Blockchain: Leveraging Digital Ledger Technologies to Manage Building Enclosure Performance

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With the increasingly stringent performance targets set for modern building enclosures (LEED, NetZero, Passive House, etc.), it is no longer realistic to expect that traditional building methods and project delivery models alone will help designers and owners attain them.

For many, the implementation of building enclosure commissioning (BECx) as outlined in industry standards such as *ASTM E2947, Standard Guide for Building Enclosure Commissioning,* or the *NIBS Guideline 3-2012, Building Enclosure Commissioning Process BECx* have become an indispensable quality-driven process to attain the project's performance objectives. If implemented successfully, this process could deliver invaluable insight to help owners make business decisions regarding their assets. However, like most construction processes today, it is a system that relies overwhelmingly on human actions or controls and creates a burden of paperwork stored in fragmented repositories.

Moreover, it is also founded on the supposition there is a modicum of trust between parties who are mildly adversarial at best—and downright hostile at the worst of times. As the world enters a fourth industrial revolution and the construction industry strives to modernize itself, the opportunities afforded by new technological advances such as distributed ledger technology (or blockchain) should be explored to uncover previously concealed value streams.

BLOCKCHAIN TECHNOLOGY: A PRIMER (HINT: IT'S NOT ALL ABOUT BITCOIN)

Distributed Ledger Technology (DLT, or blockchain) was first introduced in 2009 by an individual (or group of individuals) under the pseudonym Satoshi Nakamoto.[1] They proposed a new electronic currency (Bitcoin) based on cryptographic proof, instead of trust, to solve the "double-spending problem" that hindered previous attempts at creating reliable electronic currencies.

At its core, blockchain is a mechanism used to store information in a computer database in a persistent and tamper-resistant fashion. The blockchain is a growing list of records ("blocks") that are linked to a set of existing records ("chain") and secured using complex mathematics and cryptography. Each block contains:

- The data stored in it;
- A cryptographic key (or hash function) linked to the previous block; and
- A timestamp.

Unlike traditional database systems, which allow users to create, read, update, or delete records depending on their rights, blockchain data architecture only allows users to either add or view records. Since these systems are deployed over decentralized peer-to-peer networks, it means the data is not stored on a single server but rather across *all* the computers in the network, rendering it virtually impossible to hack, while giving all users access to the same information (i.e., a single source of truth).

TRACEABILITY: A FUNDAMENTAL TENET OF QUALITY MANAGEMENT IN BECX PRACTICE

ASTM 2947 defines BECx as "architecture or engineering-related technical services … that implement a quality-focused process for enhancing the delivery of a project by focusing on validating during the design phase and verifying during the construction phase that the performance of building enclosure materials, components, assemblies, and systems are designed and installed to meet the Owner's Project Requirements (or OPR)." This definition demonstrates that BECx is fundamentally a quality management system. For any such process to be successful, it must be founded on a robust traceability framework that allows stakeholders to "trace the history, application, use, and location of an item or its characteristics through recorded identification data."[2] Every item used, or decision made, in the process must carry sufficient embedded information to identify where it came from (backward traceability) and where it will ultimately end up (forward traceability).

It becomes self-evident that blockchain technology is an especially suitable candidate to resolve BECx's traceability problems. A BECx process delivered over a blockchain network would create an intrinsic archive of every decision made during the project's design phase. Moreover, one could also envisage a scenario where supply chain transparency could be affected during construction by embedding any component or system forming part of the building enclosure into the same blockchain. The entire history of these items could easily be queried from their inception (i.e., what material or system was specified to meet the OPRs?) through their operational lifecycles (e.g., what maintenance is required to ensure components remain at optimal efficiencies) by any stakeholder with access to the network since the same information would be distributed across the entire network.

TOWARD NEW HEIGHTS

It is no secret the construction industry has significantly trailed behind other industries, in terms of productivity. A 2016 article published by the McKinsey Global Institute[3] has ranked the construction industry as one of the least digitized sectors in the global economy, effectively undermining its productivity. The adoption of blockchain

technologies in the industry could help close this significant productivity gap. As demonstrated in this article, this technology could be leveraged as part of a quality-driven process such as BECx to improve traceability and validation. ■

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REFERENCES

1. The exact identity of Satoshi Nakamoto remains clouded in mystery, and much speculation still abounds as to whether this person is a single individual or a group of individuals.
2. Traceability as defined by the ISO 9000 family of standards.
3. McKinsey Global Institute (2016), *Imagining Construction's Digital Future*.

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