



Smart contracts and possible applications to the construction industry

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1. Introduction

The Final Report, an inquiry into Construction Industry Insolvency in NSW (Collins 2012), requested by the NSW Government in light of a number of mid-tier builder insolvencies in NSW and the knock-on effect on subcontractors, highlighted payments withheld or not paid, to be at the heart of the problem.

Uncertainties in payments leading to cash flow difficulties have been highlighted as a cause of business failures and escalating disputes in previous research (Carmichael, 2002; Carmichael and Balatbat, 2010). Not surprisingly, most of the 44 recommendations that the Final report put forward to the NSW Government were directly or indirectly related to payments.

In order to address the problem the Final Report proposed the creation of a „Construction Trust”, as pioneered by the Office of Government Commerce in the UK in 2011, which was described as having the following mission:

The Construction Trust: Any payment by a principal to a head contractor or by a head contractor to a subcontractor on account of, or in respect of, any work done or materials supplied by the head contractor, any subcontractor, sub whether as a result of a favourable adjudication under SOPA or not, shall be made and treated in the following way:

- *such work shall be held on trust for the head contractor, subcontractor, sub subcontractor and supplier; and*

- *the head contractor, subcontractor, sub subcontractor and supplier;*

- *by the head contractor the instant they are received by electronic transfer from the principal.*

The statutory Construction Trust requirement should apply to all building projects valued at \$1,000,000 or more.

The statutory Construction Trust will be established for the purposes of paying the subcontractors and suppliers (Collins 2012, p. 355).

In its essence, the Construction Trust would hold payments in trust in order to safeguard and protect subcontractors and suppliers from a head contractor insolvency. The Construction Trust would guarantee that payments from the principal to the head contractor would follow through to subcontractors and suppliers, as the Trust mission clearly alludes to.

As a result of the recommendations put forward by the Final Report, the NSW Government made several changes to the Building and Construction Industry Security of Payment Act 1999. Unfortunately, the NSW Government decided not to implement the Construction Trust. The official NSW Government answer to the recommendation was:

Not supported at present time. The Government recommendation is to trial the use of Trust Accounts on selected government construction projects before consideration of wider application (NSW Office of Finance and Services 2013).

Understanding if trust accounts, or the Construction Trust, could make the construction industry more robust and reliable is beyond the scope of this paper, but we propose an alternative solution.

We believe that smart contracts can be used to create a contract that is „in the money” (premise #1); as well as interacting between other contracts so that a trustful chain of payments can be established (premise #2); with the benefit of „speed of thought” cash transactions.

The scope of this paper is to show that adopting smart contracts would yield the same benefits as implementing a *Construction Trust* proposed by the Final Report.

2. Quick introduction to smart contracts

Smart contracts were first mentioned in 1994 by Nick Szabo. Szabo envisioned the idea of embedding smart contracts in physical objects which he described as smart property. His example of choice was a car loan, writing that if you miss a car payment, the smart contract could automatically revoke your digital keys to operate the car.

Essentially, smart contracts are computer protocols that facilitate, verify, or enforce the negotiation or performance of a contract, or that obviate the need for a contractual clause (‘Smart Contract’ n.d).

The possibility to embed the terms and conditions of an agreement into a „physical“ item differs immensely from a paper contract, which upon being signed off is often shelved, to be revoked later when the parties are in arrears.

Smart contracts allow for a set of instructions to be incorporated into a contract, and although smart contracts can probably be forgotten too, payments will be denied unless the contract agreed conditions are satisfied. In that sense, clauses in smart contracts are self-executing, self-enforcing, or both.

It goes without saying that smart contracts technology is still embryonic. Startups like ethereum.org, codius.org, counterparty.io, proofofexistence.com and so forth are empowering smart contracts technology, but they are not mainstream yet.

Nevertheless, as we shall show later in this paper, (1) the possibility to embed funds within a Smart Contract, and (2) the possibility to interlink different contracts in order to create a chain of events, such as payments, might well be what the construction industry has been craving for.

However, before we can move forward, we need to discuss and understand cryptocurrencies, as without this new form of paying for goods and services smart contracts would be sterile.

3. Quick introduction to cryptocurrencies

It is not a secret that although smart contracts were first discussed in 1994, it wasn't until the recent development of cryptocurrencies, Bitcoin being the main example, that the true potential of smart contracts was unlocked. Before that, smart contracts were an interesting idea, but without a „smart“ currency to back it up.

Everything changed with the creation of the blockchain, and the bitcoin. Since then all kinds of cryptocurrencies have emerged.

Essentially cryptocurrencies are a medium of exchange using cryptography to secure the transactions and to control the creation of new units ('Cryptocurrency' n.d.). Cryptocurrencies are often compared to digital currencies, an internet based medium of exchange.

Understanding how cryptocurrencies work, terminology such as „bitcoin mining“, or even the blockchain, is beyond the scope of this paper. However, basic knowledge is required in order to understand the benefits of cryptocurrencies and the applications to the construction industry

Like smart contracts, the applications and ramifications of cryptocurrencies are still embryonic, but for the purpose of this paper we are only interested in two features; (1) the possibility to write instructions in „digital coins“ and (2) the „speed of thought“ at which cryptocurrencies are transacted between parties.

As we shall see, these two features are what set cryptocurrencies aside from traditional forms of money such as coins, or cheques. Combined with smart contracts, cryptocurrencies can guarantee and create a chain of payments way beyond what the construction industry has seen so far.

4. How smart contracts could be used in the construction industry

As so often happens in the construction industry, the principal puts together a set of drawings, specifications, and other relevant documents in order to tender or negotiate a particular scope of work. Eventually, a contract is signed with a builder, sometimes a letter of intent will suffice, sometimes not even that, to carry out the works in exchange for a sum of money.

Once the contract is signed, the head contractor breaks up the scope of works in trades and signs various sub-contracts to perform the works. There are situations where different arrangements are made between principal and head contractor, head contractor and subcontractor, but at the end of the day, any time construction work has been carried out, a bill will be presented for a party to pay.

Payments withheld or not paid at all, as discussed at the beginning of this paper, most likely puts several parties on the brink of bankruptcy.

But what if the principal could embed the contract sum in a construction contract? And we literally mean embed money into the contract. We believe this would give a sense of security to all the parties involved in the project and protection against insolvency. This is what we would like to call a construction contract that is „in the money”.

As mentioned before, instructions can be added to cryptocurrencies. The principal, if using a smart contract, is entitled to embed digital currencies into the contract together with a number of conditions that have to be fulfilled for the head contractor to be paid. The payment is already embedded in the contract. The head contractor only needs to deliver their scope of works.

Smart contracts together with cryptocurrencies would allow for the drafting of contracts with embedded funds in order to protect head contractors, subcontractors and suppliers against the insolvency of the principal or late payments. It goes without saying that the same technology can be employed in contracts between head contractor and subcontractor, subcontractor and suppliers, subcontractors and labourers.

But the benefits to the construction industry of smart contracts, or contracts „in the money” don’t stop here. Smart contracts can also be linked together. This means that a simple payment to the head contractor could carry instructions for a percentage of such payment to follow through to another contract.

In other words, contracts related to the same project, but between different parties, could be linked together in order to create a web of payments. Payments can be self-executable and self-enforceable, only dependent upon the execution of the works as per the contract conditions.

In summary, together with the possibility to embed funds within the main contract, we believe that adopting smart contracts in the construction industry would offer the same benefits as the creation of a Construction Trust. Overall, smart contracts can:

- (1) guarantee that the required funds to carry out the construction works would be available to finance the project;
- (2) protect head contractors, subcontractors, and suppliers from withheld or late payments; and
- (3) safeguard the various parties involved in the project from the insolvency of one party.

Further to the benefits mentioned above, payments between parties would also occur at the „speed of thought”, eliminating many of the cashflow issues often experienced by companies operating in the construction industry.

Going forward, we would like to recommend the creation of a smart contracts committee in order to explore, research, and test the implementation of smart contracts in the NSW construction industry.

5. Barriers to the implementation of smart contracts within the construction industry

Smart contracts as well as cryptocurrencies are not mainstream yet. In the particular case of bitcoin, a report carried out by Deloitte (Deloitte 2014) highlighted the need for stability, acceptance and trust for the digital currency to go mainstream. Smart contracts are not any different. Overall, the technology still has a long way to go before it can convince the various parties involved in the construction industry that it's fit for purpose.

Furthermore, the construction industry already has a reputation for being slow at implementing technology in its operations and learning how to use smart contracts and cryptocurrencies is not something that can be learned overnight. Nevertheless, the premise of potentially solving the construction industry's high rate of insolvencies and payment issues in the construction industry, is a premise worth fighting for.

6. Conclusion

The Final Report requested by the NSW Government to identify the cause of insolvency in the construction industry proposed the creation of a Construction Trust to guarantee payments between the various parties involved, mostly subcontractors and suppliers. The NSW Government made amendments to the legislation but decided not to implement the creation of the Construction Trust.

This paper proposed that smart contracts combined with cryptocurrencies allow for the encryption of funds within a construction contract as well as interconnection between other contracts in order to secure payments. These two features, if implemented correctly, would offer the same benefits as proposed by the Construction Trust.

This paper recommends the creation of a NSW committee to explore, research, and test the implementation of smart contracts in the construction industry. Although smart contracts technology is still embryonic, the opportunity to protect the various parties from insolvencies and late payments might be what the construction industry has been craving for.

7. Bibliography

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