

## **A SYSTEMATIC LITERATURE REVIEW ON IMPACT OF BLOCK CHAIN BASED SMART CONTRACT ON CONSTRUCTION PROJECTS WITH A FOCUS ON HUMAN FACTOR OF TRUST AND TRADE CREDIT EXTENDED BY SUPPLIERS**

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### **ABSTRACT**

*The objective of the present article is to identify research gaps in study of human factor of trust while finalizing construction project orders. A systematic literature review is done for the research conducted in this domain both while clients finalize contracts on contractors and when such contractors place orders on their sub-contractors and suppliers. The focus is to identify work done in this domain with critical factor of trust and trade credit extended in such negotiations. The paper introduces smart contracts and blockchain concepts and how it may be useful in construction projects. A review of literature is also conducted on the impact of smart contracts on construction projects and how will this affect the trust factor in the negotiations mentioned before. The research identifies the research gaps and elaborates the scope of future research in this field.*

**KEYWORDS:** *Trust, Trade Credit, Project Management, Construction, Smart Contracts, Blockchain.*

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### **Introduction**

Trust plays a big role in construction projects. Trust between client and contractor as well as between contractor and their sub-contractors and suppliers. Trust between project team members is also a big factor, but our research will not deal with this domain. It's general unsaid notion while executing projects that "project is running fine till the parties do not touch the contract". Implying that many things get done based on trust. The phrase *touching the contract* indicates a dispute. Though this is may appear counter intuitive, professionals with practical exposure understand that relationships matter more than what is inked in contracts. The author has over 18 years of experience in the execution of large projects and attempts to validate if the same reflects in the research. Literature review is conducted for work done in the area of trade credit extended by suppliers in construction projects and how trust between the two parties plays a role.

The word 'trustless' has become a common word in the cyber security space. With advent of blockchain technology the concept of trust is taking a new dimension. The commitment between parties can now be coded into the system and on fulfilment of duties and actions specific triggers get activated. We will study the body of research done in this field and how it will impact the client contractor trust relationship.

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## **Block Chain**

Distributed Ledger Technologies emerged to ensure no centralized control and secure transaction can take place with synchronization and replication. A peer-to-peer network and encryption makes this possible. It is referred along with cryptocurrency and Bitcoin. Blockchain was invented to resolve what is called a “double spend problem”.

Block chain is a technology that creates a trustless, immutable, uncensored and decentralized network to transfer value. In simple words it removes the need to deposit our trust in a centralized entity like a bank or institution to validate the transfer of value between peers.

### **Double Spending Problem**

Since digital or cryptocurrency or tokens can be reproduced, how can one ensure that same tender is not be spent over again! This is the double spending problem. The problem can be there with even gold or paper currency, but it is harder to do there. Blockchain solves this double spending problem.

Using Bitcoin, we can illustrate how blockchain can be effective in solving this “double spending problem”. Transfer of money is one problem but what happens with other unique digital or physical assets? What we intend to explain is in cases like real estate transactions, property rights, rare collectible items transfer or online game how this will be even more complex.

### **Smart Contracts**

As a simple definition, a smart contract can be said to be a piece of software code (computer program) that lives in a decentralised environment (Blockchain). To explain how Smart Contracts works, lets consider the vending machine. When a user interacts with a vending machine, the no intermediary like a shopkeeper comes between the user and the product he wants to buy. When the user inputs the money, the software checks the amount and clears if found adequate to choose a ‘asset’ i.e drink or item inside the vending machine. Once cleared, the machine drops the “asset” like the drink to the user. This straightforward transaction, illustrates how a contract can work.

In the digital world, the asset can be any kind of asset. Any asset in the digital or physical can be uniquely represented in a smart contract. To illustrate imagine the case of an inheritance. Transfer of assets from an estate can be automated without needing an executor when a smart contract is in place. Smart contract is the tip of the iceberg for a revolution.

A very promising area for blockchain is in higher education by transforming the “record keeping” of degrees, certificates and diplomas” There’s no doubt Smart Contracts have the potential to change our entire economy and society. Whether through the supply chain, voting or autonomous organisations, it’s easy to see that the potential is there. If we think about other technologies like AI, Robotics and IoT mixed with blockchain technology and smart contracts; we are looking at a whole different world. The great challenge in our future won’t be the development of these technologies nor the mass adoption, instead - their purpose.

In this paper we will study the application of smart contracts in construction project management and specifically in supply chain for construction projects.

### **Literature Review**

(Bărbuță-mișu, 2019) illustrate with study of 958 European firms that trade credit offered /received is directly correlated with return on equity, firm size, current liquidity, liquidity ration and long term loans. (Owusu-Manu et al., 2014) study trade credit influencing factors in Ghana and 75 firms and conclude on factors of financial profile of contractor, parties profit margin, repayment terms, corporate image, age of contractor and parties cashflows. (Levine et al., 2018) prove that firms in high-trust countries and dependent on liquidity obtain more trade credit and sustain during banking crisis than firms in low-trust economies. (Cheung & Pok, 2019) illustrate that the trust view of CSR and trade credit as well as substitution view of CSR are enforced by their findings analysing data over 1991-2015. (Raja Ghosh, Sarojkant Singh, 2022) show that trade credit availability increases with CSR. (Coggins et al., 2022) concludes underbidding as one of the causes of insolvency in Australian construction firms but also cite trade credit extended as a factor. (Michalski, 2007) shows that trade credit management helps in achieving the aim of firm value maximization using portfolio management theory. (Akinsiku & Olubunmi, 2014) highlights reasons of non-performance and cost overruns with reference to trade credit. (Cui et al., 2010) highlights cashflow management as key success factor in construction projects and how trade credit reduces overdraft requirements. (Bo et al., 2016) highlight the importance of trust in dispute and bilateral

lock-in construction projects. The author shows that interest-based negotiation behavioral strategy i.e factors of goodwill trust and competence trust rather than rights-based negotiation behavioral strategy i.e with contractual control is adopted in China. (Briscoe et al., 2004) researches firms in UK and concludes that client lead supply chain integration are driven by performance improvement and innovation. It bases its conclusion on being a key parameter in negotiations and supplier appointment. (Sridharan & Simatupang, 2013) research on how power and trust can play a critical role in creating mutual competitive advantage of collaboration in supply chain. (Khalfan et al., 2001) concludes how trust is important for supply chain integration in construction supply chain. (Manu et al., 2015) trustworthiness and trustfulness are influenced by change, economic climate, payment practices, perception of future job opportunities, project specific context and job performance.

(Lamb, 2018) reports the advantages and barriers to blockchain in architecture, engineering and construction industry through an extensive literature survey and addresses the maturity and application as nascent in this industry.

(S Ahmadisheykhsarmast & Sonmez, 2018) address the problem of non-payment of dues and thus leading to bankruptcy of companies with smart contracts. The authors also rake the issue of the currency risk of cryptocurrencies. (Badi et al., 2021) studies the factors affecting adoption of smart contracts in UK construction industry and highlight 4 factors viz supply chain pressure, competitive pressure, top management support, and observability.

(Debono, 2019) examine the possibility to incorporate smart contracts in public procurement and possible hurdles. They highlight areas like terms which many not be deterministic and requiring human judgement and hence a hurdle for computer program, sometimes indeterminate concepts may be used, expression of the code and obligations may defer and changes to the contract may be a serious problem. (Owusu et al., n.d.) does a survey of publications on smart contracts from 1997 to 2018 and examines 182 research works and finds most works from USA, UK and China. The study also shows a lack of interdisciplinary research. The study highlights huge gap in research in construction and project management for application of smart contracts.

(Shojaei et al., 2020) examines integration of BIM and blockchain for smart contracts and concludes that not all clauses need to be incorporated into the block chain due to complexity and still the system will provide tamper proof evidence to resolve disputes. The research has kept cryptocurrency out of consideration and considers the present banking system in the framework. (Nanayakkara et al., 2021) illustrate the utility of block chain based smart contracts in solving the payment related issues including incomplete payments, non-payment, high cost of finance, extending payments beyond agreed time etc.

(Salar Ahmadisheykhsarmast & Sonmez, 2020) propose a new payment security system based on blockchain to resolve the payment problem in construction projects. (Chaveesuk et al., 2020) study the issue of trust on unknown third party and how blockchain can be utilized to reduce this gap. The authors conclude that two constructs i.e. ease of use and perceived usefulness will be critical for adoption with the study done in Thailand. The authors also cite the factors of financial costs, trust, readiness and facilitating conditions affect the constructs.

(Sheng et al., 2020) propose a model to reduce the threshold for acceptance of smart contracts for quality acceptance in construction projects and addresses the gap between the pertinence of business logic to construction management and generality of prevalent approaches for modelling smart contracts. (Koc, 2020) identifies 18 factors for adoption of smart contracts in construction and lists simple layout, clarity in responsibility and risk allocation, reduction of risks and conflict as the most important factors.

(Li & Kassem, 2021) study 153 construction specific study on smart contract and distributed ledger technologies. The authors identify 8 themes viz payments, information management, procurement, supplychain, regulation, compliance, construction management and delivery, dispute resolution and technological systems. (Hesam & Martin, 2021) discusses non-payments as a issue plaguing the construction industry and how smart contracts can resolve it. The authors discuss challenges with blockchain-based payment automation, smart contracts for dispute resolution, informatics, namely zero-trust computing and single source of truth usable in audit for projects. (Chuanni et al., 2022) provides method to incorporate blockchain in scheduling for projects.

### Findings and Research Gap

The literature survey indicates a research gap in study of trade credit offered to suppliers in construction projects. Most of the trade credit literature were found to be based supply chain and manufacturing firms. The research done in trade credit for construction projects brings out thr following factors:

Return on equity, firm size, current liquidity, liquidity ration and long-term loans, financial profile of contractor, parties profit margin, repayment terms, corporate image, age of contractor and parties cashflows, CSR.

Apart from CSR most factors prove to be financial parameters. Even CSR in India is linked to profits for firms. As a such we find a lack of research on how trust factor plays out while the trade credit is offered in construction and large complex projects.

The literature survey on smart contracts highlights the barrier to application of blockchain and advantages of application of blockchain in construction projects and we find there is huge gap here too. A major factor most research found was non-payment as an important area to be addressed and how blockchain based smart contracts can be a solution to this issue. We also find that research has been done on applying smart contracts without cryptocurrency and using present banking system. Further, smart contracts application on portions of the construction project management like quality has also been explored.

The present research shows that blockchain based smart contracts and their impact on trust in offering /receiving trade credit is a research gap.

### Conclusion

Smart contracts and their application in construction is evolving and their impact will be revolutionary. Our research presents gaps in research in this area with the role of trust in supply chain in construction and its criticality to cashflows and financial performance. The present research work carried out in area of trust and trade credit extended, indicates that major factors are financial parameters and these can be immensely affected if blockchain based smart contracts are introduced. Whether the entire construction supply chain integration or a pilot implementation in one process like quality is useful, can be an area of research, but either approach will have tremendous impact on construction project management.

The present methods of negotiations in construction supply chain are impacted by trust between client and contractor, however, the construct for trust is scantily researched in such application whereas the financial parameters are more researched, as such it may be perceived that these financial parameters are premises for extension for trade credit. Research on cases where these financials are weak/absent will reinforce or enlighten whether trust can offset such conditions. The present paper establishes that block chain based smart contracts will resolve the payment-based issues in construction contracts, however, in projects where trust levels are high, whether the application is worth is unclear. Nevertheless, due to increase in transparency due to implementation of smart contracts, trust will be impacted positively. The author intends to research these gaps further and this work will serve other researchers to find areas for future work.

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