Al-Azhar University Civil Engineering Research Magazine (CERM)
Vol. (44) No. (2) April . 2022

THE IMPACT OF USING BLOCKCHAIN TECHNOLOGY IN FINANCIAL MANAGEMENT OF CONSTRUCTION PROJECT

Manal A. Elfadil[1] and Prof. Dr.Omar Elnawawy[2] , Prof.Dr. Ayman Hamdy[3], Prof.Dr. Mohamed Mekawy[4]

[1] Author, Ain shams University, Cairo, Egypt, and E-mail: manal.aqeed@gmail.com
[2] Prof.Dr, Ain shams University, Cairo, Egypt, and E-mail: nawawyomar@hotmail.com
[3] Prof.DR, German University, Cairo, Egypt, E-mail: ayman.hamdy@guc.edu.eg
[4] Prof.DR, Ain shams University, Cairo, Egypt, and E-mail: melmikawi@gmail.com

الملخص العربى :

قد أدى التقدم في التكنولوجيا إلى مشهد سريع التغير لعقود البناء. يكافح المحامون لمواكبة وتيرة الابتكار ، والحاجة إلى توفير الحلول القانونية واستيعاب الأساليب الجديدة. أصبحت نمذجة معلومات البناء جزءا من اللغة الشائعة في البناء على الرغم من الأدلة المحدودة على تأثيرها على الأرض. تظهر العقود الذكية كامتداد منطقي ل بيم حيث يصبح الأداء التعاقدي نفسه آليا. ومع ذلك ، تعمل العقود الذكية بشكل أفضل حيث تكون قصيرة الأجل أو ذات تأثير فوري. هذا يتعارض مع الطبيعة المعقدة والطويلة الأمد لمشاريع البناء. علاوة على ذلك ، فإن قيود التخزين والتوافق ومشكلات الموثوقية جنبا إلى جنب مع السرية والطبيعة طويلة المدى لدفاتر الأستاذ الموزعة تشكل مشاكل إضافية. يناقش هذا العمل ما يمكن تحقيقه في صناعة البناء من خلال اعتماد العقود الذكية. وقدم منتدى على شبكة الإنترنت بيانات ثانوية لإعطاء السبر بشأن القضايا المثارة. الأهداف هي إدخال جوانب التقدم التكنولوجي في التجارة بشكل عام وإجراء اتصالات مع أفضل الممارسات والقيود داخل البناء. الفرضية المتقدمة هي أن جوانب معينة من عقد البناء لا يمكن أن تكون ذكية تماما وأفضل ما يمكن تحقيقه على المدى القصير إلى المتوسط هو وضع شبه آلي. علاوة على ذلك ، يجب النظر إلى العقود الذكية كجزء من الثورة التي يقودها بيم في البناء

وليس منفصلا عن ذلك. والتوصية هي أن تستهدف أوجه التقدم الإضافية ، مثل ترميز بيانات إدارة المشاريع وإدارة العقود ، من أجل تحسين الكفاءة التشغيلية وتحقيق وفورات في القيمة .

Abstracts

Advances in technology have resulted in a fast-changing landscape for construction contracts. Lawyers struggle to keep up with the pace of innovation, the need to provide legal solutions and accommodate new approaches. Building information modelling (BIM) has become part of the common parlance in construction notwithstanding limited evidence of its impact on the ground. Intelligent contracts appear as a logical extension to BIM whereby the contractual performance itself becomes automated. However, intelligent contracts work best where they are short term or are of instantaneous effect. This is at odds with the complicated and long-running nature of construction projects. Further, storage constraints, compatibility, and reliability issues together with confidentiality and the long-term Nature of distributed ledgers

pose additional problems. This work discusses what could be achieved in the construction industry by the adoption of intelligent contracts. An online forum provided secondary data to give soundings on the issues raised. The objectives are to introduce aspects of technological advancement within commerce generally and to make connections with best practice and limitations within construction. The hypothesis advanced is that certain aspects of the construction contract cannot be fully intelligent and the best that can be achieved in the short to medium term is a semi-automated position. Further, intelligent contracts should be viewed as part of the BIM-led revolution in construction
And not separate from it. The recommendation is that incremental advances such as the coding of project management and contract administration data be targeted to provide improved operational efficiency and value savings.

Key words : Block chain, Smart contract, Traditional contract, Cash Flow

1. THE INTRODUCTION

This research introduces a new technology called Block chain technology and the main cause of this research is that the construction industry faces many challenges and one of the main Challenges that it faces the payment insolvency and the third-party trust, which results in Unnecessary cost as well as time delay.
Traditional contract which depends on traditional paper and clauses, could be implemented or not which means that there are escalating disputes with presence of a third party, and that waste time and expenses.
Smart contract which depends on Block chain technology 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. The principal, if using a smart
Contract, is entitled to embed currencies into the contract together with several conditions to be
Fulfilled by the contractor to be paid. The contractor only needs to deliver their scope of works.
The smart contract is one of the main applications of block chain technology that has an essential Role in digitalization of traditional paper contracts. Block chain is a distributed database (ledger)
That maintains a list of records (of transactions, information, Internet Protocol (IP) …etc.).
These records are called blocks. Each block has a timestamp, a link to the previous block, and contains the history of every block (transaction) that came before it down to the second it was Created.

This ‘chains’ the blocks together. The whole system is end-to-end encrypted. Every transaction is linked to a unique cryptographic signature (called a hash function) that is easy to verify and nearly impossible to falsify because the block chain is hosted by a growing network of (personal)
Computers; each computer is a ‘node’ in the system and each node monitors every other node on a continuous basis. The system grows with each transaction and can become global.
The traditional contracts on constructions and payment insolvency area discusses the issues
Facing the construction industry in general and the contractors in particular regarding the
Insolvency in payment and how the presence of a third party affects the whole project regarding
Payments and time schedule and on the other hand adding no value to the project.
This Report covers the potential of using Smart Contracts and block chain technology in
Construction management for civil engineering projects. First will start with the traditional
Contracts on constructions and payment insolvency area discusses the issues facing the
Construction industry.
The second area defines the block chain technology and its characteristics, then it discusses its
Advantages for the construction industry and how can future projects benefit from this
Innovative technology.
The third area will be a detailed literature review on the function of Smart Contracts as well as its
Viability in other fields. In addition, it will define the core of this report which is the smart
Contracts and its characteristics and how it can be beneficial to this industry which lacks the
Dynamic feature regarding accepting new technologies, it also discusses its advantages and
Disadvantages and its potential to the construction industry and the platform that can operate the
Smart contracts.
This can indicate that the topic is still new and has minimum application until now in the field of Construction and is only based on researches. Therefore, there is a deeply need to embrace a
Framework to understand the construction company’s familiarity with the smart contracts and the Block chain technology.
Finally, the report process recommendations for future research studies. In addition to, A
Methodology for a currant new research will be included depending on a questionnaire to be
Developed to see how the companies as well as professionals who work in the field of
Construction view the smart contracts and if it is a viable option for them to use in the near
Future. The methodology to be adopted will look over about the experts’ opinion about the use of Smart contract in the construction field.
A professional questionnaire will be directed to
Construction companies in Egypt as well as companies outside Egypt. As secondary approach, the study would provide a

Questionnaire/interview with one of the major operators of the smart
Contracts -if possible- to better understand their technology and how they see its potential to the
Construction industry.

2. THE OBJECTIVE:

Study the impact of using blockchain technology for construction projects focusing on financial management.

We propose a design methodology for the smart contract conducted on financial management of construction projects using blockchain technology. Specific focus on the issues facing the construction industry in general and the contractors in particular regarding the insolvency in payment and the effect of the presence of a third party.

Using model by using excel and financial sap :to enhance cash flow curves in case of using electronic method depending on questionnaire and data collection.

And drawing cash flow diagram for real model for three building as a part of madinaty project using traditional method of contract, drawing cash flow diagram for the same buildings using electronic method and compare them if there is an improvement in the curve or there is no change and if we assume there is an improvement whether the use of smart contracts instead of the two is a greater improvement or not and based on expert responses.

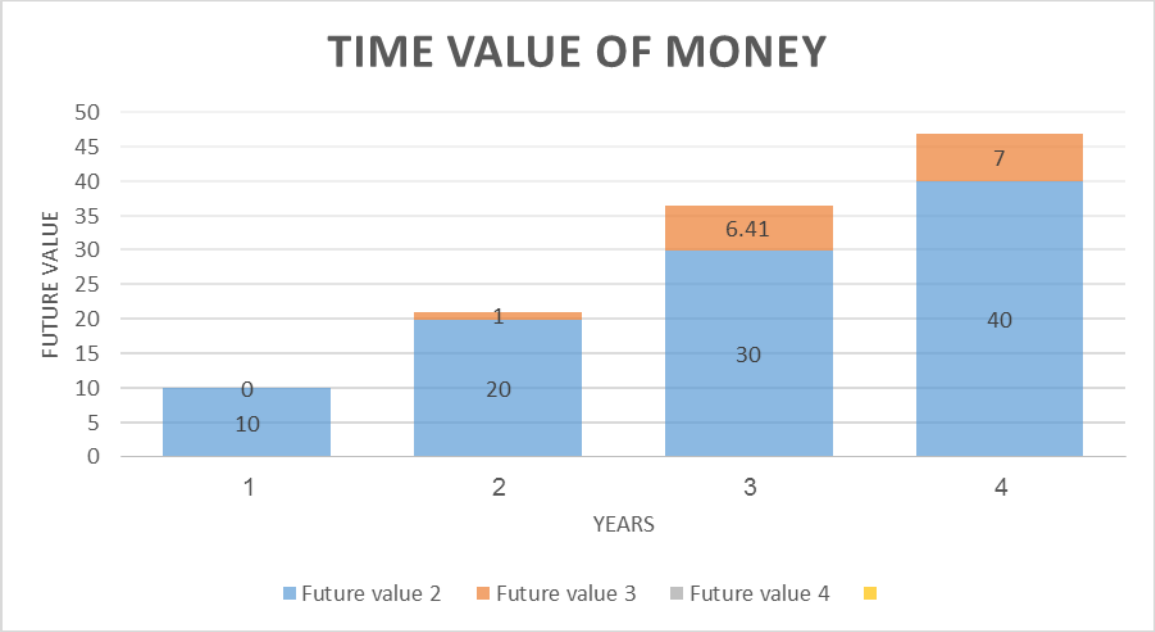
Create and distribute a survey on blockchain technology in construction projects. Collect responses from experts and professionals based on their responses to the questionnaire survey to determine their knowledge of blockchain (and smart contracts) and its applicability in construction projects. This is followed by a discussion and identification of trend.

Explain the time value of money and its relationship to the search results and its relationship to the block chain

Future Value and compounding the first thing we will study is future value. Future value (FV) refers to the amount of money an investment will grow to over some period of time at some given interest rate. Put another way, future value is the cash value of an investment at some time in the future. We start out by considering the simplest case: a single-period investment

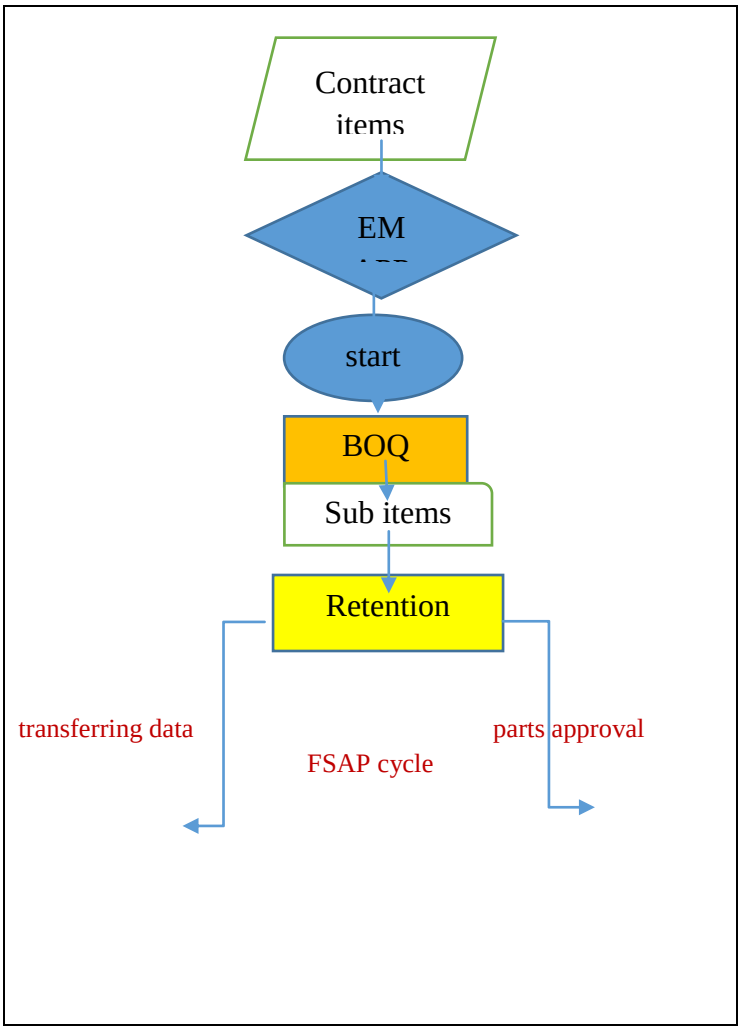
AN EXAMPLE:

Suppose you invest $100 in a savings account that pays 10 percent interest per year. How much will you have in one year? You will have $110. This $110 is equal to your original principal of $100 plus $10 in interest that you earn. We say that $110 is the future value of $100 invested for one year at 10 percent, and we simply mean that $100 today is worth $110 in one year, given that 10 percent is the interest rate. In general, if you invest for one period at an interest rate of r , your investment will grow to (1+1 r) per dollar invested. In our example, r is 10 percent, so your investment grows to 1 + .10 = 1.1 dollars per dollar invested. You invested $100 in this case, so you ended up with $100 * 1.10 = $110.



4.4 Figure (1)

In the previous example we need to take time value of money in our considerations so we need technology to take this considerations as smart contract because if traditional contracts and traditional methods are used in the disbursement of invoices, from the contractor's point of view, there will be a delay in disbursing invoices, and therefore a delay in time, which leads to inflation and the value of money decreases when disbursed late. In this research, electronic methods will be used as an alternative to the blockchain and smart contract applications to prove that if these smart contracts are used, cash flows will improve, from the contractor's point of view.



4.4 Figure (2) FSAP Cycl

3. THE Literature reviews:

Table 1 of Authors

Authors	Purpose	Method of statement	Limitation and obstacles
1-Cardeira et al.(2015)	Proposed a block chain framework to minimize time and cost.	The study reveals the main benefits of knowledge mapping for FM improvement in decision making process. Problem identification and solving by providing quick access to critical information. Knowledge gaps and island of expertise	Did not take into account price fluctuation
2-Ko et al. (2018)	Effect of real time and cost saving	By using real statement with application to simulate the block chain software's as primavera	Not mentioned
3-Figorilli et al.(2018)	Transparency in the sales and a block chain-	based frame work and solution for online publishing and sale of digital assets	A lack of practical applications to validates the usability
4-Firas et al.(2017)	Propose a list of requirements for a human and machine-readable contract authoring language , friendly to lawyers , serving as a common	By studying other researches	Research challenge which is the ability to translate the aforementioned language to executable code
5-Zaheer et al.(2018)	Explores the concept of smart contracts through the block chain technology	By studying other researches	There are no legal frame work backing or supporting smart contract
6-Ahmed S.almasoud et al.(2020)	This research has not proposed a framework that facilitates the interchangeable use of	-systematic mapping study was selected as the research methodology for this	-Skills is very limited and there is a lack of empirical evidence

	smart contracts for block chain but introduce the advantages of smart contracts	**study -by using some prototype applications such as IOT**	
7-Maher Alharby et al(2017)	**Is to identify the research topics that have been carried out about block chain-based smart contract**	**- By read more than 30 scientific papers and know the advantages and disadvantages of block chain technology**	**-The identified gaps are the lack of studies and performance issue, -the lack of studies on deploying smart contract on different block chain platforms other than Ethereum**
8-Willi et al .(2018)	**This research aims to demonstrate the importance of cash flow generating standard for individual financial contract level data and the ability to create such a standard**	**-hashing algorithms in block chain platform and smart contracts**	**-Many people still confuse block chain technology with Bit coin , however , they are not the same Bit coin is just one of maney applications that use Block chain**
9-Nishara et al. (2018)	**-Propose a solution to provide originality and authenticity of published and posted freely online digital content such as a book.**	**-the analysis will particularly focus on risks related to a dominant position of private powers in distributed ecosystems and on the possible emergence of a stateless global society**	**More programmers to transform the language of the law into an understandable language**
10-Syed et al .(2020)	**-this research present a new penetration testing frame work for smart contracts and decentralized apps.**	**-Simulation of block chain software systems using financial SAP**	**-Average programmers and developers cannot implement Blockchain this need specialized**

			skills.
11-Rifat sonmez et al.(2020)	**Third party and mediators such as bank or lawyers presence causes problems and novel smart contract payment security system named SMTSEC solves this problems.**	**By using technology named SMTSEC (Novel Smart contract Payment Security System.**	**Scalability has been remained a challenge for the block chain from technical level**
12-Schar et al. (2021)	**1-Defi: decentralized finance purpose to an alternative financial infrastructure built on top of the Ethereum block chain** **2- to create protocols that replicate existing financial services in a more open , interoperable, and transparent way**	**Using small applications stored on a block chain and executed in parallel by a large set of validators. In the context of public block chains, the network is designed so that each participant can be involved in and verify the correct execution of any operation.**	**Defi: has certain risks , namely ,smart contract execution risk , operational security , and dependencies on other protocols and external data as if there are coding errors, these errors may potentially create vulnerabilities that allow an attacker to drain the smart contract's fund**
13-Evin Ozkan , Neda Aziz et al. (2021)	**This research has multiple objectives:** **1-to enhance the procurement process** **2- to analyze how these improvements support companies to gain competitive advantages in their industries**	**The textual analysis supported us to understand the participants' opinions and experiences in the business context. When we were analyzing the data, we read the text in detail and discussed participants' responses within the business context.**	**The authors declare no conflict of interest**
14-Karamitsos et al.(2018)	**Propose for obtaining optimum management of the smart city's assets**	**use case for renting residential and business buildings is examined**	**Blockchain technology are generally not suitable for IoT applications**

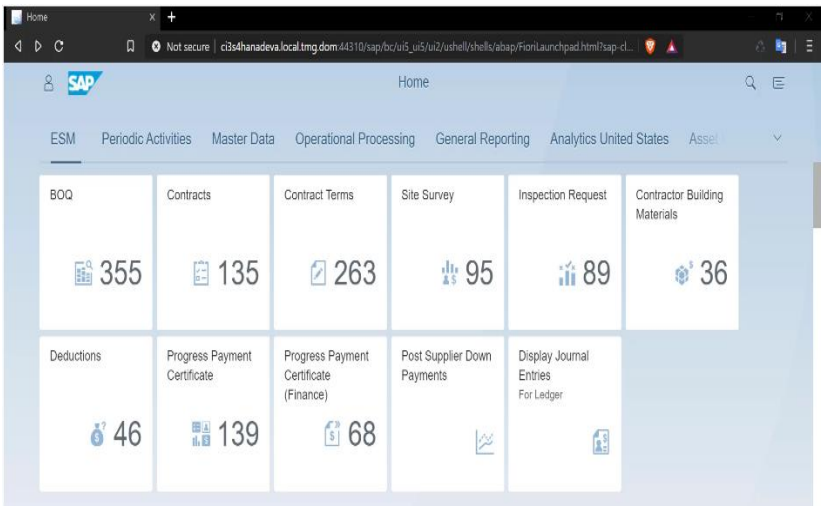
			because IoT devices may have to work with low computational capability or very low power
15-Ahmedishy Khsarmast et al.(2018)	**Minimizes the time-cost overruns by using smart contract with real state**	**-By providing an example from procurement phase within the construction industry, procurement process and LOC necessity is explained** **-integrating smart contracts with project management software such as Primavera**	**Smart contract and block chain technologies are unchangeable, which means that once a smart contract is created it can never be modified again. So, tampering with the code and smart contract is almost impossible**
16-Yongshun et al.(2022)	**Improvement and transform AECO industry by using block chain technology specially smart contract**	**Using Excel software to compare curves before using block chain and smart contracts and after using smart contract software for financial flows**	**A lack of practical applications to validates the usability**
17-Salleh,Rozan Mohamed.(2017)	**Study the effect of Block chain technology on contract management with smart contract applications with real state**	**with smart contract applications with real state**	**Research challenge which is the ability to translate the aforementioned language to executable code**
18-Alan J.Mcnamera et al.(2021)	**Propose for identify key considerations for I contract in order to develop theoretical adoption model and offer an agenda of six research directions for future I contract development**	**-by using charts to illustrate how I contract will use in general**	**Not mentioned**

	Then identified nine key themes of relevant considerations , barriers and contributing factors informing the development of the Tri-Dimensional I contract model		
19-Manjupillai et al.(2013)	**Automated systems to reduce the amount of time it takes to create , negotiate , review , execute and approve contracts with an electronic that automates workflow with methods**	**Method of real statement using software programs as Excel to explain benefits of block chain and to simulate this applications used in smart contract**	**There are no legal frame work backing or supporting smart contract**
20- Maria Papadak et al.(2017)	**Contribute to the body of knowledge of smart contracts within block chain technology .Based on a systematic mapping study**	**Offer a broad perspective on their problems and corresponding and**	**Double confirmation and blocking : when different nodes with access rights modify the same state of the same smart contract it may face double confirmation**

Based on previous table: this research aims to show the importance of the blockchain and the application on it and its impact on financial.

Blockchain advantages:

- More secure
- We don’t need a third party trust
- Transactions are submitted automatic when conditions are met
- Data change difficulty and therefore forgery is not possible
- the application(in smart contract)
- note that in previous data the authors didn’t took the financial management effect on cash flow diagram and in this research we will show this effect by using financial sap program as electronic method and diagram the cash flow in excel program and the blow figure will show the application of FSAP as electronic method



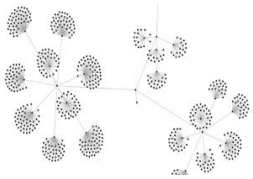
4.4 Figure (3) shows the program interface.

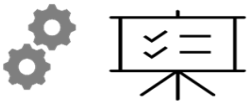
And in this research according the advantages of blockchain and its application (smart contract) with previous authors including their problems about the lack of studies and skills we have to define the smart contract and its impact on financial management which is research topic.

- A smart contract is a computer protocol that is stored inside the blockchain, and is intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract.
- A smart contract would be activated/executed automatically when certain condition are met.
- The clauses and terms of a traditional contract are replaced by sentences and commands written in lines of code.
- Besides, a smart contract can be created by machines or programs that operate automatically.
- They are valid without depending on the authorities that regulate it.
- It is an immutable code and visible by all it based on blockchain technology

Smart contracts depend on Ethereum, which is a platform that is built especially for creating smart contracts

1. Smart contract steps:





Coding Execution

Distributed ledger

4. CONCLUSION:

Types of contracts depend on how the owner and contractor guarantee their rights and they are generally formulated in a traditional with hard document in detailed clauses, and this requires the presence of specialized engineers to interpret these clauses to preserve the rights of the two parties, which make this method expose one of the parties to losing of their rights in the event of lack of detailed study.

And the smart contract which uses blockchain technology solved this problem.

5. REFERENCES:

1. HELDER CARDEIRA, "SMART CONTRACTS AND POSSIBLE APPLICATIONS TO THE CONSTRUCTION INDUSTRY", NEW PERSPECTIVES IN CONSTRUCTION LAW CONFERENCE, BUCHAREST, ROMANIA, MARCH 2015.
1. ZAKARIA DAKHLI , ZOUBEIR LAFHAJ, ALAN MOSSMAN, "THE POTENTIAL OF BLOCKCHAIN IN BUILDING CONSTRUCTION", J. BUILDINGS, APRIL 2019
2. MAHDI SAFA, SYLVIA BAEZA AND KELLY WEEKS, "INCORPORATING BLOCKCHAIN TECHNOLOGY IN CONSTRUCTION MANAGEMENT", EMERALD, OCTOBER 2019
3. ŽIGA TURKA, AND ROBERT KLINCB, "POTENTIALS OF BLOCKCHAIN TECHNOLOGY FOR CONSTRUCTION MANAGEMENT", CREATIVE CONSTRUCTION CONFERENCE 2017, CCC 2017, PRIMOSTEN, CROATIA, JUNE 2017
4. SHOJAEI A., FLOOD I., MOUD H.I., HATAMI M., ZHANG X., "AN IMPLEMENTATION OF SMART CONTRACTS BY INTEGRATING BIM AND BLOCKCHAIN". IN: ARAI K., BHATIA R., KAPOOR S. (EDS) PROCEEDINGS OF THE FUTURE TECHNOLOGIES CONFERENCE (FTC) 2019. FTC 2019. ADVANCES IN INTELLIGENT SYSTEMS AND COMPUTING, VOL 1070. SPRINGER, CHAM, 2020
5. JAN VEUGER, "TRUST IN A VIABLE REAL ESTATE ECONOMY WITH DISRUPTION AND BLOCKCHAIN", 2ND CONFERENCE OF INTERDISCIPLINARY RESEARCH ON REAL ESTATE, CARTAGENA, SEPTEMBER 2017
6. JIM MASON, "INTELLIGENT CONTRACTS AND THE CONSTRUCTION INDUSTRY", J. LEG. AFF. DISPUTE RESOLUT. ENG. CONSTR., 2017
7. S. AHMADISHEYKHSARMAST, R. SONMEZ, "SMART CONTRACTS IN CONSTRUCTION INDUSTRY", 5TH INTERNATIONAL PROJECT AND CONSTRUCTION MANAGEMENT CONFERENCE (IPCMC2018), NORTH CYPRUS,2018