compliance: The injunctive use case from the Singapore High Court shows how SBTs can be employed as compliance tools. Architecture DAOs might explore using SBTs to flag rule violations or enforce project agreements, discouraging malpractice and reinforcing organizational integrity.
5. Streamlining task allocation: By adopting practices from platforms like TalentLayer, Architecture DAOs can issue SBTs that certify member skills and expertise, ensuring that tasks are allocated efficiently to qualified contributors. This reduces ambiguity and improves project outcomes.

However, the review (Arlav, 2025) highlighted the lack of an important tool for the Architecture DAO: a tool that helps to keep the record of the skills and competences of a member.

Conceptual Framework of SBTs for Architecture DAOs

Based on the review of practice and problems, the design of a SBT for an Architecture DAO should have the following capabilities: Record-keeping and Governance.

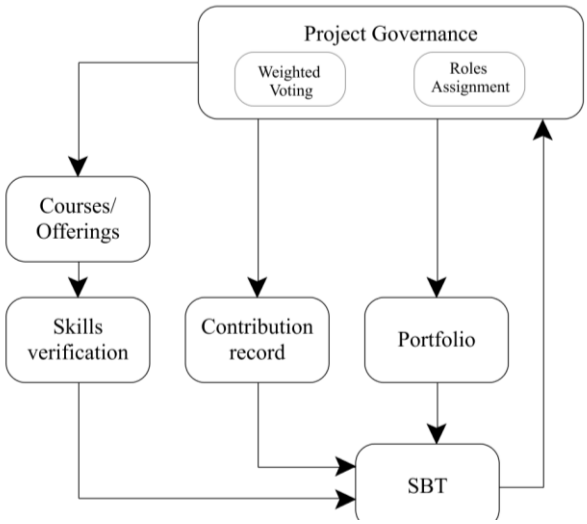

Figure 1: SBT Operating Framework

Record-keeping with SBTs

The first purpose of a SBT for Architecture is record keeping. Record-keeping serves the purpose of tracking and documenting skills, projects, and contributions of members. The key areas of application of such SBTs would be:

- Skill Verification: SBTs represent members' verified skills, such as architectural design, parametric modeling, coding etc. SBTs issued upon verification of skills or completion of skill-based tasks (e.g., “Urban Design Specialist” or “3D Visualization Expert”).
- Contribution Records: SBTs serve as immutable records of members' completed projects, specific tasks, or milestones. SBTs awarded for participation in projects (“Sustainable Housing Project Contributor”).
- Professional Portfolio: These tokens collectively act as a transparent, on-chain portfolio, showcasing a member's history within ArchiDAO.

The implementation of record-keeping SBT’s can be justified by the following benefits:

- Provides a reliable and transparent system for recognizing contributions.
- Helps with task delegation by identifying members with specific expertise.
- Builds trust within the DAO by showcasing verifiable participation and skills.

Governance with SBTs

The second purpose of SBTs in architecture DAOs is to assist with decentralised project governance (Hunhevicz et al., 2024). Governance refers to the purpose of facilitating voting and decision-making within Architecture DAOs. The key areas of application of such SBTs would be:

- Reputation-Weighted Voting: Voting power is linked to the governance SBTs held by a member. These tokens reflect contributions, roles, or tenure in the DAO (Dounas, 2022). For example: SBTs issued based on member contributions to ArchiDAO's operations or specific projects.
- Project-Specific Governance: Governance SBTs can be issued for specific projects or initiatives, enabling members directly involved in those efforts to have a stronger influence on related decisions. For example: SBTs that grant members eligibility for governance roles, such as committee leaders or project managers.

The implementation of governance SBT’s can be justified by the following benefits:

- Ensures governance power is distributed equitably based on contributions.
- Prevents vote-buying or influence manipulation.
- Encourages active participation in ArchiDAO's decision-making processes.

SBT Implementation Case by ArchiDAO

Motivation

In 2021, a concentration of effort was made in developing a protocol for collaboration and for creating an equitable, bottom-up decision-making structure and token smart contract that would allow the recording and execution of decisions, but also act as a kind of competence record, in

the same manner that an architecture professional licence would in certain countries. The initial buoyancy of the blockchain market and a philosophical and organisational approach to making ArchiDAO as open and as decentralised as possible, gave rise to several decisions on how the organisation would operate, in as much as a decentralised, i.e permissionless way possible. As such the ArchiDAO developers turned towards creating a non-fungible token that would act as the identity of the members, which with the rise of Soul-bound tokens would solve many of the challenges existing in space.

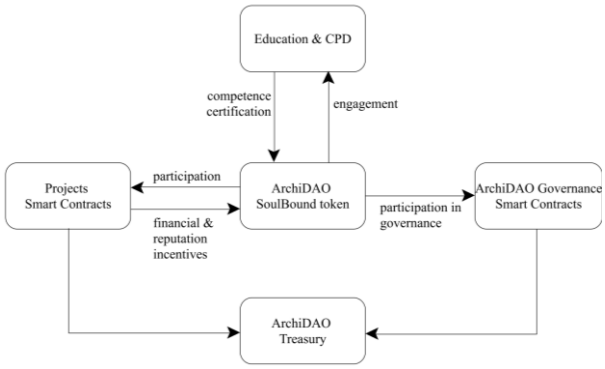

Figure 2: Overall Implementation Approach by ArchiDAO

By integrating SBTs, ArchiDAO aimed to facilitate not only trust among distributed team members, but also to ensure that responsibilities are assigned based on verified competencies, thereby enhancing overall project integrity and output quality. ArchiDAO's deployment of SBTs represents a pioneering step toward establishing a reliable, ethics-driven framework in the digital governance of architectural practices.

Technical Implementation

The technical implementation of Soulbound Tokens (SBTs) for ArchiDAO is built upon two key systems: the Polygon Blockchain and the Polybase Web3 Database (Figure 3). While the Polygon Blockchain ensures immutability, security, and decentralization of SBTs, Polybase provides a flexible, updatable storage solution for evolving records. Unlike traditional blockchain storage, where any modification requires burning and reissuing a new token, Polybase enables updates to existing records while maintaining the same soulbound identity. This feature is particularly crucial for SBTs related to skills development, as competencies continuously evolve over time. By integrating these two systems, ArchiDAO ensures that members' credentials, expertise, and contributions remain verifiable, updatable, and permanently tied to their identity without compromising security or decentralization. This architecture also avoids having to re-issue a token once it gets updated, as it would happen if archiDAO only used an ERC721 contract.

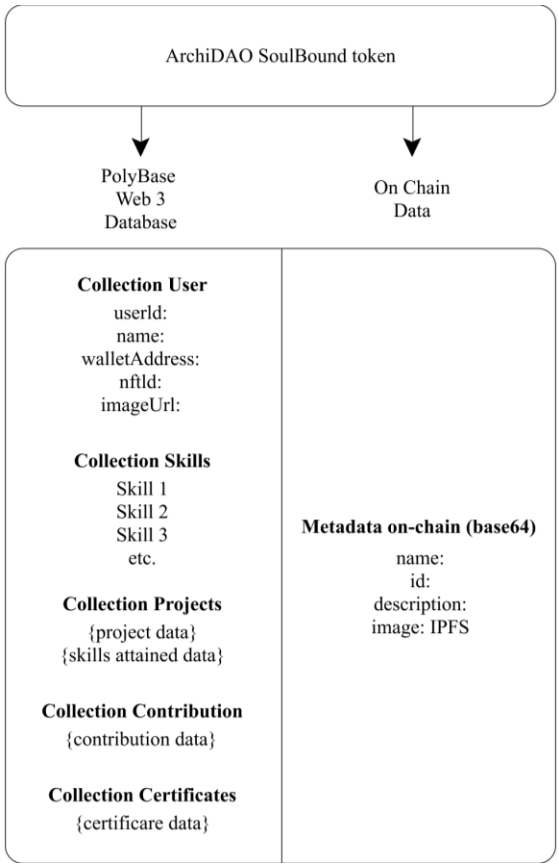

Figure 3: SBT Technical Implementation

Other technical components that ensure that each SBT can be securely created, uniquely identified, and managed within the ArchiDAO ecosystem:design and implementation of Soulbound Tokens:

1. ERC721 Standard: The code begins by importing `ERC721.sol` from OpenZeppelin, which is a standard for creating non-fungible tokens (NFTs). This standard is crucial because SBTs share many properties with NFTs, such as uniqueness and ownership. It also ensures that the token is secure by using a well-tested implementation.
2. Ownable Contract: The `Ownable.sol` import adds an ownership control mechanism, allowing certain functions to be restricted to the owner of the contract. This is vital for administrative tasks and secure management of DAO's operations.
3. URI Storage: The `ERC721URIStorage.sol` import provides methods to store and manage URI links for NFTs. In the context of SBTs, this allows each token to have a unique identifier that links to additional information about the token's attributes or the achievements it represents.
4. Utility Libraries: Imports such as `Counters.sol`, `Strings.sol`, and `Base64.sol` provide additional utility

functions for managing token indices, string manipulations, and encoding data respectively.

These tools are essential for handling the complexities of token management within the blockchain environment.

Discussion

Alignment between case implementation and review

ArchiDAO's implementation of Soulbound Tokens mostly aligns with the insights drawn from the broader systematic review of DAO tools and SBT applications in practice. By integrating on-chain identity, skill tracking, and reputation-based governance, ArchiDAO tries to address many of the core needs identified—namely ensuring trust, transparency, and verifiable skill sets among its contributors. Similar to Snapshot, ArchiDAO leverages SBTs to tie voting rights to individuals' proven contributions rather than mere token ownership. Moreover, this approach also resonates with protocols like Proof of Humanity, which seek to establish unique identities. However, ArchiDAO goes beyond most existing DAO tools by specifically thinking about how SBTs might connect to professional licensing concepts within architectural practice. This offers a more specialized use case, illustrating not just verifiability of identity but also credentialing of professional skills—an area that the general-purpose DAO tools have seldom addressed.

Rethinking Licensing in Architecture

The use of SBTs in an architectural context prompts a fundamental question: could these tokens serve as a form of "digital license" in place of traditional professional accreditations? Traditional frameworks rely on professional bodies to verify credentials and ensure ethical practice. SBTs might decentralize this process by storing immutable, non-transferable records of education, training, and project contributions. This would enable a more fluid, global recognition of qualifications, potentially bypassing regional licensure barriers.

Professional and legal qualifications are significant and it is unclear if such a system is desirable. Regulatory bodies play critical roles in safeguarding public welfare, and while SBTs can document credentials and achievements, they do not replace the oversight functions that government bodies or professional associations provide. Consequently, architecture as a profession must work toward creating bridges between decentralized systems and established licensing authorities. This hybrid approach might ensure that SBTs preserve integrity, rigor, and ethics central to architectural practice.

SBT and Governance

By assigning voting power based on verified contributions, ArchiDAO's SBT-driven governance model exemplifies how NFTs can evolve beyond mere collectibles. Traditionally, token-based governance has faced criticism for enabling whales—large token holders—to overshadow smaller stakeholders in decision-making. Linking governance rights to Soulbound Tokens instead promotes a more equitable structure since SBTs are non-transferable and tied to a real track record of work and expertise. In this sense, SBTs occupy the middle ground between identity and reputation, blending the concept of who you are (identity) with the record of what you have done (reputation). Such reputation-weighted voting incentivizes meaningful involvement, as members build their governance influence through tangible contributions, rather than by purchasing tokens on an exchange.

Limitations and Future Research

This paper presented a comprehensive exploration of the application of SBTs within the context of Architecture Decentralized Autonomous Organizations. Through a systematic review of DAO tools and practices, a conceptual operating framework was developed to guide the use of SBTs for record-keeping and governance. The study further illustrated the framework through a case study of ArchiDAO, offering insights into the technical and organizational possibilities of integrating SBTs into decentralized architectural practice.

This paper represents a view into a very early attempt at applying SBTs, and the results should be understood as preliminary. From a technical perspective, several areas for future research have been identified, including the development of privacy-preserving mechanisms such as zero-knowledge proofs to protect sensitive career details, the establishment of performance metrics, trust scores, and quantified efficiency gains, and improvements in scalability as Architecture DAOs grow in both membership and record complexity. Enhancing smart contract standards and building robust API layers that integrate with multiple blockchain networks would also help advance mainstream adoption of SBT-based systems.

From a conceptual standpoint, there are promising opportunities to bridge traditional regulatory structures with decentralized governance models. Before such integration becomes viable, it is likely that an initial period of unregulated, decentralized skills verification will emerge. In this context, the profession must define which authorities, peer groups, or standards bodies have the credibility to issue SBTs for professional skills. Verified senior professionals, for instance, could play a role in granting SBTs to junior colleagues upon the completion of defined milestones.

Importantly, SBTs should not be seen solely as replacements for traditional licenses. They offer the ability to document a broader range of skills, project contributions, and professional achievements, potentially providing a more detailed and dynamic record of competence than conventional certification frameworks. However, SBT systems must be designed to comply with legal requirements across different jurisdictions if they are to be recognized alongside or within institutional accreditation processes. Comparative research is needed to explore how SBTs could operate either as parallel

credentialing systems or be integrated into existing professional infrastructures.

The study also notes that SBTs are compatible with various governance models, including quadratic voting and token-weighted systems. There is, however, no single standardized approach. Governance mechanisms must be adapted based on the specific scale, structure, and needs of each DAO. This necessity for context-driven governance design underscores the flexibility and potential of SBT-based systems, while also pointing to the complexity of their successful implementation.

Conclusion

This paper presented a comprehensive exploration of the integration of Soulbound Tokens within the context of Architecture DAOs. The systematic review highlighted the significant potential for SBTs to redefine governance, accountability, and transparency in decentralized project delivery within an architectural context. By delving into various tools and frameworks, and by presenting a specific case study of the ArchiDAO, the paper is able to illustrate practical implementations and the broader implications of these digital assets.

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