

Achieving Contractual Security in Smart Contracts

تحقيق الأمن التعاقدي في العقود الذكية

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Abstract :

Achieving contractual security in smart contracts is a crucial subject in the realm of financial and legal technology. This type of contract involves the utilization of blockchain technologies for its formation. These contracts rely on encrypted algorithmic software that is tamper-proof and contains detailed terms and conditions of the contract, enabling the contracting parties to interact and execute contracts securely and autonomously without the need for a third party. This reduces risks and increases trust between the parties throughout various stages of the smart contract, starting from smart negotiation to smart execution.

Keywords : : Smart Contract; Blockchain; Contractual Security; Contract Formation.

ملخص:

يشكل الأمن التعاقدي في العقود الذكية موضوعا هاما في عالم التكنولوجيا المالية والقانونية، يتضمن هذا النوع من العقود استخدام تقنيات البلوكتشين لإبرامها، تعتمد هذه العقود على برامج خوارزمية مشفرة غير قابلة للتلاعب والتي تحتوي على شروط وأحكام العقد بشكل مفصل تتيح للإطراف المتعاقدة في التفاعل وتنفيذ العقود بشكل امن و الي دون حاجة الى طرف ثالث مما يقلل من المخاطر و يزيد في الثقة بين الأطراف وذلك في مختلف مراحل العقد الذكي ابتداء من مرحلة التفاوض الذكي وصولا إلى مرحلة التنفيذ الذكي .

الكلمات المفتاحية: العقد الذكي ،البلوكتشين، الأمن التعاقدي ،إبرام العقد.

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Introduction

In light of rapid technological advancements and the digital transformation era, smart contracts have become an effective means of achieving contractual security in economic exchange processes. Smart contracts represent an important development in the world of contracting, combining Blockchain technology¹ and artificial intelligence to enable the automatic and secure execution of the terms and conditions agreed upon by the parties involved.

The term "smart contracts" first appeared in the early 1990s, thanks to the American legal scholar and programmer Nick Szabo in 1994, who published an article titled "Smart Contracts," in which he introduced the idea of contracts that are automatically executed and governed by software rather than human intervention, which is now known as smart contracts.

In 2009, the cryptocurrency Bitcoin and the Blockchain technology emerged, allowing all transactions to be recorded securely and safely. This distributed and tamper-proof system provided a new opportunity to implement the concept of smart contracts in a more advanced way. Furthermore, in 2013, Vitalik Buterin launched Ethereum, which greatly contributed to the development and diversification of the uses of this underlying technology, including smart contracts.

There has been notable progress in the legislation surrounding smart contracts in several countries around the world. In recent years, there has been growth in the regulation of the uses of symbolic technologies, including smart contracts, reflecting an increasing interest in blockchain technology applications. Developed countries such as the United States, Switzerland, and China have been working to create legislative environments that support and regulate the use of smart contracts, reflecting their desire to enhance innovation, support technological development, and ensure protection and security for the users of these contracts.

Laws such as the Uniform Electronic Transaction Act (UETA) regulate electronic signatures and the presentation of electronic contracts in the United States, as well as the Electronic Signatures in Global and National Commerce Act (ESIGN), which defines the rules that confirm the legal validity of electronic signatures and contracts.

Similarly, in Switzerland, the Federal Act on the Amendment of Federal Legislation on the Connection with the Adoption of Legislation to Developments in Information Technology (FADIT) was introduced to keep pace with developments in information technology, including smart contracts.

As for the French law, there has been hesitation in supporting the digitization of contractual practices. The topic of electronic contracts was completely overlooked in the 2016² reform of the Contract Law. However, blockchain technology was later recognized through a class of financial instruments known as "Mini Bons" or treasury bonds, as well as in the Anti-Corruption Law and the modernization of economic life.³

Regarding Arab states, it is worth noting that most have yet to adopt laws explicitly dealing with smart contracts. The United Arab Emirates (UAE) is a leading country in using financial technology and smart contracts. The UAE issued Law No. 2 of 2002 concerning electronic transactions and commerce specific to the Emirate of Dubai, followed by Federal Law No. 1 of 2006. Both laws contain clear references that can be beneficial for blockchain technology, mentioning all the terms and concepts relied upon by blockchain⁴.

In Algerian legislation, smart contracts are an increasingly important topic. However, they are not considered part of the electronic contracts and transactions regulated by Algerian lawmakers, as there is no specific provision referring to blockchain technology.

In view of the above, and with the emergence of smart contracts and their use in contracting processes, a question arises regarding the level of trust that contracting parties place in the smart programs used for the creation and execution of contracts. Furthermore, to what extent is the principle of contractual security realized in smart contracts?

To answer this issue, we have relied on the descriptive, analytical, and comparative approach. Accordingly, we will divide our study into two sections:

1. Contractual Security in the Smart Contract conclusion Phase
2. Contractual Security in the Smart Contract Execution Phase

1. Contractual Security in the Smart Contract concluding Phase:

The smart contract concluding phase consists of several stages, starting with the smart negotiation phase, which aims to define the terms and details of the contract in a transparent and comprehensible manner for all parties involved. This progresses to the smart completion phase, which is crucial in ensuring the correct execution of the contract according to the agreed-upon terms.

1-1- Smart Negotiation Phase:

Before the formation of a smart contract, as with any other contract, a negotiation and bargaining phase must take place. This phase is of significant importance in contracts, in general, because it allows for proper preparation of the agreement, which can prevent disputes between the parties in the future.

Negotiations refer to the exchange of proposals, compromises, correspondence, reports, technical studies, and even legal consultations exchanged by the parties involved before the contract is made, ensuring that both are aware of the best legal forms that serve the interests of the parties and understand the resulting rights and obligations⁵.

In the context of smart contracts, smart negotiations are one of the digital methods implemented using intelligent software. These programs stand out for their distinctive features, including the ability to make independent decisions and adapt to various circumstances that may arise during negotiations without the need for human intervention⁶.

Smart programs have evolved with the advancement of artificial intelligence. For example, the Massachusetts Institute of Technology (MIT) designed a digital marketplace known as "Kasbah," which was one of the virtual markets demonstrating negotiation processes conducted by trusted intelligent programs⁷.

Subsequently, smart programs became more effective in the negotiation processes, especially in determining the terms of the contract. These terms may include aspects that are not previously known to the users during the negotiation, due to the smart program's ability to assume responsibility independently at this stage. The program benefits from its previous experiences and knowledge in setting the terms, which is one of the distinctive features of digital smart programs. Additionally, it may be difficult for the programmer to predict the program's behavior in advance due to the complexities and continuous changes in the negotiation circumstances⁸.

In addition, digital platforms provide users of smart programs with the ability to track all stages of smart contracts, including the smart negotiation phase, by accessing the DATA room available on these platforms. This is done within an informational protocol known as Building

Information Management (BIM), ensuring the exchange of documents and compliance with the agreed deadlines in such contracts⁹.

Smart programs negotiating with each other aim to achieve the user's goals and interests, leading to what is known as competitive smart negotiation. This is similar to traditional negotiations between natural persons, in terms of the repeated exchange of offers, with the goal of either concluding the contract or terminating the negotiations¹⁰.

It is worth noting that the negotiation process does not occur randomly through the smart programs representing the parties involved in the contract, but rather is subject to specific rules and regulations. These include the number of parties participating in the negotiations, the maximum number of rounds allowed, as well as the instructions and protocols followed in the process. These rules and regulations vary depending on the design of the digital platforms, the capabilities of the smart software, and the negotiation strategies employed, reflecting a disparity in platform technology and its ability to effectively meet users' needs¹¹.

Besides, these programs rely on a specific model that contains data and information reflecting the user's intentions and will, in order to make the appropriate decision regarding the completion of the smart contract and the termination of negotiations. Of course, these instructions vary from one smart program to another, depending on the nature of the contractual transaction. In some cases, these instructions may be complex, while in others they may be less complicated, highlighting the importance of this information in directly guiding the decisions of the smart programs¹².

Based on that, smart negotiations can be defined as the process through which interaction, exchange of offers, and discussions take place between smart programs via blockchain-based databases or other digital smart platforms. The goal of this process is to conclude smart contracts in the best interest of its users, and it offers flexibility in determining and terminating its terms according to the specified circumstances and needs.

1-2 The Smart Completion Phase :

The smart contract raises a number of unresolved legal questions regarding how the smart contract council is achieved through digital platforms, as well as determining the time at which the smart contract is considered to be finally completed and the location of its conclusion for the contracting parties. Therefore, we will address, in this context, the smart expression of will (first), as well as the time and place of the smart contract's conclusion (second).

1-2-1 The Smart Expression of Will:

A smart contract assumes the existence of two wills and their agreement to produce a legal effect. One party must make an offer, followed by the acceptance of the second party, through smart programs that represent these parties on the digital platforms they operate on.

A-) The Smart Offer:

An offer can be defined as a definitive expression of the will of a person who proposes to another party to enter into a specific contract under defined conditions, so that when this offer is followed by a matching acceptance, the contract is concluded. In this case, the expression of will is considered an offer when it is precise, specific, and definitive¹³.

As for the smart offer, it is considered a new method of expressing the will of a person without the need for their direct intervention at the time the offer is made by the smart offer program. The smart offer in smart contracts can be defined as an expression of the will of the party wishing to contract, made through a smart program that includes all the essential elements and

conditions required to conclude the contract. This is done through blockchain-based database platforms or other smart digital platforms¹⁴.

After verifying these conditions through a digital signature using the user's private key, the conditions are converted into an encrypted format that can only be understood by the smart programs operating on these platforms. These conditions must include the elements of the offer, ensuring that it is definitive, final, and precise, meaning it includes all the essential elements of the contract. In this way, the offer is considered to have been effectively made¹⁵.

The offer made by these programs should not necessarily be directed to a specific person; it can be addressed to one individual, multiple individuals, or even to the public. Additionally, it can have a specified time period or remain indefinite, aligning with the nature of how the smart offer functions¹⁶.

B-) The Smart Acceptance:

Acceptance is the definitive expression of the will of the party to whom the offer is made, agreeing to the proposal presented by the offeror. Acceptance is the agreement to form the contract based on the offer, and it is often issued after the offer. It is referred to as the second will, while the offer is considered the first will¹⁷.

According to general provisions, acceptance must meet specific conditions. It must be clear and definite, produce legal effects, and have an external manifestation. Additionally, the acceptance must match the offer and not include any reservations or exceptions, meaning it should not alter, limit, or add to the offer; otherwise, it would be considered a new offer¹⁸.

The acceptance in a smart contract does not differ from that in a traditional contract, except in the medium through which it is made, which is the internet¹⁹.

In smart contracts, the acceptance is made by the offeree when they express their agreement to the offer by signing the contract with their private key. This is then encrypted on blockchain-based databases or other smart digital platforms through which the contractual process is carried out²⁰.

Once the smart program receives the offer directed to its user, it can issue an acceptance according to the provided conditions and instructions, provided that they match the terms of the offer. After achieving this full alignment, the smart contract is concluded by the smart program in favor of the users, ensuring their interests are effectively realized according to the predefined terms²¹.

1-2-2: Time and Place of the Smart Contract Conclusion:

In traditional contracts, the contract is concluded when acceptance is coupled with the offer. At that moment, the wills of the contracting parties align to finalize the contract, which can occur either in a physical assembly (i.e., between present parties) or in a virtual assembly (i.e., between absent parties). Determining the time of conclusion for traditional contracts does not present significant legal challenges when compared to the determination of the time and place for the conclusion of smart contracts, due to the unique nature of the latter. This will be explained further below:

A-) The Time of Conclusion of the Smart Contract:

Determining the time of acceptance refers to identifying the moment when the contract is concluded, according to the general rules of contracts. This depends on whether the contract is

between present or absent parties²². In the case of a contract between present parties, the moment of acceptance is the moment the acceptance is issued, meaning the contract is concluded at the same time the offer is accepted.

However, in the case of a contract between absent parties, according to Article 67 of the Algerian Civil Code, the moment of conclusion of the contract is when the offeror becomes aware of the acceptance. It is assumed that the contracting party becomes aware of the acceptance at the place and time it reaches them. It is known that there should not be a time lapse between the moment the acceptance is issued and the moment the offeror becomes aware of it, if the contract is between present parties. If there is a time lapse between the two, the contract is considered to be between absent parties²³.

As for contracting via blockchain, the smart programs on digital platforms based on blockchain technology replace the offeror in determining the acceptance from the offeree. Therefore, there is no need for a time lapse to define the moment of conclusion of the smart contract. The contract is concluded as soon as the smart acceptance is issued and linked to the smart offer presented to the offeree. Consequently, smart contracting via blockchain is considered a contract between present parties, as the programs independently handle the process, acting in place of the contracting parties and expressing their wills²⁴.

The blockchain network manages the execution of the contract without referring to the parties or needing permission or authorization from anyone²⁵.

B-) The Place of Conclusion of the Smart Contract:

Although contracting via blockchain is considered a contract between present parties in terms of time, it is regarded as a contract between absent parties in terms of location. This is due to the contracting parties using smart programs across blockchain-based platforms from different locations. Therefore, the rules governing contracts between absent parties apply when determining the place of conclusion of the contract. This means that the place of conclusion of the smart contract is the place where the offeror is located at the moment the acceptance is issued, unless otherwise agreed or a conflicting legal provision exists²⁶.

2- Contractual Security in the Execution Phase of Smart Contracts:

The execution phase of smart contracts is one of the most critical phases these contracts go through, as it generates significant legal effects. Smart programs are responsible for fulfilling rights and obligations. To ensure the successful execution of a smart contract, a set of conditions must be met. Therefore, this section will be divided into two sub-sections as follows:

1-1: Mechanism of Smart Execution:

The fundamental principle in contractual obligations is the fulfillment of what the obligor has committed to, regardless of the content of the obligation, whether it involves providing something, performing a specific act, or refraining from an act. The obligor is responsible for carrying out their commitment.

Furthermore, the principle of good faith must govern the execution of the contract, as stated in the first paragraph of Article 107 of the Algerian Civil Code.

Smart programs are responsible for executing smart contracts autonomously, without the need for human intervention as an intermediary in the transaction, once the conditions set by the parties are met. This is why such contracts are referred to as self-executing contracts²⁷.

And according to the rule "If this...then that,"²⁸ smart contracts operate based on predefined conditions. Furthermore, once smart contracts acquire executive power, meaning once they are concluded and become binding, no modifications can be made to them. The data included in the contract's terms are fixed and unchangeable²⁹.

As a result, insurance companies have started using smart contracts to execute insurance agreements via blockchain-based platforms. For example, AXA Insurance created the digital platform "Fizzy," which allows users to easily conclude smart contracts using blockchain technology. This ensures transparency, accuracy, and security in executing the specified terms. Travelers, for instance, can rely on "Fizzy" for automatic compensation in case of flight delays exceeding the limit specified in the smart contract. Thanks to this platform, risks and costs associated with traditional insurance operations are mitigated, providing a more comprehensive, faster, and efficient experience in fulfilling contractual obligations.

These smart contract models are an essential part of technological advancement in the insurance industry and reflect the efforts made to provide innovative and secure solutions for the parties involved³⁰.

Cryptocurrency transactions via blockchain platforms are one of the prominent applications of smart contracts. Whether used for fulfilling obligations or for the buying and selling of cryptocurrencies, these transactions can be executed smartly through the use of intelligent programs.

In this regard, it is worth mentioning the ruling issued by the Massachusetts District Court in the United States in 2018, which declared the legitimacy of dealing with cryptocurrencies. The court ruled that cryptocurrency transactions are permitted, as they are considered commodities subject to the Commodity Exchange Act. Therefore, any manipulation, fraud, or deceit in cryptocurrency transactions falls under the authority of the Commodity Futures Trading Commission (CFTC)³¹.

However, the question remains regarding how smart execution can be achieved when some contractual obligations require recognition of the physical real world to activate the automatic execution mechanism and replicate it on the blockchain. This necessitates relying on the services of a trusted intermediary known as an "Oracle."³²

This software system forms the communication bridge between the virtual digital world and the physical real world. It serves as the digital intermediary relied upon to establish the connection and provide services to smart programs via blockchain platforms, enabling them to fulfill their smart contractual obligations. In certain cases, the execution of these obligations depends on obtaining data and information from outside the environment or platform where the program operates³³.

The importance and effectiveness of the Oracle program are particularly evident in ongoing smart contracts, as time is a crucial element in such contracts. The execution of obligations occurs in installments, which means that smart programs on digital platforms need periodic updates of data and external information regarding the subject of the contract to ensure the proper execution of the smart contract. The services provided by the Oracle program allow for the sequential and successive execution of the contract's terms, ensuring the rights of the contracting parties. These smart programs work for the benefit and on behalf of the parties within these digital smart platforms.

Given the above, smart execution is not a simple task for the programs that operate on behalf of users. While some contracts are executed easily, others face challenges, especially those that

require information and data that may not be available on digital smart platforms but rather in the physical real world. This is where the challenge of executing smart contracts lies. However, thanks to technological advancements and artificial intelligence, some smart servers have emerged, acting as intermediaries between the digital world and the physical reality.

1-2 Conditions of Smart Execution:

The fundamental idea behind smart contracts is the ability to automatically and intelligently execute obligations based on pre-defined conditions. However, to achieve this successfully, certain important conditions and factors must be in place to apply the concept of smart execution to this contractual model.

1-2-1 Contracting via Digital Smart Platforms:

This condition implies that the contract must be executed through blockchain-based platforms that support the idea of smart execution³⁴. Furthermore, it is important to note that contracts made in this smart environment do not require direct interaction between the contracting parties. Instead, these platforms manage the process of smart contracting³⁵.

It is also noteworthy that blockchain platforms possess technological capabilities that enable them to carry out a series of processes and procedures to ensure the integrity of the contracting process. These capabilities include verifying the accuracy of the data and information contained within the platform³⁶.

In addition, once the data has been validated, the blockchain platform stores and preserves the data through digital encryption. These platforms are also characterized by decentralization, which is one of their core features. Decentralization can facilitate the distribution of the smart contracting model within the platform, with all stages of the contract being formed through this platform³⁷.

1-2-2 The Contract Must Be Executed by Smart Programs:

The smart program is the essential element in the execution of smart contracts, due to its unique features, including autonomy in performing the tasks assigned to it. The smart program has the ability to make decisions and execute actions without the need for direct human intervention.

Moreover, the smart program provides these services within smart digital platforms that include a group of smart programs, each designed to perform a specific function that contributes to achieving the set goals. Therefore, the smart program collaborates with these programs to execute smart contracts comprehensively and effectively within the digital platform³⁸.

Thus, the autonomy of the smart program is measured in relation to the user, not in relation to other smart programs. The assistance the program provides to other programs occurs within the execution processes it is tasked with and does not affect its autonomy³⁹.

1-2-3 The Binding Force of the Smart Contract:

The importance of smart contracts executed through blockchain platforms becomes apparent after they gain binding force. No party to the contract is allowed to modify it by adding, removing, or altering any conditions. The obligations arising from the contract are executed by the smart program.

Therefore, the principle of mandatory execution has been established, where the smart programs operating on blockchain platforms are responsible for the smart execution. In addition,

these platforms provide certain guarantees to facilitate the execution of contractual obligations and strengthen the contractual penalties in the event of a breach of those obligations⁴⁰.

1-2-4 : The Conditional Nature of Smart Contracts:

The smart program has the ability to execute smart contracts based on the "(If...then)" rule, where contractual obligations are executed sequentially, consecutively, and gradually according to the conditions agreed upon in the contract⁴¹. Therefore, the content of the smart contract must be formulated in a way that aligns with the nature of how smart programs operate, in order to ensure the integrity of the smart execution. This can be achieved by using conditional statements. For example, if the goal of the smart contract is to purchase a digital book from the book owner, the contract stipulates that upon delivery of the book to the buyer, the amount will be transferred and paid to the book owner's account.

Additionally, the execution of smart programs depends on the programmed conditions, as they do not interact with people but instead operate with their own specific programming language⁴².

In the case of unclear contractual conditions, this could lead to errors during the contract's execution, negatively affecting the user. Sometimes, the program may fail to execute the contract conditions due to the prior experiences it has gained, and it may determine that these conditions do not align with the corresponding obligations in the smart contract⁴³.

Based on the above, the contracting parties must interpret the contractual intent by expressing their will through the instructions and conditions they provide to the smart programs. This will must be formulated in a way that aligns with the programming system of blockchain platforms or any other digital smart platform.

Conclusion:

At the end of this research paper, we have reached several findings and recommendations.

First: Findings:

- ✚ Smart contracts are electronic contracts that use blockchain technology for their execution. These contracts rely on encrypted, algorithmic, and tamper-proof programs, which contain the detailed terms and conditions of the contract. These encrypted programs operate on blockchain platforms such as Bitcoin and Ethereum. They allow the contracting parties to interact and execute contracts securely and automatically.
- ✚ In smart contracts, the agreement between the parties is made through the electronic expression of their will, which reduces costs by eliminating the need for a third party such as a lawyer, mediator, or notary. These contracts are characterized by autonomy, as the agreement is made in a voluntary and efficient manner through the automatic verification of the parties' identities.
- ✚ The process of executing smart contracts is not limited to digital platforms only but also requires interaction with the real world to achieve full execution. Technological advancements provide a program known as an oracle, which acts as an intermediary between the virtual and real worlds, enabling smart programs to rely on it to obtain the necessary information and data to execute the obligations related to smart contracts.
- ✚ Smart contracts offer superior contractual security thanks to several advantages. They enhance transparency by recording all details and transactions on the blockchain, and they

rely on encryption to protect sensitive data and information. Due to trust in the software, there is no need for a third party, which reduces risks and increases trust between the parties.

Recommendations:

- ❖ It is essential to update Arab legislation, including Algerian legislation, to align with the latest developments in contracting, including blockchain technology and smart contracts.
- ❖ It is important to consider the need to reconcile modern developments in contracting with traditional contracting methods, including the traditional contract, which is one of the fundamentals of the current legal system.
- ❖ It is necessary to legislate specific provisions for smart contracts at all stages, starting from smart negotiations to completion and smart execution, by establishing mechanisms, regulations, and instructions for each phase of this process, with a focus on the technical, legal, and procedural conditions required to ensure the success of smart contracts.

¹ Blockchain is an encrypted information program that records and stores information in a unified series of Blocks on the network in a secure and transparent manner: seen : Mustafa Muhammad al-Hisban : The legal system of blockChain technology under e-commerce legislation- Journal of law and humanities Sciences ZIANE ACHOUR University in Djelfa n° 03 Volume 12 year 2019 Page 139.

² Ordinance n°2016-131 of February 10th, 2016 reforming contract law .

³ Law No. 2016-1691 of 9 December 2016 on transparency, the fight against corruption and the modernization of economic life.

⁴ Article (2)Federal Law No. (1) of 2006 Concerning Electronic Transactions & Commerce in Emirate of Dubai defined Automated Electronic Medium as : “An electronic software or system of an information technology means that automatically operates independently, totally or partially, without supervision by any natural person at the time an action takes place or is responded to. Article 12 of Federal Law No. 1 of 2006 on Electronic Commerce and Transaction published in the Official Gazette n° 42 year 36 on January, 31st, 2006 defined it as “A contract may be formed between automated electronic mediums, including two or more electronic information systems already prepared and programmed for such tasks. The contract shall be proper, valid and legally effective, even if no natural person intervenes personally or directly concluding the contract in such systems.”.

⁵ RagabKarim Abdullah, contractual negotiations , faculty of law university of cairo Egypt 2000 page 64.

⁶ Abbas Al-Aboudi, Contracting by means of instant communication and its authenticity in civil proof (a comparative study), Al-Thaqafa Library for Publishing and Distribution, Amman, Jordan, 1997, p. 83.

⁷ Medhat Mohamed Abu Al-Nasr, Artificial Intelligence in Organizations, first edition, Arab Group For Training & Publishing, Cairo, Egypt, 2020, p. 127.

⁸ Samir CHOPRA and Laurence F. White : A legal theory for Autonomous Artificial Agent, University of Michigan Press ,2011, p31.

- ⁹ Tina BALKE, « Entity » and « Autonomy », the conclusion of contracts by software agents in the eyes of the law A software agent definition based analysis, revue d'intelligence artificielle, vol 24, N03, France 2010, p392.
- ¹⁰ Marie -Hélèneverrons, GENCA :GeNCA: a general contract-based negotiation between agents model, PhD thesis, University of Science and Technology, specializing in computer science, Lille, France, 2004, p12.
- ¹¹ Maxime Marge, Dialectics multiagent system to support deliberation, PhD thesis, University of Science and Technology, specializing in computer science, Saint Etienne, France, 2005, p18.
- ¹² Fatima Zahra RabhiTebboub, The Intelligent Agent in the conclusion of the contract, paper presented at the International Forum on Artificial Intelligence A New Challenge for Law held on November 27, 28, 2018 at the University of Algiers 1, Algiers, Algeria, p. 80.
- ¹³ Abu Al-HamadRagab, Electronic Contract Formation and Termination, Al-Wafa Legal Library, Alexandria, First Edition, 2019, p. 44.
- ¹⁴ AlaaYacoub Al-Nuaimi, The Legal System of the Electronic Agent, Al-Halabi legal publication , first edition, Beirut, Lebanon, 2018, p. 40 and beyond.
- ¹⁵ Ammar Abdul Hussein Ali Shah, The legal system of smart contracts, a comparative study, Dar Misr for Publishing and Distribution, first edition, Egypt, 2024, p. 165.
- ¹⁶ Ammar Abdul Hussein Ali Shah, op. cit. p. 166.
- ¹⁷ Muhammad SaadiSabri, op. cit. p. 109.
- ¹⁸ Article 66 Algerian civil law
- ¹⁹ Ismat Abdulmajid Bakr, The Role of Scientific Techniques in the Development of the ContractDar Al-Kutub Al-Ilmiyah, Beirut, Lebanon, first edition, 2015, p. 75.
- ²⁰ Ali Abdel Sattar Abdel Rahman, Liability of the electronic medium and the means of proving it (a comparative study), daargamaagadida for publishing and edition, Alexandria, Egypt, 2017, p. 66.
- ²¹ Omar Abdul Hussein Ali Shah, op. cit. p. 168.
- ²² Suleiman Marqas, Al-Wafi in the Commentary on the Civil Code, The Theory of Contract and Unilateral Administration, Part II, Shatat Publishing library of Egypt, Cairo, Egypt, 1987, p. 193.
- ²³ Abdul Razzaq al-Sanhouri, al-Wasit fi Sharh al-Qanun al-Madani, Part I, Theory of Obligation in General, Sources of Obligation, Manshurat al-Halabi al-Huqamiya, Beirut, Lebanon, p. 237
- ²⁴ HaithamElsayed Ahmed Issa, The Emergence of Smart Contracts in the Blockchain Era, first edition, DAR NAHDA for Publishing and Distribution, Cairo, Egypt, 2021, p. 79.
- ²⁵ HaithamElsayed Ahmed Issa Op cit same page.
- ²⁶ Haitham Al-Sayed Ahmed Issa, op. cit., p. 81.
- ²⁷ NarimanMassoudBourgheda, Blockchain contracts (smart contracts) from the perspective of contract law, Algerian Journal of Political and Economic Legal Sciences, 2019, Volume 52, Issue 2, p. 106.

²⁸ Muammar Ben Tarbah, Smart contracts embedded in blockchain: Any challenges for current contract systems? Kuwait international Law School Journal, Part 1, Special Supplement, May 2019, Issue 4, p. 482.

²⁹ KawtharFenech, The evolution of the endowment product through blockchain technology, Journal of Economics, Management and Commercial Sciences., Faculty of Economic and Commercial Sciences and Management Sciences, Messila University, Volume 3, Issue 2, Algeria, 2019, p. 176.

³⁰ Elise Huber, smart- contracts: unidentified contracts? village-justice, village-justice.com.expert article published on June 29th, 2018, available at link: <https://www.village-justice.com/articles/lessmart-contracts-contrats-non-identifies.28893html>. visited on 24/02/2024.

³¹ United states district court, district of Massachusetts, civil, case n°.18-100077-RWZ, commodity futures trading commission, v.my.prig com pay.inc et al , September, 26, 2018 (Adapted from Ammar Abdul Hussein Ali Shah, op. cit. p. 193.)

³² NarimanMasoudBorghdeh, op. cit., p. 110.

³³ Ammar Abdul Hussein Ali Shah, op. cit., p. 195.

³⁴ Al-Ayashi Al-SadiqFadad, Smart Contracts, Al-Salam Journal of Islamic Economics, Issue , December,1st, 2020, p. 160.

³⁵ Muammar bin Tarbah, op. cit., p. 482.

³⁶ L.C lin and T.C liao, A survey of block chain security issues and challenges, international journal of net worksecurity , vol.19, N°5,2017, p653.

³⁷ Hanaa Muhammad Hilal Al-Huneiti, What are Smart Contracts, International Islamic Fiqh Academy Conference 2019, 24th Session, Dubai, p. 30.

³⁸ AyaneAmirouche, The automated electronic medium as a mechanism for expressing the will, Comprehensive Journal of Law, Faculty of Law, BadjiMokhtar University - Annaba (BMUA), Volume 10, n° 10, Algeria 2021, p. 92.

³⁹ Firas Al-Kababsa and Nabila Kurdi, intelligent Agent from a Legal Perspective: a Technical Evolution or a Reversal of the Rules?Journal of Sharia and Law, Faculty of Law, United Arab Emirates University, Vol. 27, No. 55, UAE, 2013, p. 139.

⁴⁰ MuammarBin Tura, op. cit. p. 486

⁴¹ Daoud Mansour, The smart contract and its role in establishing trust in contractual relations, Journal of Legal and Economic Research, University Center Aflou/Laghout-Algeria., Volume IV, n°04, Algeria, 2021, p. 72.

⁴² Haitham Al-Sayed Ahmed Issa, op. cit., p. 45.

⁴³ Ammar Abdul Hussein Ali Shah, op. cit., p. 204.

Bibliography:

A- Law :

1- National laws :

- Civil Code (promulgated by Ordinance No. 75-58 of 20 Ramadhan 1395 corresponding to September 26, 1975, as amended and completed by Law No. 07-05 of May 13, 2007), Algeria
- Law 18-05 of May 10th , 2018 on e-commerce (OG 28 of 05/16/2018)
- Law 18-07 of 10/06/2018 on the protection of natural persons in the processing of personal data (OG 34 of 10/06/2018)
- Law No. 18-09 of 10/06/2018 on consumer protection and suppression of fraud (OG 35 of 13/06/2018).

2- Foreign laws :

- Law No. (1) of 2006 Concerning Electronic Transactions & Commerce in Emirate of Dubai
- Ordinance n°2016-131 of February 10th, 2016 reforming contract law .
- Ordinance n°2016-520 of April, 28th, 2016 regarding cash vouchers .
- Law No. 2016-1691 of 9 December 2016 on transparency, the fight against corruption and the modernization of economic life,

B- Books :

- Abbas Al-Aboudi, Contracting by means of instant communication and its authenticity in civil proof (a comparative study), Al-Thaqafa Library for Publishing and Distribution, Amman, Jordan, 1997.
- Medhat Mohamed Abu Al-Nasr, Artificial Intelligence in Organizations, first edition, Arab Group For Training & Publishing, Cairo, Egypt, 2020.
- Mohamed Sabri Saadi, el Wadih in Explaining the Civil Code, General Theory of Obligations, Sources of Obligation, Contract and Unilateral Will, Fourth Edition, Dar Al-Huda Algeria, 2009.
- Abu Al-Hamad Ragab, Electronic Contract Formation and Termination, Al-Wafa Legal Library, Alexandria, First Edition, 2019, p. 44.
- AlaaYacoub Al-Nuaimi, The Legal System of the Electronic Agent, Al-Halabi legal publication , first edition, Beirut, Lebanon, 2018, p. 40 and beyond.
- Ammar Abdul Hussein Ali Shah, The legal system of smart contracts, a comparative study, Dar Misr for Publishing and Distribution, first edition, Egypt, 2024.
- ⁴³HaithamElsayed Ahmed Issa, The Emergence of Smart Contracts in the Blockchain Era, first edition, DAR NAHDA for Publishing and Distribution, Cairo, Egypt, 2021
- Suleiman Marqas, Al-Wafi in the Commentary on the Civil Code, The Theory of Contract and Unilateral Administration, Part II, Shatat Publishing library of Egypt, Cairo, Egypt, 1987
- Abdul Razzaq al-Sanhouri, al-Wasit fi Sharh al-Qanun al-Madani, Part I, Theory of Obligation in General, Sources of Obligation, Manshurat al-Halabi al-Huqamiya, Beirut, Lebanon

- Ismat Abdulmajid Bakr, The Role of Scientific Techniques in the Development of the Contract Dar Al-Kutub Al-Ilmiyah, Beirut, Lebanon, first edition, 2015, p. 75.
- ⁴³ Ali Abdel Sattar Abdel Rahman, Liability of the electronic medium and the means of proving it (a comparative study), daargamaagadida for publishing and edition, Alexandria, Egypt, 2017.
- Abdul Razzaq Al-Sanhouri, Al-Wasit fi Sharh al-Qanun al-Madani, The Theory of Obligation in General, Evidence, Effects of Obligation, Halabilegal Publications, Beirut, Lebanon.

C- Theses :

Marie -Hélèneverrons, GENCA :GeNCA: a general contract-based negotiation between agents model, PhD thesis, University of Science and Technology, specializing in computer science, Lille, France, 2004.

Maxime Marge, Dialectics multiagent system to support deliberation, PhD thesis, University of Science and Technology, specializing in computer science, Saint Etienne, France, 2005.

D- Articles :

- Mustafa Muhammad al-Hisban : The legal system of blockChain technology under e-commerce legislation- Journal of law and humanities Sciences ZIANE ACHOUR University in Djelfa n° 03 Volume 12 year 2019.
- RagabKarim Abdullah, contractual negotiations , faculty of law university of cairo Egypt 2000.
- Samir CHOPRA and Laurence F. White : A legal theory for Autonomous Artificial Agent, University of Michigan Press ,2011.
- Fatima Zahra RabhiTebboub, The Intelligent Agent in the conclusion of the contract, paper presented at the International Forum on Artificial Intelligence A New Challenge for Law held on November 27, 28, 2018 at the University of Algiers 1, Algiers, Algeria
- Tina BALKE, « Entity » and « Autonomy », the conclusion of contracts by software agents in the eyes of the law A software agent definition based analysis, revue d'intelligence artificielle, vol 24, N03, France 2010.
- Hala Salah Al-Hadithi, Small Technology Transfer Contracts (Smart Contracts), Journal of the College of Law for Legal and Political Sciences, Kirkuk university , Vol. 10, No. 38, 2021.
- NarimanMassoudBourgheda, Blockchain contracts (smart contracts) from the perspective of contract law, Algerian Journal of Political and Economic Legal Sciences, 2019, Volume 52, Issue 2.
- Muammar Ben Taryah, Smart contracts embedded in blockchain: Any challenges for current contract systems? Kuwait international Law School Journal, Part 1, Special Supplement, May 2019, Issue 4.
- KawtharFenech, The evolution of the endowment product through blockchain technology, Journal of Economics, Management and Commercial Sciences., Faculty of Economic and Commercial Sciences and Management Sciences, Messila University, Volume 3, Issue 2, Algeria, 2019.
- Al-Ayashi Al-SadiqFadad, Smart Contracts, Al-Salam Journal of Islamic Economics, Issue , December,1st, 2020.
- L.C lin and T.C liao, A survey of block chain security issues and challenges, international journal of net worksecurity , vol.19, N°5,2017

- Hanaa Muhammad Hilal Al-Huneiti, What are Smart Contracts, International Islamic Fiqh Academy Conference 2019, 24th Session, Dubai
- AyaneAmirouche, The automated electronic medium as a mechanism for expressing the will, Comprehensive Journal of Law, Faculty of Law, BadjiMokhtar University - Annaba (BMUA), Volume 10, n° 10, Algeria 2021
- Firas Al-Kababsa and Nabila Kurdi, intelligent Agent from a Legal Perspective: a Technical Evolution or a Reversal of the Rules?Journal of Sharia and Law, Faculty of Law, United Arab Emirates University, Vol. 27, No. 55, UAE, 2013
- Daoud Mansour, The smart contract and its role in establishing trust in contractual relations, Journal of Legal and Economic Research, University Center Aflou/Laghouat-Algeria., Volume IV, n°04, Algeria, 2021

E- Websites :

Elise Huber, smart- contracts: unidentified contracts? village-justice, village-justice.com.expert article published on June 29th, 2018, available at link: <https://www.village-justice.com/articles/lessmart-contracts-contrats-non-identifies.28893html>.