SMART CONTRACTS AND BUSINESS DECISION

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Abstract

In the last 10 years the blockchain technology has become mainstream research topic because of its features that offers, as: decentralized system, peer to peer (P2P) transaction, distributed consensus, and anonymity properties. Also, the blockchain technology overshadows regulatory problem and technical challenges and one of the opportunities that offers the blockchain technology is the 'smart contract'. A smart contract is a set of programs that can be much better from the traditional contracts for some features which are self-verifying, self-executing and tamper resistant. Also, smart contract with the integration of blockchain technology without which cannot function, is capable of doing a task in real time with very low cost and provide a greater degree of high security level. The aim of this paper is to explain the concept of the smart contract and its components and function. The paper is aimed at presenting the issue of smart contract, blockchain technology. The specific focus was on the application of smart contracts in real estate.

Key words:
Contracts, blockchain technology, real estate, business, contract law

JEL Classification O31, P14, L85 https://doi.org/10.52665/ser20230204

INTRODUCTION

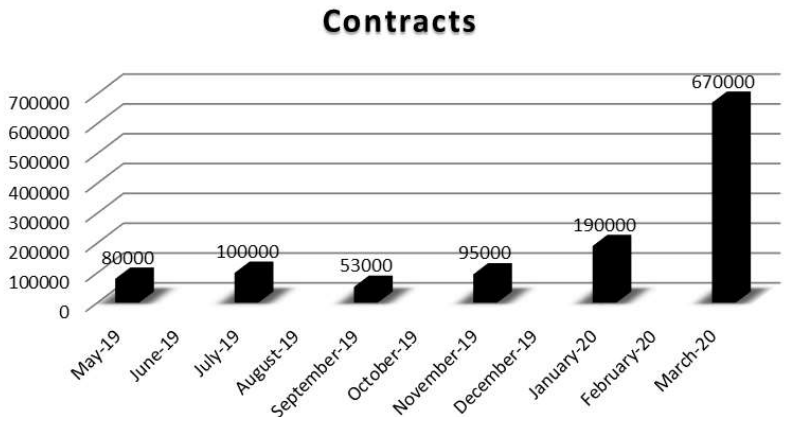
The world is built on contracts and no individual or firm on earth can function in current society without the use and reuse of contracts. The task of creating, maintaining, and enforcing contracts have become so complicated that entire judicial and legal systems have had to be setup in the name of "contract law" to support it. Most of all contracts are in fact overseen by a "trusted" third party to make sure the stakeholders at the ends are taken care of as per the conditions arrived. There are contracts that even talk about a third-party beneficiary. Such contracts are intended to have an effect on a third party who is not an active (or participating) party to the contract (Levi, Lipton, 2018; Giancaspro, 2017). Settling and arguing over contractual obligations takes up the bulk of most legal battles that civil lawsuits are involved in. Surely enough a better way to take care of contracts would be a godsend for individuals and enterprises alike. Not to mention the enormous paperwork it would save the government in the name of verifications and attestations.

After its inception in 2009 the Bitcoin cryptocurrency has undergone a meteoric rise. The transactions involving bitcoins are stored as an electronic payment system in a public, distributed, decentralized, and shared ledger that needs no intermediaries such as a central bank. Due to the use of cryptographic techniques, the distributed ledger, now named Blockchain, is immutable and auditable, thus providing an uncensored source of trueness. Regardless of this concept, blockchains can be seen as special types of distributed database systems, i.e. a platform for data analytics (Giancaspro, 2017). Blockchains are different because they have centralized control, which ensures that no one person has the ability to roll back or alter the past, whereas conventional centralized databases are centrally managed by an agency who can change access rules or modify records.

Blockchains also made event-driven, self-executing code statements known as smart contracts possible. They allow for the encoding of rules and circumstances decided by the various trading parties. Those contracts execute pre-specified tasks autonomously, such as settling a deal, by analyzing changing environmental conditions in accordance with the embedded rules of the deal. There is currently tremendous regulatory confusion about the status of smart contracts and blockchains. In addition, there are technology shortcomings which need to be addressed before smart contracts can be completely accepted and adopted.

The smart blockchain technology is in a good way of usage. This is proven even form the number of people who have started to make their personal contract based in this blockchain technology. Based on a report done by the cointelegraph.com on April 23, 2020 by 'Joshua Mapperson', related to smart contracts. Based on his analyzes have concluded that the most preferable for people is the Ethereum smart contract which belongs to public blockchain. Based on his report the total number of the Ethereum blockchain has reached nearly 2M (1,971,632), and the highest level of use has reached on March 2020. Below in the Chart 1, are shown these numbers of contracts per every two months since May, 2019.

Chart 1: Number of Contracts every 2 months

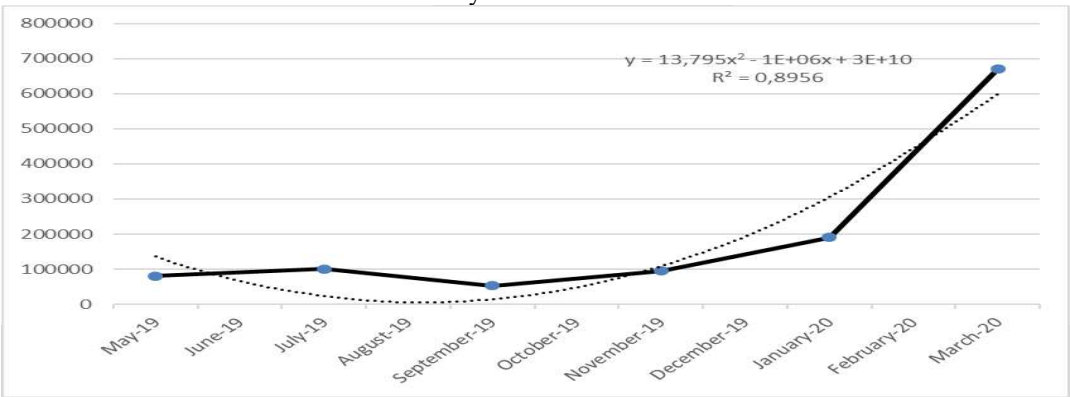


Source: https://cointelegraph.com/news/ethereum-smart-contracts-up-75-to-almost-2m-in-march

As can be seen from the chart above, the number of smart contracts last 5 months has a huge increase in usage thing that makes us conclude that people are understanding more and more the way how smart contracts can replace the traditional contracts.

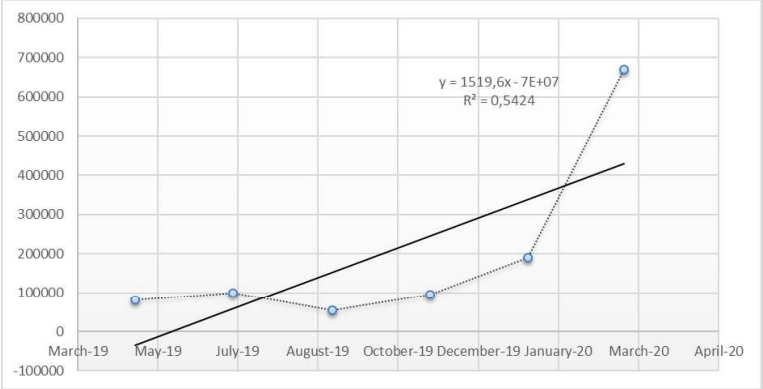
And below in the chart 2, based on the previous chart where is shown the usage number for smart contracts we have tried to add a polynomial trend-line and in the chart 3 we have used the linear trend-line where in both are shown forecast for this period. Based on this analyze we can conclude that number of smart contracts is increased and will keep doing this for a good period time.

Chart 2: Polynomial Trendline Chart



Source: own processing

Chart 3: Linear Trendline Chart



Source: own processing

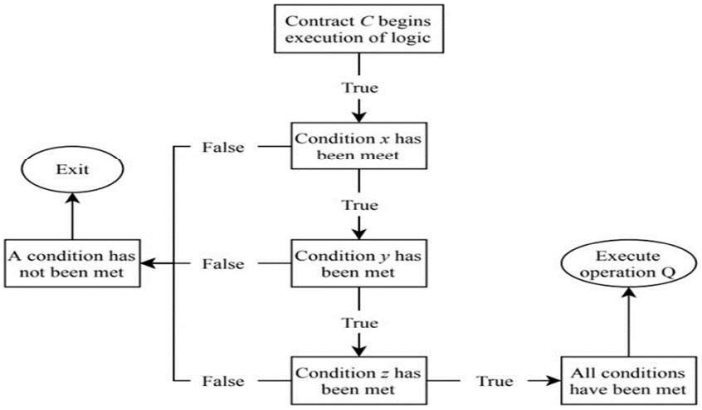
LITERATURE REVIEW

According to Carvalho, Gilcrest (2018) and Sadiku, Eze, Musa (2018) the idea of the term 'smart contract' was firstly proposed by Nick Szabo, a computer scientist and cryptographer. Based on him, briefly, a smart contract can be looked as a self-executable computer program or computer code that is able to carry out the terms of a small data contract or big data like a business agreement between two or more parties. Smart contract contains automate algorithms, which are used to be executed when any certain conditions are met.

In the Fig.1 is shown a model of those algorithm, how the program is running step by step during any execution of any operation. Suppose a smart contract C that has as input 3 conditions X, Y and Z. and produces an output operation Q. Based on this logic a smart contract is executed. Complexity of any smart contract is depended by the input conditions (X, Y, Z or more), and the required output.

Is also important to be said that there is some smart contract which may have an arbitrary amount of operational conditions. But in practical terms and conditions, any modern smart contract is able to execute successfully any algorithm, started form the simplistic procedure as in Fig. 1 to much more complex procedures for executing a required operation.

Fig. 1: Execution logic of a smart contract C



Source: Carvalho, A., Gilcrest, J. (2018). "Smart Contracts: Legal Considerations"

As can be seen from the Fig. 1 where is explained the logic of execution of a simple contract between two parties, passes through some steps. Firstly, the program starts running and then the program faces with inputs, which in this event are the conditions. In this example are total 3 conditions, but there can be less conditions or more conditions in some more complex programs. If any of those three conditions X, Y or Z is not met by the operation of the contract Z, then this contract operation will be terminated and the program will require from user to Exit. Otherwise if all the three conditions will be met, the program will show to user that the Contract C is executed in operation Q and the program is finished with the procedure of executing a smart contract.

How Smart Contract Works

A smart contract is a user-defined program running in blockchain technology. Smart contracts allow the execution of valid transactions between multiple agents, without any third parties. The main goal of any smart contract is to provide security that is superior to traditional contract law while reducing the transaction cost too (Mohanta, Panda, Jena, 2018; Sadiku, Eze, Musa, 2018). All smart contracts have some features which makes the smart contracts much better and more trustable for users despite the traditional contracts, Fig. 2.

Fig. 2: Features of Smart Contracts

Source: own processing

Applications of Smart Contract

A Smart Contract can be useful in a wide range of industries and companies or institutions such as healthcare, automobiles, real estate, insurance, lotteries, supply-chain management, cryptocurrency exchanges, financial exchanges, covenants, law, government (e-voting system), creating a will and many more fields (Sadiku, Eze, Musa, 2018; Yining, Manzoor, Seneviratne, 2019; Norta, Kormiltsyn, Udokwu, 2018). Below we will mention some applications where this technology can be used, in such as:

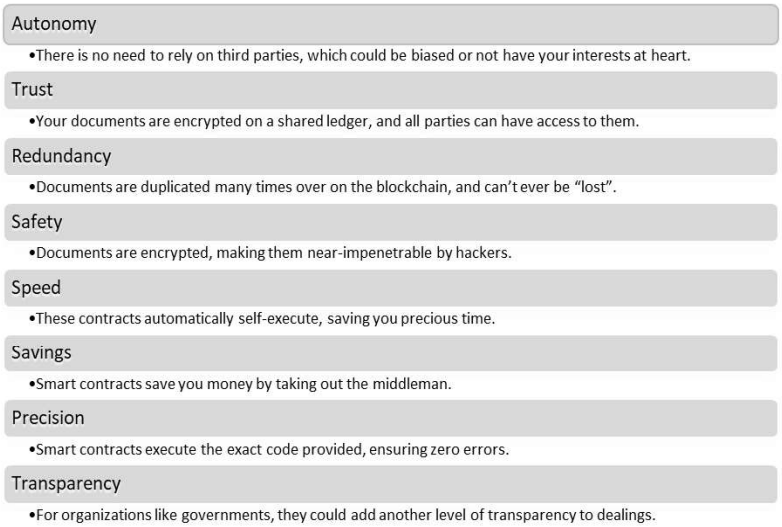
Automobile: For example, for self-parking vehicles, smart contracts could put into place a means of detecting who was at fault in a crash (if this happens). With the use of smart contracts, any automobile insurance company could charge rates differently based on conditions that are agreed and the situation that is created (after a crash).

Real Estate: For example, a real estate owner rent one apartment to tenant X, and the ledger can cut the costs based on the conditions agreed. All you do is to check the conditions and if both parties agree can easily sign the contract and doing payment easily, by paying via online payment or (cryptocurrencies) and encode your contract on the ledger (where cannot modified by approvement of both parties). You accomplish automatic fulfilment.

Healthcare: The health insurance contract can be made online through the blockchain and this will enable it to be viewed in any health institution. Since the contract is registered on the blockchain, all hospitals have access to see it. As well the ledger can be used for healthcare management, such as supervising drugs, regulation compliance, managing healthcare supplies and other parts of health field.

Smart contracts are appealing for a variety of reasons in Table 1. Differences between traditional and smart contracts are in Table 2.

Tab. 1: Benefits of Smart Contracts



Source: own processing

Tab. 2: Differences between TC and SC

	Traditional Contract	**Smart Contract**
Execution	From the signing till termination (agreed by parties or not)	Immediate and irrevocable
Readability	Easy for humans	Easy for machines (difficult for humans)
Adaptability of contracts to external events	Possible subject to parties involved in agreement	Difficult – contract stored in public blockchain Possible – contract stored in closed blockchain
Drafting	Slow – requires lawyers, originals exchanges and signing	Fast – if you can program Slow – if you require for programmers
Security	Limited	Cryptographically Protected
Archiving	Difficult	Easy
Data Extraction	Possible but very slow	Immediate / Automatic
Confidentiality	Good	None – if is stored in public ledger Excellent – if is stored in private ledger

Source: https://steemit.com/smartcontract/@blockchains-exp/differences-between-traditional-contract-and-smart-contract-more-here-https-www-blockchains-expert-com-en-are-smart-contracts-d6d6094f349b6

Blockchain Technology

A blockchain is a distributed database system that can keep records of all transactions that have ever occurred in the blockchain network. This database is replicated and shared among the network's participants. The main feature of blockchain is that, the blockchain allows even untrusted participants to have a communication and make transactions between each other in a secure way without the need of having a trusted third party, as traditional ones.

Blockchain contains an ordered list of blocks (of what is built), where each block is identified by its cryptographic hash that are unique. Each block contains information of the block that came before it, resulting in a chain of blocks (Alharby, Moorsel, 2017). Each block consists of a set of transactions that are done. After a block is created and then appended to the blockchain, the transactions in that block cannot be changed or reverted or manipulated. This is done to ensure the integrity of the transactions and in this way prevent double-spending problem.

As the first generation of the blockchain technology are emerged the cryptocurrencies. Cryptocurrencies are basically digital currencies (maybe future of fiat currencies) which are based on cryptographic techniques and peer-to-peer network. The first and most popular example of cryptocurrencies is Bitcoin. Bitcoin contains an electronic payment system which allows any two untrusted parties to exchange digital money with each other in a secure manner in blockchain without going through a middleman (as bank).

Transactions that occurred in the network can be verified by special nodes known as miners. Verifying a transaction is the process of checking the sender information and the content of the transaction. Miners generate a new block of transactions in the blockchain technology by solving a mathematical puzzle (called as Proof of Work) and then spread that block to the network. Other nodes in the network are used for making the validation of the correctness of the generated block and the build process is done only if it was generated correctly. However, Bitcoin system has a limited programming capability which are used to support even more complex transactions.

Other types of blockchains such as Ethereum have emerged the second generation of blockchain to allow building complex distributed applications beyond the cryptocurrencies, process that was not available at first generation (Blockchain). Smart contracts, for what will be discussed next in the following section, this type of contracts is considered as the main element of this new generation. Ethereum blockchain is the most popular and most used blockchain for developing the smart contracts. Ethereum is a public blockchain with a built-in Turing-complete programming language to allow writing any smart contract and any decentralized application (Alharby, Moorsel, 2017; Philippe, 2017).

There are two types of blockchain which are divided in public or private blockchain system. In the public blockchains, any anonymous user can join the network, to read the content of the blockchain and to send a new transaction or to verify the correctness of the blocks. Examples for the public blockchains are listed Bitcoin, NXT and Ethereum. In other hand, in the private blockchains, only authorized users which have permissions are able to join the network, to write or to do any transactions to the blockchain. It can be a company or a group of companies that are usually responsible for giving users the permissions for having access and joining the network. Examples for the private blockchains are Ever-ledger, Ripple and Eris.

The Automated Nature of Smart Contracts

One of the key attributes of the smart contracts is their ability for having an automatic and relentlessly execute during transactions without having the need for human intervention. However, this automation nature and the fact that smart contracts cannot easily be amended or terminated unless both the parties included in the contract incorporate for capabilities during the process of creation of the smart contract, present some of the greatest challenges which can be facing widespread during the adoption of smart contracts.

For example, with traditional paper contracts, a party can easily excuse a breach, simply by not enforcing the available penalties. If a valued customer is late with doing its payment for one month, the vendor can make a real-time decision for preserving the long-term commercial relationship as more important than any available termination right or for allowing customer to pay late fee. However, if that partnership had been reduced to a smart contract,

there would probably not be the option of not implementing the agreement on an ad hoc basis. A late payment will result in the automatic withdrawal of a late fee from the customer's account or the suspension of a customer's access to a software program or device connected to the Internet if that is what the smart contract was programmed to do. The automated execution provided by smart contracts might therefore not align with the manner in which many businesses operate in the real world (Torres, Brann, 2019; Karamitsos, Papadaki, Al Barghuthi, 2018).

Similarly, in a paper text-based contractual relationship, a party may be willing to accept, on an ad hoc basis, partial performance to be deemed full performance. This may be due to an interest in sustaining a long-term relationship, or because a party decides that partial success is preferable to no success at all. Again, smart contract code objectivity cannot reflect the reality of how contracting parties communicate.

Amending and Terminating Smart Contracts

There is actually no easy way to amend a smart contract, posing some problems for contracting parties. For example, if the parties have mutually agreed to alter the terms of their contractual agreement in a typical text-based contract, or if there is a change in legislation, the parties may easily draft an amendment to resolve the change, or simply modify their course of actions. Actually, smart contracts do not deliver the versatility. Nevertheless, since blockchains are permanent, it is much more difficult to change a smart contract than to change standard software code which does not reside on a blockchain. The consequence is that changing a smart contract will result in higher transaction costs than amending a text-based contract, which raises the margin of error that the parties do not correctly represent the changes they wish to make. There are common issues as to ending a smart contract.

Assume a party discovers a mistake in an agreement that gives the counterparty more rights than intended, or decides that it will be much more expensive to satisfy its specified obligations than anticipated. A party can engage in, or threaten, so-called "effective breach" in a text-based contract, i.e. knowingly breach a contract and pay the resulting damages if it decides that the cost to conduct is greater than the damages that it will owe. In addition, a party can bring the counterparty back to the table to negotiate an amicable resolution by ceasing results, or by threatening to take that action. Smart contracts also don't provide similar self-help remedies (Karamitsos, Papadaki, Al Barghuthi, 2018).

Projects are currently under way to build smart contracts which can be terminated at any time and updated more easily. Although this is in several respects antithetical to the unchanging and automatic existence of smart contracts, it illustrates the fact that smart contracts can only achieve market adoption if they reflect the business reality of how contracting parties behave.

Smart Contract for Real Estate

For this use case, the Blockchain of any platform type can be selected. The real estate serves as landlord for the properties that allow the use of blockchain technology to rent a variety of residential and commercial properties.

Analysis Phase

A collection of requirements from various individuals into the organization is needed during the analysis process. A series of workshops are then developed to explain how blockchain technology and smart contracts can provide organizational benefits and recognize participants, positions, and responsibilities.

Actors/Roles Externally Owned Accounts (EOA):

The landlord and tenants as outsourced accounts held. Private keys control those accounts. This actor can create value transfer transactions, create smart contracts or call contract functions.

Contract Accounts (CA):

Their own code manages those accounts. Every time a message is sent, it executes its code, allowing it to read and write to internal storage and send messages to other contracts or build contracts in return.

Miners:

They validate the blocks and transactions. The transactions are enclosed in a block, and a proof of work for this block is given. After the transaction is validated into the chain, miners are given a sum as a reward. We have chosen private Blockchain for the particular use case then the mining is not important as the parties are already identified and trusted.

Design Phase

The design of the smart contract will be established after identification of the entities and setting up of the accounts. Functions, procedures, status variables, incidents and transactions are the key components of the smart contract.

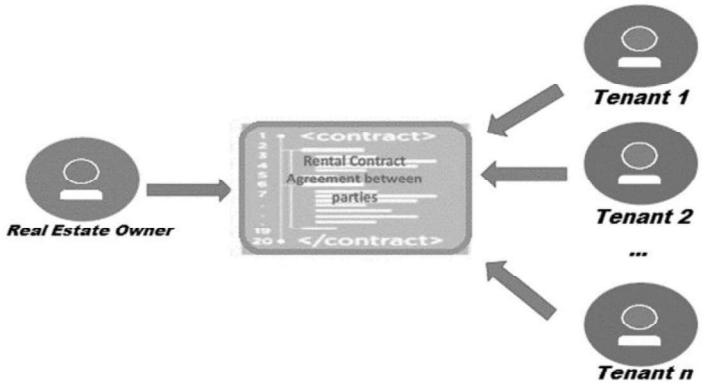
Real Estate Smart Contract Functions

The smart contract is between a landlord / owner of real estate and the tenants. The contract's aim is to ensure the rental agreement is signed, the rental sum is paid on time and the contract termination is performed correctly. The following describes the smart contract functions:
Functions-Created: The Landlord initiates the contract by setting up the rental terms and the details of landlord and tenants. After that, the state of the contract is set to "CREATED".
Functions-Started: Tenant signs the contract and rent begin and the state of the tenant is set to "STARTED" when the state is "STARTED", the rental agreement cannot be confirmed again, thus eliminating the possibility of overwriting the current tenant.
Functions-Rent Collection: The smart contract collects rent from the tenants and sends it to the landlord. This is a powerful feature of this contract to makes it "SMART".
Functions-Terminated: When the Landlord terminate the contract, the state set to "TERMINATED" and all balance deposit is sent to the tenant after checking the status of the property.

Real Estate Smart Contract Processes

For this use case, the process is one-to-many parties and the definition of the processes is described as follows:
Rent Contract Signature Process
In this process, both parties sign the smart contract (rental agreement) which include in details the rental value, payment frequency, and Real Estate Owner and Tenant's details. There is a blockchain in between both parties which is a trust and safe source for making available a smart contract that contents details from both parts. After agreeing with the conditions and this contract is signed, there is no possibilities for doing changes or manipulations. This model is showed below in the Figure 3.

Fig. 3: Process rent contract "signature"



Source: Karamitsos, Papadaki, Al Barghuthi, 2018, own processing

Rental Payments Process

This process is based on terms and conditions of the rental agreement. The smart contract initiates the lease payments from the tenants to landlord and FM contractors using different mode of payments. This model is very good because of the opportunities that offers for the payment process, more used are cryptocurrencies, based on (Karamitsos, Papadaki, Al Barghuthi, 2018). The model is shown below in the Figure 4.

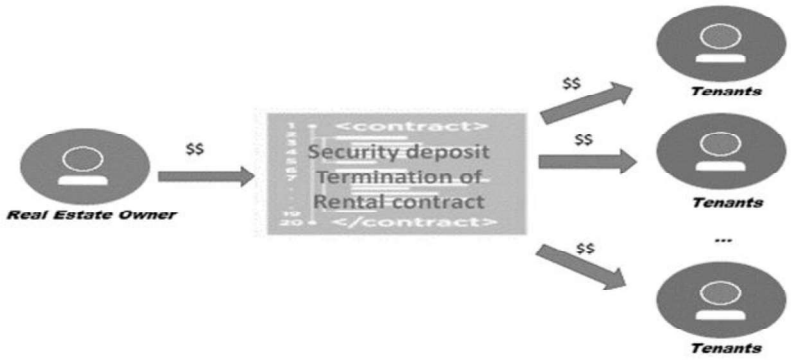
Fig. 4: Process rent contract "payments"

Source: Karamitsos, Papadaki, Al Barghuthi, 2018, own processing

Termination Rent Contract Process

This process is on the termination rental as is shown below. The smart contract triggers the payment of security deposit back to tenants after checking and adjusting any damage repair charges. Termination of the contract can come based on different conditions and may have consequences, everything accorded in agreed conditions and laws. Model is shown below in the Figure 5.

Fig. 5: Process rent contract "termination"

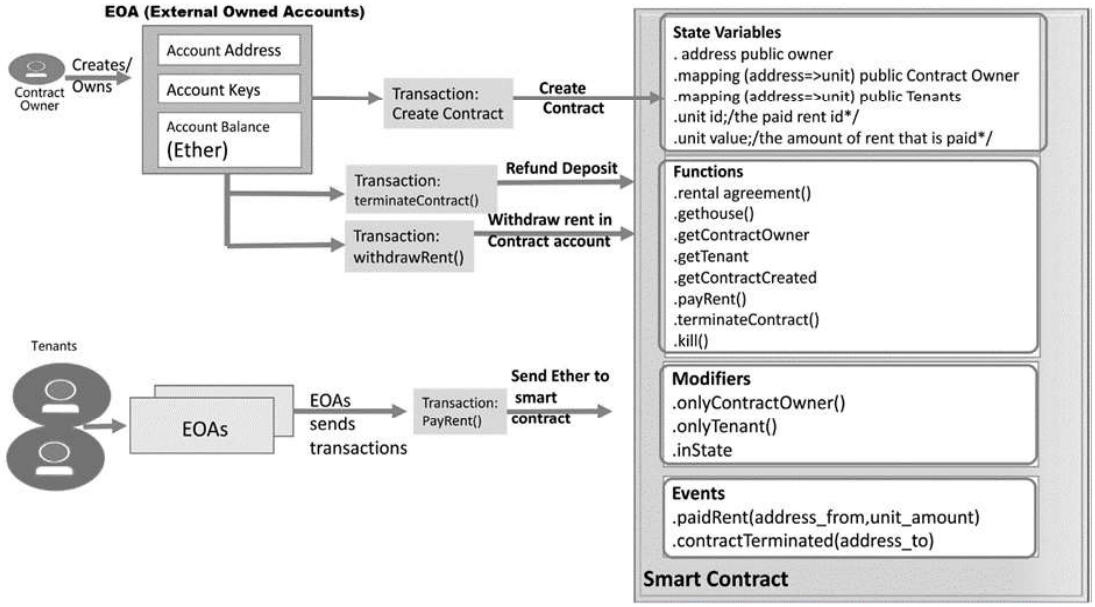


Source: Karamitsos, Papadaki, Al Barghuthi, 2018, own processing

Implementation Phase

In this implementation phase, is done the code programming part for the smart contract for the agreement of the real estate owner and the tenant. Functions and processes for this agreement are defined in the previous phase, in design phase and now these processes are just translated into the code program. The content or the structure of the code for the smart contract is shown below in the following, Fig 6.

Fig. 6: Implementation Phase



Source: Source: Karamitsos, Papadaki, Al Barghuthi, 2018

The implementation of the smart contract contains the code phase where the contract is prepared from a software engineer or programmer and the contracting parties need to complete with the information. In this case is shown a smart contract for real estate.

State Variables: In this part are listed the information that are needed by the state where should be listed the address of the object, the owner and the tenant and also information about rent payment. This information is only for the state party.

Functions: This is the main part of the code where are written all conditions of this contract as date of starting, date of terminating, payment, conditions, consequences per each if they want to kill this contract.

Modifiers: This is the part that shows who have the right access on this contract and can be able to do modification (with permission of both parties).

Event: Is the part for what the parties agreed as the price for rental, previous address, or the next address if there will have a termination of the contract.

GOAL AND METHODOLOGY

The aim of this paper is to explain the concept of the smart contract and its components and function. The paper is aimed at presenting the issue of smart contract, blockchain technology. The mentioned issue is a challenge in all areas of business and economy. The first stage of our research focused on the collection and search of secondary data of published studies in this field. The survey focused on relevant sources in the indexed databases Web of Science and Scopus. The collected data allowed us to identify the areas in which smart contracts can be used, as well as identifying their benefits. A comparison between traditional and smart contracts was carried out as part of the study. The specific focus was on the application of smart contracts in real estate. Based on the knowledge gained, the findings compiled an explanation to the code in the software that can be used in the case of smart contracts for Check legal compilance. The study has been based on general scientific methods (generalization, comparison, analysis, and synthesis).

FINDINGS

Every smart contract should be as legal as the physical one, in this way known from the parties in the contract and the state where the state will protect and known as legal contract of the contracting parties. For achieving this, needs the software to be installed on any smart contract.

This type of software is a pre-made pseudo code that will automatically process to each question to check its legality. The result of each "legal analyze" will be accompanied by "Yes" or "No".
Based on this process, we tried to make some notes that deal with the appearance of such a code. Below is shown a text which explains the parts of the code and tells what does mean every command.

```
PROGRAM: "Check Legal Compliance"
//compliance refers primarily to the GDPR
//YES means that the answer to the question is either YES or Configurable in the
//SLA
// The symbol "//" implies a comment line, meaning the text after // does not
//affect execution, it is only used to explain the specific program line and enhance
//code readability
// The word " LEGAL_COMPLIANCE" is a variable, meaning a position in the
//memory structure of the computing system that holds the value (outcome of the
//analysis: true or false for being legally compliant)
// The symbol "=" is an assignment operator, meaning that the value at the right of
//the "=" is stored in the memory position that is indicated by the (variable) name
//on the left of the "="
//The symbol "==" indicates equality between the elements (variables and/or
//values) to the left and right of the symbol
//The word "Return LEGAL_COMPLIANCE" means stop executing and return
//the value of the variable LEGAL_COMPLIANCE at that point
```

In addition, a code has been written that will ask some questions related to the contract that is done and also, refers to sensitive topics that users would often want to avoid. This part or process is very important for a smart contract, because it provides personal data protection also, will prevent invalid access that can in any way touch that part of the data and in this way will not allow the lose the existing database.
Because commitments to the contract will not be sufficient, the programmers have prepared a code that is technically implemented and automatically protects the data taken from the smart contract.
But since not everyone can apply standards and laws, in this pseudo that if the issues are not in line as need to be with the laws of the European Union, they will be automatically rejected. This part of the code is shown below.

```
LEGAL_COMPLIANCE=True;

If (L001==YES){
        If ((L002==NO)OR(L005==NO)OR(L006==NO)OR(L007==NO)
        OR(L008==NO)OR(L012==NO)){
                LEGAL_COMPLIANCE=False;
                Return LEGAL_COMPLIANCE; //stop legal analysis,
                final conclusion is reached
}

If (L003==NO){ //if not based in the EU, you need to be certified for BCR for EU
usage
        If (L011==NO){
                LEGAL_COMPLIANCE=False;
                Return LEGAL_COMPLIANCE; //stop legal analysis, final
                conclusion is reached
}

If (L003==YES){// if based in the EU,
        If (L009==YES){ //and you can offer the possibility to delete data
                //do nothing, legal compliance has been set to true before
                        }
```

And finally, if everything during the legal analyze process is in order and according to the legal regulations, in the agreement it will look like the following code:

```
{
    "questionNumber":1,
    "questionText":" Does your SaaS application deal with sensitive/personal data?"
    "answer":true
}
```

In this manner, for the case where are completed analyze done with the set of questions, and then it is saved in the archive within the archive it automatically will be listed as part of that contract and will be stored in the blockchain the date when it is done and what was the answer. Later checking will be available.

CONCLUSION

This paper has presented an overview of the Blockchain technology as a disruptive technology for smart contracts in real estate industry. This study was designed to evaluate the impact of smart contracting on implementation with the various components. Design of the real estate will determine if and when Blockchain can be used in their company as a technology. For the adoption of Blockchain into the organization, it is important to meet certain requirements in order to improve the efficiency of the current processes (Torres, Brann, 2019). The benefits of using smart contract in blockchain technology for real estate industry are as follows:
Different parties can modify database: In the real estate ecosystem, multiple parties such as owners, tenants, and financial management (FM) operators involve the management of real estate properties. They have the right of access in modifying variety of information with the Blockchain technology. This eliminates the modification between the parties.
Trustless among entities and parties: During the development of the real estate, many individuals may not have business relationships beforehand. And this may increase the loss of trust.
Advantage of Disintermediation: With the Blockchain technology, trusted intermediaries such as notary and brokers are not needed, as the transactions can be automatically checked and validated.
Transactions advantage: In real estate companies, different transactions related to different parties (such as landlords, tenants and FM services) are part of the same database. The

real estate companies face difficulties to separate the number of invoices. With the Blockchain technology, we can separate transactions between the parties seeking to improve the efficiency of the invoicing process. As an example, in the net rent lease structure, the tenant pays the facility services (such as cooling and maintenance services) directly to the FM companies and the base rent amount directly to the landlord. Such an approach can also be implemented in the framework of the electronicisation and digitisation of public administration.

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