Blockchain in The Construction Industry

Primary Issues and Potential Prospects

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Our C-suite experience and 113 experts on board, makes Maestral team more than ready for simplifying complex problems into scalable and flexible solutions ideal for driving your business further than ever.

A deep understanding of what is essential to delivering software using distributed teams is our greatest strength. In a sea of options, Maestral Solutions is an excellent partner to get things done.

Abstract

The construction industry has been faced with many challenges for a long time now. Although some of the obstacles are negligible, issues like opaque and erratic supply chain, the noticeable lack of streamlined project information exchange, insolvency, and slow technology adoption, are of crucial importance and critical to the accomplishment of the set goal.

The motivation for blockchain in construction projects comes from the fact that the industry involves and connects many businesses throughout different kind of relationships and contract hierarchies. Our research confirms that a blockchain infrastructure with a robust set of smart contracts which support general use cases can serve as a solid foundation for further product development by our partners and clients.

Product development done this way entails immense potential for client applications with diverse usage scenarios. This proposal serves as the platform for a variety of products and services in the construction industry, supporting primarily supply chains, construction information management and the regulation of payments using digital money or cryptocurrency.

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Introduction

The technology likely to have the greatest impact on the future of the world economy has arrived, and it's not self-driving cars, solar energy, or artificial intelligence.

It's called the blockchain.

The first generation of the digital revolution brought us the Internet of information. The second generation—powered by blockchain technology— is bringing us the Internet of value: a new, distributed platform that can help us reshape the world of business and transform the old order of human affairs for the better. [1]

Don Tapscott - CEO, The Tapscott Group

Looking past the marketing hype around the blockchain technology and Bitcoin [2] promotion, we were driven by the number of inquiries from our partners and clients from different industries to take a closer look at real-world use cases of blockchain in the enterprise, outside of finance and digital currency trading solely.

This paper is intended to provide a preliminary and brief overview of our ongoing research and testing of the blockchain technology, examine its capabilities and applicability in the construction industry as well as overcome existing struggles and offer new prospects.

We have based our work on a detailed analysis of online resources describing current obstacles in the industry and its leading sectors like supply chain, construction information management, and regulation of payments.

Although we will not discuss technical details concerning the technology itself, we aim at exploring the Hyperledger framework capabilities and its applicability in corporate use cases.

The Construction Industry

> *Why is productivity stagnation? According to a Construction Owners Association of America (COAA) study, 63 percent of direct labor time on mega-construction projects is spent waiting for materials and equipment, traveling to the area, taking early breaks, and planning how to do the work.*
> *This lack of productivity is reflected in the bottom line, where typical margins for construction companies range between 2 and 8 percent. Consequently, construction companies find themselves trapped between shrinking profit margins and stagnant productivity, unable to generate the profit necessary to invest in critical technology. [3]*
>
> Robert Leeds - Vice President, SAP Industries Marketing

The construction industry has been faced with many challenges for years now. Although some of the difficulties are neglectable in short and long terms, issues like qualified workers shortage, environmental sustainability concerns, an opaque and erratic supply chain, a lack of streamlined project management and its profitability, insolvency, and slow technology adoption are of crucial importance and simply mission critical. Similar and related underlying problems in all sectors of the industry have the potential to slow down and harm the industry's development and growth, especially today when other enterprises are preparing for the digital future and disruptive technology innovations.

Nevertheless, digital transformation is not the future but the present indeed, and not negotiable at all. It is an absolute game-changer for the construction industry, capable of resolving skilled labor shortage, insufficient project profitability, project information exchange, security issues and many other obstacles undoubtedly solvable by embracing the transformation.

The change is happening today.

Building Information Modelling (BIM)

In the context of construction, BIM is the process of delivering and operating built assets using well-structured digital information that all the necessary parties have access to.

It is a way of working, rather than a physical object or an entity. [4]

In recent years, the practice of defining, designing, and distributing project information and assets is managed by Building Information Modeling (BIM) and Construction Operations Building information exchange (COBie) protocols and related digital formats. BIM and COBie have both been emerging as a standard and necessity for designers, engineers, managers, and companies. As such, they can solve technical and legal disputes, in case any of the process collaborators show a tendency to jeopardize the project's authenticity and life-cycle. [5]

Although BIM and COBie are capable of solving a project's technical intrinsic, they fall short and are inadequate in resolving collaboration concerns between contributors. These areas of concern are a major problem for the industry and touch on responsibility, trust, data security, ownership, intellectual property, copyright protection, and others.

Construction Operations Building information exchange (COBie)

COBie is an information exchange specification for the life-cycle capture and delivery of information needed by facility managers. COBie can be viewed in design, construction, and maintenance software as well as in simple spreadsheets. This versatility allows COBie to be used on all projects regardless of size and technological sophistication. [6]

As mentioned before, the industry's insolvency is another critical point. Doubts about legal obligations, warranty and scheduling of subcontractors payments, and the financial insecurity in general, lead to overall disappointment among partners and result in failures of projects and companies. [7]

The last and arguably largest concern we want to address with blockchain is the industry supply chain. Regardless of business and type, every supply chain deals with almost the same issues. From paperwork delays, unnecessary administrative costs, and obscure legal regulations in operating countries or regions; to the insufficient transparency in tracking orders, shipments, and delivery of goods and materials; to errors, fraud, and counterfeit in the market. The blockchain is capable of overcoming all these issues concerning missing workflows and protocols.

The Blockchain Technology

Blockchain

A blockchain, originally block chain, is a continuously growing list of records, called blocks, which are linked and secured using cryptography.

By design, blockchains are inherently resistant to modification of the data. The Harvard Business Review describes it as "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way." [8]

The motivation for blockchain in construction projects arises from the fact that the industry involves and connects many businesses throughout different kinds of relationships and contract hierarchies. Consequently, it suffers from all the complications we mentioned in the previous section, like supply chain, project management, insolvency, and others.

Relationships and communication channels among contractors, subcontractors, and other participants are very often undefined by project agreements and contracts. Connections are peer-to-peer and distributed in nature, but channels rarely have established protocols and conventions.

In such an unsystematic installment, blockchain provides solutions for transparent interaction with many side benefits while solving the core obstacles in information transfer. Blockchain can secure construction information management during all building life-cycle phases and at the same time offer clarity with open and safe information exchange channels for all participants.

Backed by blockchain, BIM and COBie systems can become a decentralized infrastructure for project information management, ensuring data security and protection of intellectual property, with instant access to all data.

On the construction and building side, blockchain can improve overall supply chain performance and traceability. Accordingly, based on supply chain audit logs, regulation of payments between contractors and contributors is managed via smart contracts in near real-time, without risk for business liquidity and stability

Smart Contracts

Smart Contracts are self-executing contractual states, stored on the blockchain, which nobody controls and therefore everyone can trust.

A smart contract is a computer protocol intended to facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts allow traceable,

Our research confirms that the blockchain infrastructure with the robust set of smart contracts supporting general use cases could serve our partners and clients as the foundation for further product development.

The first feasible product idea covers supply chain in general, as the sector shows immense potential for client applications with different usage scenarios.

Apart from the supply chain case, the foundation would serve as the platform for all other products and services too, particularly construction information management (BIM, COBie) and regulation of payments with digital money or cryptocurrency.

Primary Issues and Potential Prospects

As already stated, our research aims to address the following primary use cases and potential applications for blockchain in the construction industry.

Supply Chain

Various endeavors have already started. Provenance, a UK-based startup, tells prospective clients they can use its blockchain-based technology to "share your product's journey and your business impact on environment and society." Walmart is working with IBM and Tsinghua University, in Beijing, to follow the movement of pork in China with a blockchain. Mining giant BHP Billiton is using the technology to track mineral analysis done by outside vendors. The startup Everledger has uploaded unique identifying data on a million individual diamonds to a blockchain ledger system to build quality assurances and help jewelers comply with regulations barring "blood diamond" products. [10]

Many supply chains are already using technology to reduce risks and losses, but decentralized and solitary efforts to the problem are ineffective. This is the main reason why blockchain can become the "supply chain operating system" [11] and bring prosperity to almost any supply chain usage scenario.

Sitting on top of our blockchain foundation, we consider the supply chain "operating system" for construction projects as a multipurpose service for all participants; producers, manufacturers, retailers, distributors, and other suppliers. The product would act as the gateway for a rich set of client applications seamlessly integrated.

Blockchain allows us to track and monitor all supply chain events and transactions transparently. Whenever an item or product in a supply chain, moves from production and manufacture to sale, it's status attributes change (i.e. ownership, location, title, etc). These attribute change events become a permanent part of the irreversible history of the product. This type of transparency backed by securely documented product background could reduce information exchange impediments, delivery time delays, overall distribution costs, unavoidable human errors and losses from gray or counterfeit markets. Most importantly, this transparency could change the way we manage projects and make profit saving decisions.

This type of blockchain service can help businesses protect their reputation, increase profits, encourage partnerships, and position them as a leader in the market.

Figure 1. Product history records persist on transparent, immutable, and reliable ledgers in the peer-to-peer network.

Construction Information Management

The US state of Illinois is working to issue birth certificates via Blockchains. In the UK, the Land Registry is piloting the replacement of deeds with Blockchain secured digital records. In Dubai, you can bypass passport control if you load your details onto their municipal Blockchain ahead of arrival. [12]

Persistent problems in communication between idea, plan, design, and construction, often characterize construction information management. The lack of a transparent and incorruptible information exchange and a delivery platform across all project stages results in a defensive approach to collaboration among participants.

Blockchain offers solutions with the potential to complement and even disruptively improve information and change management in BIM and COBie systems, and construction information management in general.

By recording, authoring, and auditing decision making in the plan and design phases, and then integrating with construction and implementation processes, blockchain revitalizes the current relationships between the contributors to the process and promotes a more collaborative approach to due diligence, accountability, and innovation.

Blockchain makes construction information visible to all parties, in a secure and trustworthy manner and starting from the inception phase. This way information and change management processes become cheaper, instantly accessible, less error-prone, and more reliable, which leads to overall costs reduction and more significant profit margins.

Blockchain has the potential to reverse the current trends by creating a Panoptican effect, where all parties behaviour is moderated as they known that there is the possibility that their conduct will be properly observed at a later date. [13]

Besides supply chain and payments blockchain services, our blockchain foundation would serve as the platform for BIM, COBie, and even Building Management Systems (BMS) products and services.

Building Management Systems (BMS)

A building management system (BMS), otherwise known as a building automation system (BAS), is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems. [14]

The real potential lies in integrating all these logically independent services using efficient data interchange channels. Monitoring, Analytics, Machine Learning (ML), Internet of Things (IoT), and Smart Contracts are only a few can be built on top of the blockchain foundation.

Figure 2. Blockchain makes construction information visible from the inception phase, in a secure and trustworthy manner acceptable for all parties.

Regulation of Payments

Firms are dealing with greater requirements for reporting, transparency, and dissemination of data. Costs have gone up and revenues have gone down. This technology really gets to the core of all those issues. [15]

Blythe Masters - CEO, Digital Asset Holdings

With the recent rise of cryptocurrency, markets are reassessing their understanding of modern finance. Cryptocurrencies are not only disrupting the finance world and could revolutionize the way we live and trade. Cryptography and digital trading concepts challenges current thinking and is something that will influence every aspect of our future. According to Harvard Business Review, blockchain will transform the financial system as the web changed media. [16]

As the blockchain hype is primarily around the finance world and cryptocurrency, it is easy to predict how the technology fits our use case with the construction industry, particularly with supply chain and construction information management.

The regulation of payments will revolutionize construction financing and growth. Funding and liquidity backed by Smart Contracts and distributed network of trustworthy peers will result in a completely decentralized financial system for construction.

The long-term future of the construction industry relies on the stable financing of infrastructure for information exchange and supply chain. Blockchain technology encourages decentralization of payments and helps the construction industry to solve insolvency and unregulated cache flow.

Within our blockchain foundation, we expect parties with digital identities and wallets integrated with local and regional banks, to increase their profits with fast and secure transactions, steer rapid business development via an ecosystem of client applications, and innovate by extending the foundation capabilities.

Figure 3. Payments are instant and backed by Smart Contracts and cryptocurrencies, allowing traceable, irreversible, and highly credible transactions.

Conclusion

To better leverage the opportunities and prospects of blockchain technology in the construction industry, all players will have to work together and diligently steer the movement forward. The effort depends on the number of parties involved and the following domino effect.

Companies should pay attention to the various startups in the industry too. There are several startups today that are researching, experimenting and developing with blockchain. They will likely move quickly offer new products and services in the construction industry market, especially in the supply chain, construction information management, and regulation of payments.

Additional benefits of blockchain technology are unleashed once combined with Machine Learning (ML) and the Internet of Things (IoT). In preparation for servicing our clients and partners, our Business, Product, and Development practice groups have made tremendous investments in building teams adept at leveraging these technologies.

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