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Innovating DBL Business Models: Tokenomics, Smart Contract SLAs, Decentralised Knowledge Graphs and Smart Oracles

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INTRODUCTION & AIM

The digital transformation of the construction sector remains hindered by fragmented data ecosystems, inconsistent formats, and the absence of trusted mechanisms for exchanging and monetizing building-related information. The Digital Building Logbook (DBL), although central to EU policy, has traditionally functioned as a static repository rather than an active economic infrastructure. BUILDCHAIN addresses this gap by integrating tokenomics, smart contracts, Decentralised Knowledge Graphs (DKGs), and a Decentralized Oracle Network (DON) to create a trustworthy, interoperable, and economically sustainable environment for building-lifecycle data. The aim of this work is to demonstrate how these components collectively enable verifiable, machine-actionable documentation and support new business models for data and services within the built environment.

METHOD

The BUILDCHAIN architecture transforms heterogeneous datasets into semantically enriched Knowledge Assets (KAs) linked through a DKG, enabling discoverability, interoperability, and automated reasoning. External data sources—including environmental and climate data feeds, and market price indices—are validated through a reputation-aware oracle mechanism that ensures integrity, timeliness, and Quality-of-Experience-based trust. Smart contracts govern access control, SLA enforcement, and automated payments, ensuring that service execution and data exchange follow transparent, verifiable rules. A tokenized economic layer supports fungible transactions, unique certified assets, bundled datasets, automated reward distribution, and compliance-ready tokenization for regulated workflows. Business model analysis, including value network mapping and multi-actor canvases, evaluates the sustainability and incentive alignment of the proposed DBL economy. The overview of BUILDCHAIN functionalities is depicted in Fig. 1, while the SLA management and credentials verification is depicted in Fig. 2.

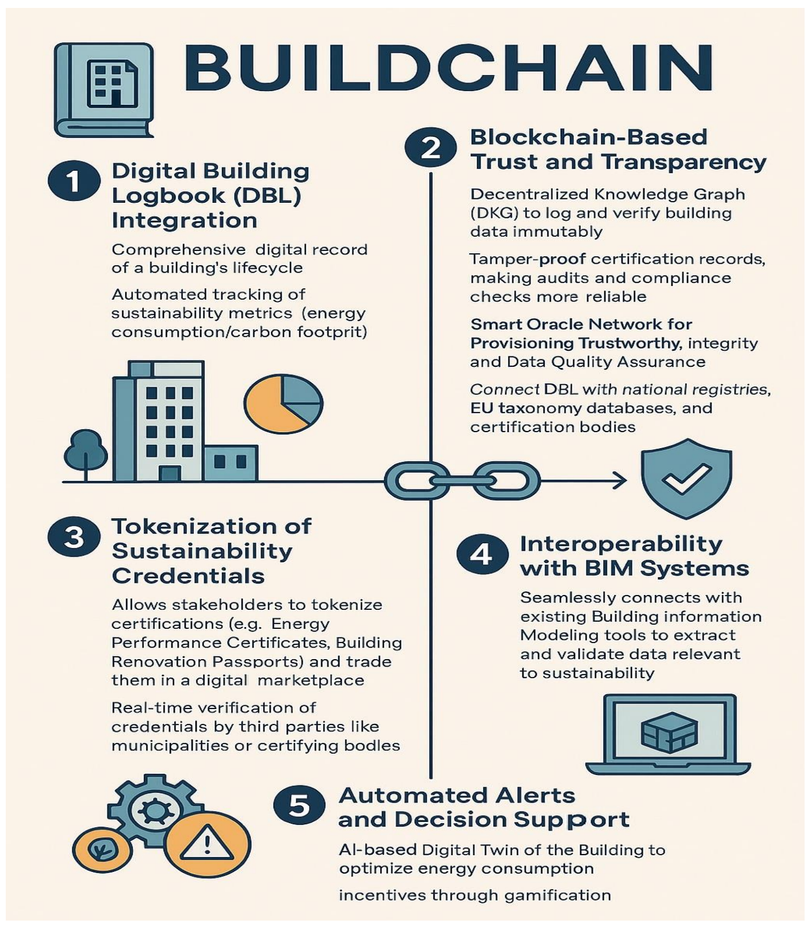

Fig. 1. Overview of BUILDCHAIN functionalities.

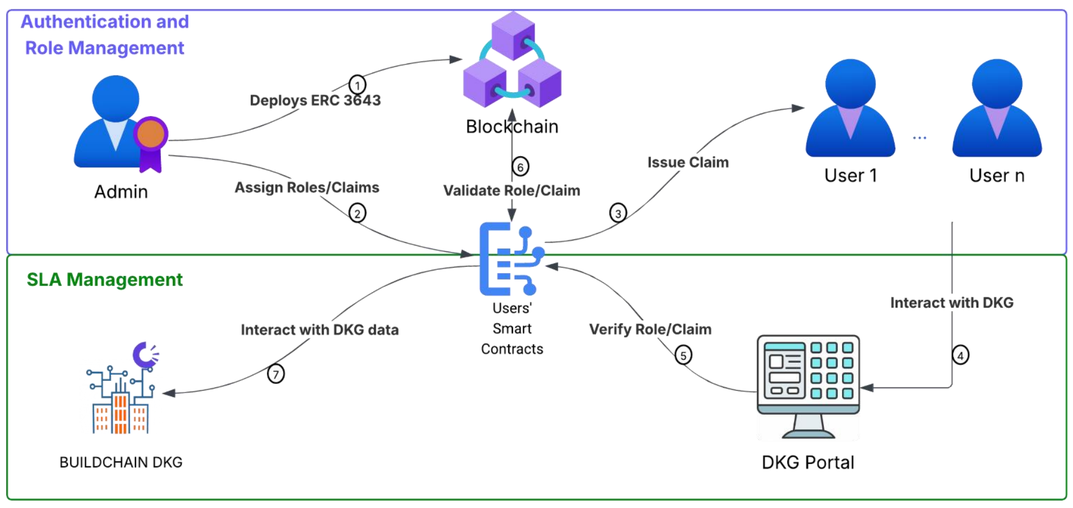

Fig. 2. Context-Aware SLA Management and Role-Based Credential Verification

RESULTS & DISCUSSION

The integration of tokenomics, smart contracts, DKGs, and smart oracles enables three interconnected markets within BUILDCHAIN: a service marketplace for tools operating under subscription-based, usage-based, or hybrid pricing; a data marketplace where building-related datasets can be monetized under verifiable access conditions; and a side market that allows third-party applications to integrate with the DBL, DON, and BIM ecosystem. Digital wallets and token-based remuneration ensure transparent compensation for data providers, tool developers, and oracle operators. Representative scenarios from Construction Economics (UC10) and Energy Efficiency Tool (UC12) illustrate the system's functionality in practice. In UC10, a budgeting tool retrieves DBL project data and DON-verified price indices, executes SLA-bound analytics through smart contracts, and stores results as Knowledge Assets, while certified cost reports are minted as ERC-721 tokens. In UC12, an energy-efficiency management tool accesses DBL building data, acquires real-time weather information through the DON, and performs optimization routines governed by SLA-controlled smart contracts; the resulting performance indicators and recommendations are logged as KAs and can be tokenized for verifiable reporting. Together, these workflows demonstrate how BUILDCHAIN supports traceable, trustworthy, and economically sustainable decision-making across the construction lifecycle, enabling automated governance, transparent remuneration, and high-integrity data flows. The value network of the BUILDCHAIN ecosystem is depicted in Fig. 3.

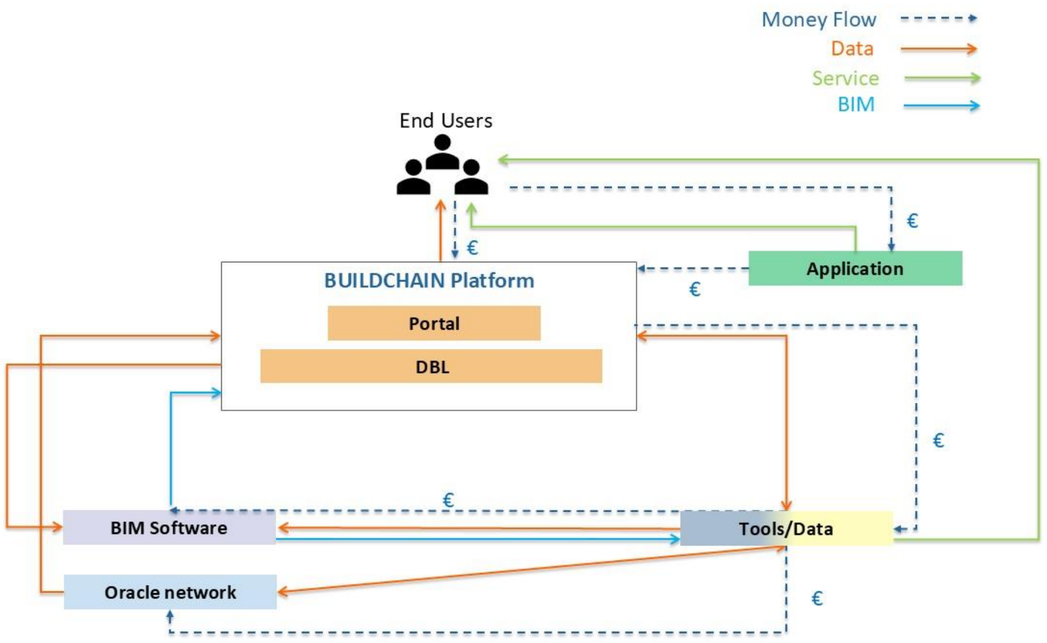

Fig. 3. Value Network of BUILDCHAIN Ecosystem

CONCLUSION

BUILDCHAIN redefines the role of the Digital Building Logbook by transforming it into a dynamic, token-enabled economic infrastructure. Through the combined use of DKGs, smart oracles, smart contracts, and token standards, the platform enables verifiable data flows, automated governance, and sustainable monetization pathways for both services and datasets. This integrated approach enhances transparency, trust, and value creation across the construction value chain, offering a scalable model for digital building ecosystems in Europe and beyond.

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