

Smart contracts

Messaour Djalila*

University of Batna-1- (Algeria), djalila.messaour@univ-batna.dz

Governance and Economic Laboratory

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Abstract:

Smart contracts are self-executing digital agreements embedded within software programs designed to autonomously enforce the terms of a contract without the need for intervention or mediation by third parties. These contracts represent an innovative legal mechanism that differs from traditional contract law by utilizing decentralized and automated processes.

The automation provided by smart contracts improves transactional transparency and efficiency by accelerating execution and settlement while building trust between parties. This is achieved through encryption techniques that support data security and reduces the risk of fraud.

Due to their distinct operational characteristics, the widespread adoption of smart contract technology requires the creation of robust legal frameworks to ensure their enforceability, conformity with existing statutory requirements, and the resolution of potential legal conflicts. These frameworks must align traditional principles of contract law with evolving technological developments to regulate and legitimize this contemporary contractual model effectively.

Keywords Automaticity; Computer protocols; Legal contract; self-executing ; Legal nature.

* Corresponding author.

INTRODUCTION

Smart contracts emerged with the introduction of information systems designed to support the different stages of the contract, and automate the entire process from the conclusion and implementation stages to the follow-up and implementation stages.

The blockchain platform acts as a legal intermediary, facilitating the documentation of final transactions. It serves as an alternative to traditional intermediaries, such as financial institutions in cash transfer operations, registries in real property ownership management, and agents or intermediaries in contractual arrangements for sales and rentals.

In response to concerns about the risks associated with the spread of smart contracts, some countries have developed legal frameworks to define their position on this modern form of contracting. However, these laws did not address the concept of the smart contract as a modern means of contracting, but rather recognized its value in proof.

The issue raises a problem regarding how this modern contractual model was concluded and its impact on the implementation of contracts within the traditional contract system ?

To address this problematic, we have divided the study as follows:

Chapter I: The concept of smart contracts:

Chapter II: The concept of smart legal ncontracts:

Chapter III: Types of legal smart contracts:

Chapter I: The concept of smart contracts:

We study the concept of the smart contract by defining it, determining its characteristics, and how to conclude it, as follows :

I- Definition of smart contracts

The term “smart contract” was first introduced by Nick Szabo in 1994. He described it as “a set of promises, defined in digital form, accompanied by protocols that govern the performance and enforcement of these obligations by the parties involved.”¹ Therefore, a smart Contract is not a written contract on paper of the traditional kind, nor is it simply an online contract².

Smart legal contracts are innovative legal instruments that diverge from traditional contracts due to their self-executing characteristics. They enable the codification of contractual terms into programming code, which is autonomously executed on a blockchain or other distributed ledger systems.

The Blockchain is a decentralized and distributed cryptographic digital “ledger”

that is used to record transactions. The principles underlying this technology allows people who do not know or trust each other to build a large digital record of “who owns what” that will enforce the consent of everyone concerned.³

Smart contracts function as encrypted digital agreements with predefined provisions and conditions that initiate automatic execution once specific criteria are satisfied. Smart contracts offer various attributes that enhance the efficiency, transparency, and security of transactions, making them applicable across numerous legal and commercial sectors.⁴

II-Characteristics of smart contract:

Smart contract automation refers to the self-executing nature of smart contracts within blockchain frameworks. These contracts are independent legal instruments in which the terms of the agreement are Smart contracts are executed and stipulated conditions are executed automatically when pre-defined conditions are met. This eliminates the need for intermediaries, ensuring that transactions are conducted precisely as programmed, without the risk of interference or manipulation. Smart contract automation provides various advantages, such as:

1- Coding Accuracy:

Smart contracts have the advantage of precision in coding because:

- They are self-executing electronic directives encoded in computer language.
- They form a segment of computer code that has the capacity to monitor, perform, and enforce the terms of an agreement.⁵
- Software in which computer code binds two or more parties for the purpose of executing predefined legal effects, and which is recorded on a distributed ledger⁶.

Smart contracts require precision in coding to ensure the proper execution of transactions and contractual terms, as well as to prevent the exploitation of information security vulnerabilities.

2- Efficiency :

This is achieved by automating contract execution, enhancing efficiency by accelerating transaction settlement and reducing administrative expenses and costs of traditional procedures.

3- Interoperability:

Smart contracts can interface with other smart contracts and blockchain-based applications, facilitating complex transactions and the development of decentralized applications.⁷

4- Decentralization:

Smart contracts operate on decentralized blockchain networks, which distribute computational and storage resources across a network of nodes. This decentralization ensures resilience against single points of failure and oversight, enhancing the robustness and reliability of smart contract applications.⁸

5- Transparency:

Smart contracts ensure the transparency of transactions by recording them and recording actions in a special system.⁹

6- Immutable execution:

Once smart contracts are deployed, they are executed directly according to pre-defined requirements and conditions, and the execution result is immutable, providing reassurance to both parties to the contract.

7- Trust :

Smart contracts rely on cryptographic principles and consensus mechanisms to ensure the safety and security of transactions, and enhance trust between parties.¹⁰

8- Security :

Smart contracts feature encryption techniques that ensure security, so that they do not allow manipulation or change of any information.

automating security protocols also, contribute to a more robust cybersecurity framework.¹¹

III: The conclusion of the smart contract:

Users interact with smart contracts by initiating the execution of specific functions within them. This is done through creating a transaction where the user identifies themselves as the sender and the smart contract as the receiver. The user also specifies the function they want to execute within the smart contract's code

These transactions are then sent to a network of validators, who are responsible for executing all blockchain transactions.¹²

Therefore, smart contracts can be used to enter into legally binding contracts, Several formal and substantive requirements must be met in order to form a legally binding contract.

Once a smart contract is concluded, it cannot be altered. If the parties' relationship changes, they must create a new smart contract to terminate the existing one and redefine their terms.¹³

Chapter II: The concept of smart legal contract:

The boom and widespread use of smart contracts in the United States have led to the development of a legal framework addressing their status within modern contract law. This effort included legal reforms under Nevada's 2017 legislation, which amended provisions of the federal Electronic Transactions Act. Although the law does not explicitly define the concept of smart contracts, it recognizes their evidentiary value and exempts them from all forms of taxation.

French law appeared reluctant to embrace the digitization of contractual practices, as it completely ignored the issue of electronic contracts in the latest reform of contract theory in 2016. However, the French legislature took steps regarding blockchain technology, the foundation of smart contracts, recognizing it on two occasions in April and December 2016. We explore the concept of the smart legal contract by examining its definition, characteristics, various forms, and legal nature :

I- Definition of smart legal contract:

The American computer scientist and legal expert Nick Szabo made a groundbreaking contribution by applying blockchain technology to legal contracts. His goal was to develop a protocol that would allow individuals without a pre-existing credit relationship to securely execute transactions without relying on external intermediaries.¹⁴

As a result, a legal smart contract can be defined as a binding agreement between parties, encoded in a programmable format, typically utilizing blockchain or similar technologies. It outlines the conditions for establishing, modifying, and terminating the contractual relationship. The legal recognition of smart contracts varies across jurisdictions. Some laws explicitly acknowledge smart contracts, while others may require amendments to existing legislation to accommodate this technology.¹⁵

II- Key Features and Effects of Smart Contracts :

From various definitions of a smart contract, several key features and effects can be discerned :

1-Legally Binding Contracts :

-Legal smart contracts are inherently encrypted, and their legal enforceability depends on meeting established and applicable legal standards.

-To be legally enforceable, a smart contract must fulfill the fundamental requirements of a traditional contract, including an offer, acceptance, and the intention of the parties to create legal relations.¹⁶

2- Code as law:

Smart contracts operate on the principle of “code as law,” which means that the code itself is the source of contractual obligations. If the code is well-written and accurately reflects the intentions of the parties, it can serve as a legally binding agreement.¹⁷

3-Traditional Legal Principles :

Many legal smart contracts are derived from legal principles, economic theory, and theories of reliable and secure protocols,¹⁸ to automate and implement processes traditionally handled by intermediaries, such as banks or escrow services. The legal implications involve adapting existing legal principles to this new technological paradigm.

4- Legal recognition:

The legal recognition of smart contracts may compel courts to interpret traditional legal principles within the framework of smart contracts and address issues such as the role of code in defining and managing contractual relationships.¹⁹

5- Regulatory Compliance:

The integrity of smart contracts requires adherence to rules and texts, and developers and users must be aware of and adhere to those laws, including rules related to data protection, consumer rights, and financial regulations.²⁰

6- Enforceability Challenges :

Enforcing smart contracts can present challenges, especially when disputes arise. Problems such as coding errors, unexpected situations, or unclear contract terms may lead to legal conflicts requiring human intervention.²¹

7- Development of laws:

As smart contract technology continues to advance, the legal frameworks regulating this innovative form of contracting are also evolving. This progression necessitates the development of a responsive legal environment, requiring collaboration from experts in both legal and technological fields.

III-Forms of smart legal contracts :

Smart legal contracts can take various forms with differing levels of automation and can be categorized into one of the three types outlined below:

1-Natural language contract with automatic performance by code :

This type of contract is written in natural language, with some or all contractual obligations automatically executed by computer program code. While the code facilitates the performance of these obligations, it does not establish them; rather, it serves as a tool for one or both parties to fulfill their duties. Commonly known as an "external" contract, the code operates independently of the formal agreement between the parties. Natural language contracts with automated execution are currently the most prevalent form of smart legal contracts. These contracts do not add legal complexities regarding their formation or interpretation.²²

2-Hybrid contract :²³

A legal contract involves a combination of natural language and computer code to define contractual obligations, which may be partially or entirely automated by the code. The reliance on code can vary, from contracts where most terms are encoded with minimal natural language elements (such as governing law and jurisdiction) to those primarily written in natural language with a few coded provisions. Additionally, the same contractual terms can be represented in both natural language and code. The natural language components may appear in a separate document or as annotations within the code.²⁴

3-Contract recorded solely in code :

This type of contract relies solely on computer code to define and automatically execute all contractual terms, without any accompanying natural language documentation. It poses significant challenges in contract law, particularly regarding contract formation and interpretation. These contracts introduce novel legal considerations and may become more common as technology continues to advance.²⁵

IV-Legal nature of smart contracts :

Some French jurists, including Professor Bruno Dondero, believe that the smart contract represents a pure contract in its legal sense and see it as a contract integrated into the blockchain platform.

While the majority of French jurists, including Professors Mustafa Makki and Christophe Roda, tended to question the nature of these contracts,

considering that they do not reach the status of a traditional contract and are instead technology embodied in an information program that accompanies the contract.²⁶ This implies that there was a prior traditional contract concluded.

The opinions of American jurists were also divided between those who consider this technology to be a real contract and acknowledge that they are contracts stored in an electronically edited form according to its legal meaning,²⁷ and those who consider that the smart contract is not a contract according to its legal meaning. Including the inventor of this system, Nick Szabo

The legal nature of smart contracts raises a subject of jurisprudential controversy. Many legal scholars argue that smart contracts do not constitute legal contracts but are merely computer protocols that execute an already concluded agreement. Others accept their legally binding nature, asserting that smart contracts could replace traditional legal contracts entirely. In fact, both approaches seem incomplete, as they focus on either the technical or legal features of smart contracts, while downplaying their other important aspects. (legal or technical).²⁸

The study of the legal nature of smart contracts involves an analysis of contract theory, including how contractual relationships are formed, developed, and terminated.²⁹

The execution of the contract does not depend on the actions or inactions of the parties involved but rather on the occurrence of a predetermined condition, under which the contract self-executes. This is because the contract terms are directly encoded into lines of code, making the contract itself a form of program code.³⁰

V- Challenges in Implementing Smart Contracts Within the Traditional Contract System :

Research in the philosophy of technology and the sociology of law suggests that the law's efforts to regulate science and technology are too slow to keep up with the rapid pace of scientific and technological progress.³¹

The use of computer code to establish agreements should not inherently undermine the legality or enforceability of smart contracts.

Therefore many legal systems face fundamental challenges when legally recognizing smart contracts.³²

In this context, several questions arise as to whether the smart contract meets the requirements of a valid contract, such as:

1- Offer and Acceptance:

Traditional systems often rely on explicit language, represented by offer and acceptance, which constitutes mutual consent between two or more parties to achieve the intended legal effect of a contract. Contracts are agreements that establish mutual obligations enforceable by law, and their validity is not contingent upon a particular registration mechanism.³³

Although smart contracts may satisfy the essential elements of a contract, they may fail to comply with the execution requirements of a jurisdiction or transaction due to the automatic enforcement of conditions encoded in the code.

2- Intention to Create Legal Relations :

Smart contracts might execute without clear evidence of the parties' intent to form a binding agreement.

As a result, the issue of interpreting smart contract terms written in code poses a major legal challenge. Courts and legal practitioners may also have difficulty determining the intent behind coded terms, especially when disputes arise.³⁴

3- Difficulty in enforcing penalties within a smart contract :

Although some contractual penalties are automatically incorporated into smart contracts, this approach conflicts with certain principles of contract theory. Automating penalties for rescission or dissolution undermines the authority of the principle of good faith, a fundamental pillar of contract theory, especially during the implementation stage.

4-The automated nature of smart contracts contradicts certain principles of contract theory :

One of the most important principles regulating contracts is the principle of good faith.³⁵ It is difficult to conceive of a smart contract that accounts for the good faith of both parties, given its algorithmic nature.³⁶ Consequently, this makes it impossible for a judge to evaluate this principle within the framework of the contract.

5- The smart contract is incompatible with the procedural aspects of the contract system :

Contracts often require certain procedures within the framework of contract theory, such as processes for excuses, official notifications, and

documentation, or justification procedures. These functions are challenging to execute perfectly within the framework of smart contracts

6-Integration with Traditional Contract Systems :

Incorporating smart contracts into existing legal frameworks is a complex process. Many traditional systems rely on paper-based records or centralized databases, which do not seamlessly integrate with decentralized blockchain platforms. Ensuring compatibility between these systems is critical for widespread adoption.

7- Conflict resolution :

Resolving smart contract disputes presents a challenge for traditional courts due to the difficulty of interpreting or correcting blockchain-based agreements.

8- Limited compensation :

Parties may have limited options for compensation if the smart contract is executed incorrectly due to a programming error.

9-Absence of mediation mechanisms:

Smart contracts lack built-in mechanisms for mediation or arbitration, which are often necessary in traditional disputes.

Chapter III: Types of legal smart contracts

The blockchain platform acts as an intermediary to authenticate transactions, rather than the traditional intermediary such as banks in transferring funds, real estate registry offices in registering properties, intermediaries in sale and rental transactions, and even online platforms in providing services.³⁷ Below, we outline some of the transactions that fall within the scope of smart contracts :

I-Financial Smart Contracts:

Smart financial contracts are computer programs designed to facilitate and automate financial transactions based on predefined conditions. These include activities such as loan and borrowing transactions and the trading of financial assets.³⁸

1- Loans and Borrowing:

Smart contracts are utilized to automate the lending and borrowing process by specifying the terms of the loan, including interest rates,

repayment schedules, and collateral requirements. Once the borrower fulfills the conditions outlined in the contract, the funds are transferred automatically.

2- Trading and Exchanges:

Smart contracts can enable the trading of financial assets, such as cryptocurrencies, stocks, and commodities. They allow trades to be executed automatically based on predetermined criteria, such as price or volume thresholds.

3-Payment Processing:

Smart contracts can automate payment processing by automatically executing payments when specific conditions are met. For example, funds can be disbursed to suppliers once the goods or services have been delivered and verified.

II-Real Estate Management smart Contracts:

Real estate management smart contracts are computer protocols designed to streamline and automate various aspects of real estate transactions, ownership, and management. These contracts utilize blockchain technology to ensure transparency, security, and efficiency in real estate operations. Here are some features and use cases of real estate management smart contracts:

1-Property Ownership and Transfer:

Smart contracts can be used to record property ownership on a blockchain ledger. When a property is bought or sold, the transfer of ownership can be automatically executed through the smart contract. This eliminates the need for intermediaries such as title companies and reduces the risk of fraud.

2-Rental Agreements:

Smart contracts can automate rental agreements between landlords and tenants. The terms of the lease, including rental payments, deposit refunds, and maintenance responsibilities, can be encoded into the smart contract. This ensures that the terms are enforced automatically and transparently, without the need for manual intervention.

3-Escrow Services:

Smart contracts can act as escrow agents in real estate transactions. When a buyer and seller agree on a transaction, the funds can be deposited into an escrow smart contract. The funds are then released to the seller once the conditions of the sale are met, such as the transfer of property ownership.

4-Property Management:³⁹

Smart contracts can automate various property management tasks, such as rent collection, maintenance scheduling, and dispute resolution. For example, maintenance requests from tenants can trigger automatic payments to service providers once the work is completed and verified.

5-Fractional Ownership:

Smart contracts can tokenize real estate assets, allowing for fractional ownership. Investors can purchase digital tokens representing partial ownership of a property, which can be traded on blockchain-based platforms. Smart contracts manage the distribution of rental income and capital gains to token holders.⁴⁰

III-Insurance Contract Management:

Smart contracts are among the major innovations happening in the insurance sector.

Insurance smart contracts are digital agreements that automate and execute insurance-related transactions and processes using blockchain technology. It is especially used to automatically process compensation claims when accidents occur.

Here are some key features and functionalities of insurance smart contracts:

1- Policy Issuance:⁴¹

Smart contracts can facilitate the issuance of insurance policies by automatically generating policy documents, defining coverage terms, calculating premiums, and distributing policy information to policyholders. These contracts ensure accuracy and consistency in policy issuance.

2- Premium Payments:

Insurance smart contracts automate premium payments by setting up scheduled payment transactions based on policy terms and renewal dates. Policyholders' premiums are deducted automatically from their accounts, reducing the risk of missed payments and policy lapses.⁴²

3-Claims Processing:

Smart contracts streamline the claims processing workflow by automating the submission, validation, and settlement of insurance claims. Claims submitted by policyholders are verified against predefined contractual conditions, and payouts are automatically initiated if the claim is approved, reducing processing time and administrative costs.

4-Risk Assessment and Underwriting:

Insurance smart contracts leverage data analytics and machine learning algorithms to assess risk factors, such as demographics, health history, and property value. These contracts determine appropriate premiums and coverage levels based on risk assessments, enhancing underwriting efficiency and accuracy.⁴³

5-Reinsurance Management:

Smart contracts facilitate reinsurance arrangements by automating the transfer of risk between primary insurers and reinsurers. Reinsurance contracts are tokenized and traded on blockchain platforms, allowing insurers to manage their risk exposure more effectively and transparently.

6-Fraud Detection and Prevention:

Insurance smart contracts employ advanced algorithms and data analysis techniques to detect and prevent insurance fraud. Suspicious activities and fraudulent claims are flagged automatically, enabling insurers to investigate and mitigate fraud more efficiently.

7-Policy Renewals and Endorsements:

Smart contracts manage policy renewals and endorsements by automating the renewal process, updating policy terms, and processing endorsements seamlessly. Policyholders can opt-in to renew their policies automatically, reducing administrative burden and improving customer experience.

8-Regulatory Compliance:

Insurance smart contracts ensure compliance with regulatory requirements by enforcing rules and regulations encoded into the contract code. KYC (Know Your Customer) and AML (Anti-Money Laundering) verification checks are integrated into the insurance contract management process to meet regulatory standards.⁴⁴

Overall, insurance smart contracts offer numerous benefits, including increased operational efficiency, reduced administrative costs, enhanced fraud detection, and improved customer satisfaction within the insurance industry.

CONCLUSION

To conclude, the smart contract represents an innovative tool designed to modernize the traditional concept of contracts. It embeds pre-agreed terms into a digital program or framework, effectively functioning as a program that complements the traditional contract structure.

The legal nature of smart contracts is a dynamic and evolving field, necessitating consideration of both established legal principles and the technological realities. This evolution may compel legal systems to adapt by introducing more precise provisions regarding the enforceability and regulation of smart contracts. Consequently, legal professionals must make greater efforts to understand the essence and implications of such contracts. Nonetheless, it is crucial to ensure that smart contracts accurately reflect the intentions of the parties involved to avoid unintended consequences or potential conflicts.

Implementing smart contracts within traditional contract systems presents significant challenges. Addressing these challenges requires a collaborative effort that includes legal reform, technological advancement, and establishing standardized best practices. As the legal and technological landscape evolves, smart contracts may become more integrated and widely accepted, but overcoming these hurdles is critical to their broader adoption and effectiveness.

Given the evolving nature of smart legal contracts, it is essential to enhance their development and regulation. Accordingly, we propose the following recommendations:

- 1- Create standardized, encrypted contract templates to reduce errors, minimize ambiguity, and enhance trust in smart legal contracts.
- 2- Create mechanisms that allow human intervention in smart contracts to address unforeseen events and maintain fairness alongside automation.
- 3- Training professionals, such as judges and notaries, to deepen their understanding of the legal aspects of smart contracts.
- 4- Establishing data control requirements for smart contracts, with the exception of privacy laws and animal data recording.
- 5- Develop pilot programs to safely test smart contracts before they are widely adopted.

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