Developing a Digitalised Distributed Ledger Platform for Construction Supply Chains

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1.0 Background

The construction industry produces the most complex object that modern humans create, a building or other structure. The complexity involved requires many specialists, products and components brought together to create a building. This means it contains long and complicated tree like structure of supply chains. This complex web of construction supply chain (CSC) is characterised by adversarial short-term relationships driven by the competitive bidding process, very little information sharing and little motivation for continuous learning (Behera et al, 2015). According to Behera et al (2015), supply chains of project-based industries such as in construction, have inherent uncertainties associated with the timing and specifications of the project compared to process-based supply chains such as in manufacturing industries.

Long and complex supply chains makes it difficult to monitor compliance, provide ultimate assurance of the final product and often lead to increased cost structures from payment delays to the tune of 20-30% of construction costs (SFC/CPA, 2005; Ashworth & Perera, 2018). Dainty et al (2001) highlight the seriousness of late payments by the main contractors to their subcontractors and suppliers, which creates cash flow difficulties and breakdown in trust relations and, in turn, leads to over-pricing by subcontractors against the risk of late payment. Therefore, it is clear that addressing supply chain issues are fundamental in providing greater efficiency in the construction industry.

The dawn of the Industry 4.0, has seen the development of the Financial Technologies (FinTech) and their applications. The most prominent of these is the developments in crypto currencies (eg. Bitcoin). The technology that underpins crypto currencies is known as Blockchains or Digitalised Distributed Ledger (DDL) which was invented a decade ago (Abeyratne & Monfared, 2016; Underwood, 2016).

DDL is a mechanism to replicate, share, and synchronize data spread across different geographical locations such as multiple sites, countries, or organizations. Accordingly, main property of the distributed ledger is that there is no central administrator or centralized data storage mechanism (Walport, 2016). The Blockchain is the most common distributed ledger mechanism which contains records of transactions that are shared with other members. Each of these transactions is confirmed by the agreement of a majority of members for making fraudulent transactions. Once the transaction is completed and confirmed by members and accepted by the Blockchain, it can never be altered or deleted (Efanov & Roschin, 2018).

However, capabilities of digitalised distributed ledger technologies can be extended far beyond cryptocurrencies. It enables existing applications to be improved and new applications such as Smart contracts, Blockchain-powered election, Smart power grids, Smart property, etc. practically to be deployed in public or private Blockchain networks (Di Iorio, 2017; Iansiti & Lakhani, 2017; Underwood, 2016).

Smart contracts were first proposed in 1994 by Nick Szabo as a computerized transaction protocol that executes the terms of a contract. The general objectives of smart contract design are to satisfy common contractual conditions such as payment terms, liens, confidentiality, etc. for minimizing the need for trusted intermediaries and minimizing exceptions of both malicious and accidental (Szabo, 1994). Simple meaning of Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. Smart contracts permit trusted transactions and agreements to be carried out among disparate, anonymous parties without the need

for a central authority, legal system, or external enforcement mechanism. They render transactions traceable, transparent, and irreversible. The code and the agreements contained therein exist across a distributed, decentralized Blockchain network. This research is an attempt to harness the capabilities of Blockchains and smart contracts to provide issues arising in construction supply chains.

2.0 Research Problem

The previous section examined the construction problem context and the potential offered by FinTechs. The core of the issues arising in this discussion relates to:

- Inefficiencies in supply chains are resulting in additional costs to the construction industry.
- Construction supply chains lack transparency and are fraught with issues of trust.
- Complexities in supply chains are having and impact of assuring the quality and standard of final constructed product.

This research therefore aim to develop a methodology for greater integration of supply chains through the use of DDL technologies.

The research will involve a comprehensive literature review of applicable FInTech solutions with greater emphasis on Blockchains and Smart Contracts. It will then develop a Conceptual Model for the proposed DDL for construction supply chains. A details information flow analysis will be carried out to understand the implication of data flows resulting in a Detailed Model. This will then result in the development of a prototype version of the detailed model. A process of testing and validating the model will be used to create a workable prototype. This workable prototype will then be tested and subsequently validated using real industry supply chains with the collaboration of the c4SMC industry partners.

3.0 Expected Outcomes

This research will for the first time provide a Blockchain based solution for integrating construction supply chains. Such applications are currently being tested for other industries. The DDL platform will make supply chain transactions more transparent and trust worthy. It will make payments in the construction industry instantaneous cutting down the need for supply chain cash flow related finance. Smart contracts will provide a legaly sound mechanism for the payments to happen removing the need for trickledown payments from the main contractor to subcontractors and suppliers. This should make construction supply chains more efficient and subsequently help reduce the inflated cost structures in the construction industry.

The research will develop a prototype DDL platform for construction supply chain transactions. The system and the concept would be a unique contribution to knowledge creating trusted and dependable system for construction supply chains to operate. It will enable building clients to track back supply chains up to the source from builder to suppliers as required. This will help builders to provide more reliable and conforming materials and components with good degree of guarantee.

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