

# Smart Contract Using Blockchain In Construction and Infrastructure Sector in the COVID-19 Pandemic

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## Abstract

A significant advancement has been contributed by the break-through technologies like smart contracts and blockchain in banking industry, healthcare industry, and construction industry (Zhang 2020). Blockchain can be defined as the distributed public ledger that records all data transaction that is exchanged and shared between the parties within the systems (CEMEX Ventures 2020). The blockchain offers various opportunities and advantages for all the involved parties within an enterprise (Penzes 2018). A synchronized and secure record of transactions are provided to the involved parties. The confirmation of all participants within the system is required in order to finalize the data transaction (Nicosia 2019). Every sequence of transaction is recorded by the blockchain ledger, from beginning to end, in certain irreversible and verifiable records of all transactions which are ever made. There are abundant areas of application of blockchain technology. Smart contract has an important role in the digitalization of conventional paper contracts and provides grounds for the application of blockchain technology (Strategy 2019).

This research intends to evaluate the use and application of smart contract, via blockchain technology, in the construction and infrastructure industry of the COVID-19 pandemic. Current COVID-19 pandemic condition has resulted in wider range of negative impacts on the construction sector in UAE, thereby affecting large parts of UAE economy (Gupta et al., 2020). There has been identified significant need of development and implementation of effective digital tools for data management that require least resources. In doing so, the concept of blockchain technology has emerged and investigated by the scholars in construction sector (Salama & Salama 2018). By employing the concepts of smart contracts under blockchain technology, the construction sector in UAE can be improved (Constructible 2020). This may also result in alleviating the negative impacts of COVID-19 in construction sector of UAE. The research findings will be important for the

professionals in construction sector of UAE and in delivering the concept of blockchain technology for construction industry.

**Keywords –**

**Smart Contract; Blockchain technology; COVID-19; Civil Transaction Code**

## 1 Introduction

A smart contract can be defined as the computerized transaction protocol that is run on blockchain public network and seeks to replicate legally binding contracts through a code (Level X Supply 2020). Instructions and clauses could be coded in the program (Dubai 2016). When the coded contractual conditions are met, the program is executed which pertain that the smart contracts are self-enforcement (Duy et al., 2018). Smart contracts enable automatic data transfer and embedding of payment amounts, allowing digital transaction information exchange among the contract parties after the instructions are reached. Due to their binary logic, smart contracts are decisive and the contract conditions function depends on coded scope satisfaction (Chamola et al., 2020).

Construction sector in UAE has been constantly advancing and revolutionizing and with the involvement of digitalization, the prospects in construction sector has become significantly efficient (Salama & Salama 2018). Further inclusion of information technology and other digitalization aspects in the construction sector have been focused after the global pandemic situation due to COVID-19. Blockchain technology has resulted in bringing the smart technology back to the business sectors and construction industry has been efficiently advantaged through this technology (Nicosia 2019). Smart contract is also defined as the digital contract which serves its purpose when the predefined conditions are met. According to Penzes (2018), Ethereum platform was one of the first blockchain related application which possessed the potential to execute computer scripts and codes on the blockchain. The code was secured on the blockchain and the input conditions

came from the blockchain as immutable data. Blockchain technology, implemented in the construction sector of UAE, is predicted to save over \$ 3 Billion USD, as forecasted by the whitepaper of the Dubai Future Foundation (DFF), Center for the Fourth Industrial Revolution UAE (C4IR UAE), and World Economic Forum (WEF) (Anderson 2018). The amount forecasted is another noteworthy figure for the construction of another skyscraper project. The integration of blockchain technology has also been predicted to eliminate 77 million work hours per year and 398 million printed documents – thereby saving money, time and resources. In UAE, more than 100 stakeholders from 60 governmental and non-governmental entities have been exploring the implementation prospects of blockchain technology (Dubai 2016).

In the face of COVID-19 pandemic, governments around the world have efficiently introduced measures to protect the economies, businesses and citizens. In UAE, numerous measures have been undertaken that are vital to the construction sector of UAE (Bishr 2019). The construction industry is vital for the economy of UAE and COVID-19 has significantly impacted the construction sector UAE, thereby negatively influencing the economy. Various negative impacts on the construction sector in UAE have been highlighted which include disruption events and traditional delays contributed by the breach of contract by one of the parties (AlTaei et al., 2018). Moreover, suspension claims are another emerging issue contributed by COVID-19 in the construction sector of UAE. Some developers may look to suspend their contracts due to the uncertainty of COVID-19 pandemic (Hargaden et al., 2019).

## 2 Methodology

### 2.1 Research Design and Approach

Primary research design has been selected for this research with a qualitative approach. Justification for the use of primary research design in this research can be attributed to the requirement of analysis of perspectives and views of professionals in the construction sector regarding the implications of use of smart contracts under blockchain technology. Expected implications of this technological approach in the construction sector can be perceived positive since various negative influences have been identified on data storage, exchange and management which has resulted in delays in construction projects and suspension claims.

Qualitative approach has been identified effective for the researches conducted under

exploratory paradigms (Thomas & Magilvy 2011). Qualitative approach facilitates an in-depth analysis of research problem being addressed and also facilitates the researcher to integrate their own perspectives and views (Tesch 2013). There are various advantages of qualitative approach such as presence of large amount of data, it provides a detailed and in-depth analysis of the qualitative data, and also encourage the participants of the study to expand their responses (Silverman 2016). These advantages of qualitative approach are the major justification for selection of qualitative approach for this research.

### 2.2 Sampling and Participants

Random sampling strategy has been applied in this research and the population targeted for interviews included professionals working in the finance and information technology department of the UAE organization. Simple random sampling approach provides the equal opportunity to each of the participant from the target population (Thomas & Magilvy 2011). Randomly chosen sample from the target population represent the total population in an unbiased fashion. Before the selection of sample participants, it was ensured from the participants that their construction company has been using blockchain technology for smart contracts. Selection of random sampling strategy for this research can be attributed to the unbiased representation of total population by the selected sample. Sample of two participants was selected for the interviews. Before conducting the interviews, informed consent as approved was taken from each of the participant to ensure complete ethical compliance.

### 2.3 Data Collection and Instrument

Researcher selected telephonic semi-structured interviews as the instrument for data collection and participants were interviewed for 10 minutes. Telephonic interviews were recorded and transcripts were generated from the recorded data. Primary data has been therefore collected in this research which ensured that each participant's views and perceptions, associated with the use of blockchain technology, have been reviewed and their experiences and behavior has been reviewed. This resulted in-depth evaluation of responses of participants to the questions. There are various advantages of semi-structured interviews which is why researcher has selected this approach of primary data collection. It allows the interviewees to respond efficiently to each of the questions of researcher. Moreover, it encourages two-way communication between the participants and interviewer which enables demonstration of various aspects related with the research problem being explored. Semi-structured also allow the respondents

to open up to the sensitive information that has been investigated however, no significant sensitive questions have been involved in the interviews. Semi-structured interviews enable efficient collection qualitative data and enable comparison of this data with the past researches. Primary qualitative interviews enabled collection of sufficient data as required for this study which was later analyzed by application of qualitative data analysis technique.

### 3 Data Analysis

Primary data collected through semi-structured interviews has been analyzed through application thematic analysis technique. Application of thematic analysis technique in this research can be justified with the reason that it enables familiarization of the data collected through interviews as well as allows researcher's own perceptions and opinions during the interpretation stage (Guest et al., 2011). For the analysis of qualitative data, thematic analysis technique is widely applied in the researches, particularly in case of data collected through interviews and discussion (Braun & Clarke 2012). Thematic analysis technique enabled thorough review of interview transcripts multiple time and familiarization with the collected data, which eventually results in extraction of potential themes which have been presented in the findings section.

### 4 Ethics

Research ethics are the codes and norms that a researcher is required to follow at each stage of the research to ensure integrity and quality of the research (Thomas & Magilvy 2011). Since the research was primary in nature, ethical compliance was followed in terms of beneficence, informed consent, confidentiality, and anonymity. Under the confidentiality ethics, participants' as well as organization's private data was protected and secured. Moreover, pseudonyms were assigned to each of the participant. Approved written informed consent was received from each of the participant as well as the research institute for the execution of this research project. During the interviews, no sensitive question was investigated from any of the participant.

### 5 Limitation

Research encountered certain limitations which narrowed down the scope of the research to significant extent. The major limitation was the global pandemic situation caused by COVID-19 which restricted the activities of researcher such as selection of interview setting that was convenient for the participants. Moreover, time constraints resulted in conduction of only 10-minute interviews with the participant.

## 6 Findings

Both participants belonged from the similar organization; P1 from the IT department and P2 from the finance department. Both participants were interviewed separately so that their responses can be efficiently recorded, analyzed and interpreted by the researcher. Interview questions are presented in the appendix 1. Participants were initially investigated whether they are aware of the idea of blockchain technology and smart contracts. According to the response of P1, "blockchain technology, as I perceive, is in digital journal form that enables digitalized management of data and the provenance of the digital asset." P1 also stated that the company has implemented the smart contract and blockchain technology after the pandemic condition due to COVID-19. Response of P2 was also similar and both respondents were identified to be well-aware of the blockchain technology, its application and the possible advantages their company may have in future due to implementation of this technology after the pandemic condition is over. Both participants responded that their company significantly advantaged from the smart contract strategies under the blockchain technology. P2 also quoted that "for all the aspects of construction project, blockchain technology can create single source of truth and this can be combined with the 'Building Information Modelling'. Such model can complement the activities of IT specialists and can become trusted digital twin of an asset, which may support the construction and design along with maintenance and operation."

Participants were investigated about the Emirates Blockchain Strategy 2021 and its impacts on their company's performance during COVID-19 pandemic. the strategy was highlighted to be based on the four major themes including happiness of citizens and residents, improvement in governmental transactions, improvement in the legislative compliance, and improved leadership.

Participants were investigated about the prospective implications they consider and associated with the implementation of blockchain technology. According to the P1, "traceability and transparency is predicted to be improved with the blockchain technology and in my opinion, smart contracts in construction sector are required to be managed through digital means of data gathering, storage and exchange. Current pandemic condition is challenging for the construction sector and it has restricted the conventional means of project compliance with the contract details." P2 added "there are various implications predicted and associated with the

blockchain technology. These include transparency in the data exchange, easy tracking of the data associated with the project details, and sustaining the credibility of the data”.

Participants were investigated about the perceived and observed negative impacts of COVID-19 pandemic on the construction industry in UAE and how their company has been affected. Participants counted various negative impacts on the construction sector in UAE which included halting of the spending on new projects, suspension of salaries, suspension of new projects (as responded under the reference of EMAAR Dubai). P1 also stated that “the COVID-19 pandemic has threatened the UAE construction sector by restricting the activities of project management at each level. UAE Construction Industry Think Tank has issued the white paper under which, all the construction companies have been addressed to adopt digitalized methods of project execution in different departments.”

Participants were investigated whether application of blockchain technology has affected citizens and residents in UAE. Responses were affirmative as the respondents stated that the employment of blockchain technology-based construction project contracts had positive impacts on the citizens and residents of UAE. According to P2, “payment delays were mitigated by the use of blockchain powered contracts in construction sector which was based on automated payment mechanisms. Also, this claim is made by the proponents of disruptive technology that involvement of blockchain technology in construction is going mitigate the issues contributed by the COVID-19 pandemic.”

Participants were investigated for the implications of the use of blockchain technology in improving government efficiency. According to the response of P2, “among the Middle East countries, UAE stands among the top countries that has adopted technology in its diversity of business sectors. Emirates Blockchain Strategy 2021 has been launched to mitigate the payment delay issues in construction sector and to convert 50% of the government transactions into the blockchain platform by 2021. The Strategy is expected to improve the data management and reduce the incidences of payment delays in the construction projects thereby improving government efficiencies in the UAE construction sector.”

Advancement in the compliance measures of legislative frameworks has also been predicted with the Emirates Blockchain Strategy 2021 as it aims to enable 50% of all the transactions through blockchain technology. This point was also affirmed by the participants indicating that the strategy may have direct impact on the compliance issues of legislations and regulations in the construction sector.

Furthermore, participants also indicated that the management and leadership aspects in their companies were improved and positively influenced by the application blockchain technology.

## 7 Data Analysis and Discussion

Data analysis has been conducted via application of thematic analysis technique. Four stages were followed for the application of thematic analysis by the researcher. Familiarization with the data, identification of common meanings and patterns, extraction of meanings, and development of potential themes. Three potential themes have been generated from the analysis of participants’ responses. These themes included happiness of citizens and residents, improvement in governmental transactions, and improvement in the legislative compliance.

### Theme 1: Impacts of Application of Blockchain Strategy 2021

According to the responses of the participants, delay of the payments was one of the major issues in the infrastructure and construction sectors which eventually results in the project completion. According to the responses of the participants, mitigation of the issues related with payment delays was the major aspect that resulted in smooth conduction of construction projects and improved (Dubai 2016). The blockchain in smart contracts is associated with the elimination of all the uncertainties and ensuring transparency of the transactions. The smooth conduction projects in the construction sector has resulted in making residents and citizens contented with this technology (Salama & Salama 2018). The satisfaction level of consultants, contractors, stakeholders and subcontractors has also been approached and increased via use of blockchain technology in smart contracts for the construction projects (Ahmadisheykhsarmast & Sonmez 2018). Smart contracts using blockchain technology also help in the management of list of goods in the supply chain and how much payment has been made for these goods. Once the payments are made, shipments of the smart contracts are ensured (Gupta et al., 2020). A significant and positive impact is made on the project progress and may also speed up the delivery process. Contractors, consultants, and stakeholders play an important in the construction sector and their demands must be resolved (Zhang 2020).

### Theme 2: Improvement in Governmental Transactions

From the responses of the participants, it has been reviewed that the Blockchain Strategy implemented by the UAE government has significant positive influence on the governmental transactions.

One of the major aims of the governmental Blockchain Strategy 2021 in the UAE is associated with the improvement governmental transaction systems (Krishnan et al., 2020). According to the responses of the participants, the Strategy is developed to capitalize on the blockchain technology for 50% of the government transactions. Analysis of responses of the participants indicate that the application of blockchain technology under the governmental strategies for UAE is directly associated with the impacts on the governmental efficiencies and reduction in payment delays, thereby positively influencing the UAE economy. Analysis of the responses of participants has also indicated that UAE government has efficiently launched the strategy even though the state is going through sever pandemic situation. COVID-19 pandemic has significantly affected the current situation in construction sector (Gupta et al., 2020). Thus, UAE government was required to go digital for various tasks associated with the construction project (Penzes 2018).

Information management through technological means has been substantially approached via blockchain technology (Bishr 2019). Presence of multiple players in the construction sectors require information management through efficient means and a reliable infrastructure while going through the phases of construction project (Anonymous 2020). One of the participants also highlighted the importance of building information modelling that has been considered to conduct efficient application of centralized building information model. In this modelling prospect, blockchain technology has been assessed to sort any legal issues that might be encountered, while managing all the information transactions (Dubai 2016). While addressing the various advantages of blockchain technology in construction industry, reliability of construction logbooks was recognized to become improved with this technology.

### **Theme 3: Improvement in Legislative Compliance**

By the use of schemes under 2021 Strategy, there has been observed significant compliance with the legislations and policies in the UAE, implemented for the construction sector (Anderson 2018). The primary legislating regulation currently being followed in the construction sector is the Civil Transactions Code which covers the section on construction and general contract principles. According to the analysis of responses of the participants, Civil Transaction Code is being efficiently followed under the Blockchain Strategy 2021 (Nicosia 2019). The federal law has been further

required to be complied upon efficiently by the contractors and consultants. The Blockchain Strategy 2021 would further improve the working efficiencies of employees in the IT and finance despite the various challenges posed by global pandemic situation (Luo et al., 2019).

## **8 Conclusion and Recommendation**

Blockchain Strategy 2021 implemented by the UAE government has been reviewed in this study . The use and implications of blockchain strategy in management of smart contracts in the construction sector have been evaluated through primary data collected through interviews. Participants of the research belonged from IT and finance sector of a construction company and had substantial knowledge of the application of blockchain strategy in the construction sector. Thematic analysis has been applied on the research findings which resulted in formation of three main and potential themes; impacts of application of Blockchain Strategy 2021, improvement in general transactions, and improvement in legislative compliance.

Research findings suggest that digital means of information management strategies were required urgently in the construction sector of UAE. Moreover, with the global pandemic situation, application of digital means of data storage, exchange and management was also required crucially. COVID-19 has impacted the overall operations and functions in the construction sector resulting in delay in the payments, suspension claims, and suspension of various large-scale projects due to restricted activities. With the implementation of Emirates Blockchain Strategy 2021, research highlighted the importance of economic stability through construction sector in UAE. Among the several advantages identified by the blockchain technology in smart contracts management, traceability of the of the proposed work would become easy, as suggested by the participants. This tracking and traceability would also result in further identifying all the detail the construction process is going through in different phases; such as their quantities, the origin, distribution of materials, quality, used machineries and the construction techniques.

Based on the findings of this research, certain recommendations can be made for the construction sector. Professionals in the IT departments of construction sector must comply with the legislative framework currently followed i.e., Civil Transaction Code, which ensures efficient transaction methods of payments to be followed (Strategy 2019). Furthermore, professionals in the construction sector can also employ various other digital platforms of data

management and use digitalized strategies and software (Luo et al., 2019). By developing competent framework for the construction industry, policymakers may also address the effective application of blockchain strategy in the small and medium sized construction companies.

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