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Pacta Sunt Servanda and the evolution of blockchain smart contracts: A jurisprudential analysis

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ABSTRACT:

For many years, the fundamental tenet of contract law—pacta sunt servanda, or "agreements must be kept"—has guaranteed the integrity and enforceability of contracts in a variety of legal contexts. Simultaneously, smart contracts and blockchain technology have become revolutionary developments that are changing the nature of contractual interactions. For many years, the fundamental tenet of contract law—pacta sunt servanda, or "agreements must be kept"—has guaranteed the integrity and enforceability of contracts in a variety of legal contexts. Simultaneously, smart contracts and blockchain technology have become revolutionary developments that are changing the nature of contractual interactions. These self-executing agreements, embedded in code and deployed on decentralized platforms, promise efficiency and trust but also challenge traditional jurisprudence. This paper explores the compatibility of *pacta sunt servanda* with blockchain-based smart contracts, addressing their implications for contractual obligations, enforcement mechanisms, and jurisprudential evolution. It examines how decentralized automation interacts with established legal principles, highlighting both the potential and limitations of smart contracts in upholding the binding nature of agreements. The analysis identifies critical areas requiring legal adaptation to reconcile technological advancements with foundational contractual doctrines.

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Keywords: ***pasta sunt servanda, blockchain, smart contracts, jurisprudence, decentralized automation***

1. INTRODUCTION:

The fundamental idea of pacta sunt servanda, which highlights the sanctity and binding nature of agreements, has long governed contractual responsibilities. This idea promotes predictability in both private and business dealings by guaranteeing stability and confidence in legal systems.

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But with the rise of the digital revolution, new tools like blockchain and smart contracts have emerged, upending preconceived ideas about how contracts are made, enforced, and resolved.[1] Blockchain technology provides a novel platform for implementing smart contracts, which are self-executing agreements with conditions directly encoded into software, thanks to its decentralized and unchangeable architecture. Increased efficiency, less dependence on middlemen, and improved trust through transparency are all anticipated benefits of these technical developments. They call into question whether they are consistent with well-established legal doctrines such as pacta sunt servanda.

This paper investigates whether smart contracts align with or disrupt the traditional understanding of *pacta sunt servanda*. It explores their legal validity, the role of intent and consents in their formation, and the mechanisms for enforcement in a decentralized context. This paper addresses the issues raised by automated execution and decentralized platforms while examining the consequences of smart contracts for contractual frameworks through a jurisprudential analysis. It finds that smart contracts have the capacity to change obligations and remedies. By doing this, it aims to close the gap between new technological paradigms and conventional contract law.[2]

2. The Principle of Pacta Sunt Servanda in Jurisprudence:

2.1 Historical Context

The concept of pacta sunt servanda regarded agreements as binding, provided they adhered to certain formalities. This principle evolved through the canon law of the Middle Ages and gained prominence in the modern era, particularly within the framework of international law and national legal systems. In the jurisprudence of contract law, pacta sunt servanda reflects a commitment to uphold autonomy, stability, and predictability in commercial and personal transactions. It also serves as the cornerstone for the enforceability of agreements, ensuring that parties adhere to their obligations and trust in the legal framework.[3].

[1] Szabo, N. (1997). "The Idea of Smart Contracts." Nick Szabo's Blog (Jan. 29, 2025, 8:00 P.M.) https://www.szabo.best

[2] Buterin, V. (2013). "A Next-Generation Smart Contract and Decentralized Application Platform." Ethereum White Paper, (Jan. 29, 2025, 8:00 P.M.) https://ethereum.org/whitepaper

[3] ULYASHYNA, L. (2023). THE MEANING ROLE OF THE PACTA SUNT SERVANDA PRINCIPLE IN INTERNATIONAL LAW: IDENTIFYING CHALLENGES TO THE LEGITIMACY OF PEACE AND WAR, OJS Mruni, (Jan. 29, 2025, 8:00 P.M.) https://ojs.mruni.eu/ojs/vsvt/article/view/8447

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A fundamental tenet of contract law is "pacta sunt servanda," which translates from Latin to mean "agreements must be kept," highlighting the legally enforceable character of commitments and duties in contracts. This principle guarantees that parties to a legally binding contract are obligated to carry out their end of the bargain, including terms, payment, and delivery. Contracts, which are the foundation of business and legal dealings, promote confidence and trust between parties by adhering to this principle. Without it, the confidence necessary for cooperative engagements would dissolve, and agreements would not be enforceable.[4].

Rooted in Roman law's concept of *fides*—faith or trust—the principle regarded agreements as sacred, expecting promises to be honored. Over time, as legal systems evolved, *pacta sunt servanda* transitioned from a moral precept to a legally enforceable mandate, adapting to societal and economic changes. Its resilience has ensured that contracts remain a stable and dependable mechanism for regulating relationships and transactions. Beyond domestic contract law, *pacta sunt servanda* holds significance in international law, particularly in treaty obligations. It is a foundational principle for maintaining trust and respect among states, underpinning peaceful international relations. The principle promotes stability in international relations by requiring that treaties and agreements between countries be upheld.

In contemporary legal frameworks, *pacta sunt servanda* symbolizes the continuity of principles that bridge ancient legal traditions with modern complexities. Its enduring relevance underscores its critical role in preserving the sanctity of agreements, ensuring that they are not merely symbolic gestures but enforceable commitments that sustain both commercial transactions and international cooperation.[5].

2.2 Juridical Significance

The Latin phrase "pacta sunt servanda," which means "agreements must be kept," is a cornerstone of contract law, emphasizing the legally binding nature of obligations and commitments made in contracts. This principle ensures that all parties to a legally enforceable contract must fulfill their obligations, including those related to terms, payment, and delivery. By upholding this ideal, contracts—the cornerstone of legal and corporate interactions—promote confidence and trust between parties. Without it, agreements would not be enforced,

[4] Urs, I. R., & Ispas, P. E. (2014). The Pacta Sunt Servanda Principle and the Rebus Sic Non Standibus Rule in Complying with the Contractual Obligations, Research Gate (Jan. 29, 2025, 8:00 P.M.) https://www.juridicainternational.eu/public/pdf/ji_2001_1_44.pdf.

[5] Sârghi, E. (2023). Pacta sunt servanda in comparative law, Juridica (Jan. 29, 2025, 8:00 P.M.), https://juridica.ugb.ro/.

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and the trust required for cooperative interactions would evaporate.[6]. Judicial precedents that highlight the legally binding character of promises—as long as the essential components of a legitimate contract are present—are how pacta sunt servanda is expressed in common law systems. Offer, acceptance, contemplation, and the desire to establish legal ties are some of these components. Common law has always maintained the inviolability of contracts through court decisions, guaranteeing that parties are held responsible for their contractual duties absent extraordinary circumstances.

Article 26 of the Vienna Convention on the Law of Treaties codifies pacta sunt servanda on a global level, confirming its universal applicability in the field of international law. This idea promotes trust, collaboration, and amicable relations between governments and forms the basis for the integrity of treaties and international agreements. By ensuring that nations fulfill their duties under treaties, it promotes stability and predictability in international relations. Despite its overarching significance, *pacta sunt servanda* is not absolute. Legal systems acknowledge exceptions like *clausula rebus sic stantibus* (things thus standing), which allows for the modification or termination of agreements in unforeseen circumstances that fundamentally alter the original conditions. This concept strikes a balance between the strictness of contract enforcement and the need for justice and equity in exceptional circumstances, ensuring that the principle stays flexible and adaptive to the reality of changing environments. Pacta sunt servanda's lasting significance stems from its dual function as a strict norm that upholds the integrity of contracts and as a flexible guideline that can take into account changing circumstances. It continues to be a cornerstone value that promotes responsibility, stability, and confidence in legal and diplomatic frameworks around the world, whether in domestic or international legal systems.[7].

3. Blockchain Technology and Smart Contracts:

3.1 Overview of Blockchain

[6] Abbasi Sarmadi, M., Amani, M., & Goharian, M. J. (2018). Breaching the Principle of pacta sunt servanda by Virtue of the Principle of Permanent Sovereignty over Natural Resources: Compensation or Indemnity. Journal Of Researches Energy Law Studies, (Jan. 29, 2025, 8:00 P.M.), https://jrels.ut.ac.ir/article_68057.html?lang=en.

[7] Witzleb, N. (Ed.). (2022). Contract Law in Changing Times: Asian Perspectives on Pacta Sunt Servanda. Taylor & Francis group, (Jan. 29, 2025, 8:00 P.M.), https://www.routledge.com/ContractLawinChangingTimesAsianPerspectivesonPactaSuntServanda/Witzleb/p/book/9781032414867?srsltid=AfmBOordBGPR3LnXm26zXel_rLVJNSgk5hmIM29LoXjywPugIG7r9C6J.

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Blockchain is a distributed, decentralized ledger technology that ensures transparency and immutability by recording transactions across numerous nodes. To prevent tampering, each block includes a timestamp, transaction data, and a cryptographic hash of the previous block.[8] A decentralized, shared, and unchangeable digital ledger called blockchain technology is used to track assets and record transactions within a company network. It makes it possible to track intangible assets like patents, branding, and intellectual property, as well as tangible assets like real estate, cars, and money, in a safe, transparent, and effective manner. This cutting-edge solution lowers expenses, lowers risks, and increases member trust.[9].

Blockchain functions as a distributed database in which information is kept in blocks and connected one after the other to create a chain. After a block is finished, it is added to the chain in chronological order. Each block comprises a collection of transactions. Since the ledger is immutable, transactions cannot be changed or removed once they are entered. Data security and integrity are guaranteed by this feature. The value of blockchain is found in its capacity to offer instantaneous, collaborative access to reliable information. Because it allows for real-time tracking of orders, payments, accounts, and production, it is very beneficial for enterprises. Blockchain promotes increased transparency, confidence, and efficiency since every member of the network shares a single, verified version of the truth.[10] The ability of blockchain to expedite operations by eliminating middlemen, decreasing manual procedures, and speeding up transactions is its most significant feature. Furthermore, because it is decentralized, no one organization can control the entire network, improving security and resistance to fraud and manipulation. Smart contracts, which are self-executing agreements with predetermined rules embedded directly into the blockchain, are another feature of blockchain technology. By automating procedures, these contracts further simplify operations and boost productivity. With its applications in supply chain management, finance, healthcare, and other fields,

[8] Marr, B. (2019). "The Key Advantages of Blockchain Technology in Business." Forbes, (Jan. 29, 2025, 8:00 P.M.), https://www.forbes.com

[9] Meafa, A. E., Chaouni Benabdellah, A., Zekhnini, K., Belhadi, A., & Kamble, S. (2024). Driving resiliency and digitalization in the sourcing process: integration of blockchain technology and smart contracts, Emerald Insight (Jan. 29, 2025, 8:00 P.M.) https://www.emerald.com/insight/content/doi/10.1108/bij-01-2024-0059/full/html?utm_source=rss&utm_medium=feed&utm_campaign=rss_journalLatest.

[10] European Commission. (2020). "Blockchain for Digital Identity." EU Blockchain Observatory and Forum, (Jan. 29, 2025, 8:00 P.M.) https://www.eublockchainforum.eu

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blockchain is transforming conventional business procedures by fostering an atmosphere of trust and cooperation for all parties involved.[11].

3.2 Introduction to Smart Contracts

Digital contracts with self-executing terms and conditions that are encoded directly into code are known as smart contracts. Once deployed, when certain criteria are met, they carry out predetermined tasks on their own. Computer scientist and legal scholar Nick Szabo first proposed the idea of smart contracts in the 1990s. He saw them as a way to make it easier to negotiate or carry out contracts without the need for middlemen. With the emergence of blockchain platforms such as Ethereum, which offered the decentralized infrastructure necessary to successfully execute these contracts, the concept acquired practical appeal.[12].

Automation is the main characteristic of smart contracts. Smart contracts run automatically when certain circumstances are met, in contrast to regular contracts that need human involvement to enforce. A smart contract might, for example, release funds to the seller and give the buyer ownership in a real estate transaction if all requirements, including payment receipt and title verification, are met. Delays are avoided, and the possibility of manipulation or human error is decreased. Immutability is another feature that makes smart contracts unique. The smart contract's code and terms cannot be changed once it is put on a blockchain. This guarantees that the contract cannot be altered, fostering a high level of confidence between the parties. Additionally, immutability ensures the precise logic inherent in the contract, enhancing predictability and reducing disputes.[13]. Another crucial component of smart contracts is decentralization. Smart contracts run on decentralized blockchain networks, as opposed to traditional contracts that depend on centralized middlemen like banks, attorneys, or escrow agents. By doing away with the need for middlemen, this lowers expenses and boosts productivity. Moreover, decentralization enhances security by making the system less vulnerable to single points of failure or centralized corruption. Despite these advantages, smart

[11] Lauslahti, K., Mattila, J., & Seppala, T, Smart contracts–How will blockchain technology affect contractual practices?. Etla Reports, (Jan. 29, 2025, 8:00 P.M.), https://www.etla.fi/wp-content/uploads/ETLA-Raportit-Reports-68.pdf

[12] Kaur, G., Habibi Lashkari, A., Sharafaldin, I., & Habibi Lashkari, Z. (2023). Introduction to Smart Contracts and DeFi, Springer International Publishing (Jan. 29, 2025, 8:00 P.M.), https://www.springerprofessional.de/en/understanding-cybersecurity-management-in-decentralized-finance/23904442.

[13] Le, N. T. T., Nguyen, Q. N., Phien, N. N., Duong-Trung, N., Huynh, T. T., Nguyen, T. P., & Son, H. X. (2019). Assuring non-fraudulent transactions in cash on delivery by introducing double smart contracts, SAI (Jan. 29, 2025, 8:00 P.M.), https://thesai.org/Publications/ViewPaper?Volume=10&Issue=5&Code=IJACSA&SerialNo=84.

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contracts present challenges, particularly in reconciling their automated nature with traditional legal principles. Legal contracts often allow for interpretation, negotiation, or renegotiation in response to unforeseen circumstances, but smart contracts rigidly enforce the predefined terms without accommodating ambiguity. This rigidity can lead to unintended consequences, as the execution is strictly bound to the logic of the code, which might not fully capture the complexities of real-world scenarios.[14].

Smart contracts lack a built-in mechanism to handle disputes or address external factors, such as regulatory changes or force majeure events, which may impact the agreement. Legal enforceability is another concern. While smart contracts can execute transactions, their recognition in courts or alignment with existing legal frameworks varies across jurisdictions, creating uncertainty for the parties involved. Coding errors or vulnerabilities in smart contracts can lead to significant financial and operational risks. Since smart contracts are immutable, any flaw in the code becomes permanent once deployed, potentially leading to exploitation or loss.[15] The infamous DAO hack on Ethereum in 2016, where a loophole in the code was exploited, highlighted the critical importance of secure and well-audited smart contract programming. Smart contracts are a transformative innovation, offering automation, transparency, and efficiency. However, their adoption requires careful consideration of legal, technical, and ethical challenges. By bridging the gap between code and law, smart contracts have the potential to redefine how agreements are formed and executed in the digital age.[16].

4. Compatibility of Smart Contracts with Pacta Sunt Servanda:

4.1 Alignment with Contractual Principles

By automating the enforcement of agreed-upon terms and guaranteeing that responsibilities are carried out precisely as stated, smart contracts exemplify the idea of pacta sunt servanda, which states that agreements must be upheld. Because smart contracts are self-executing, the likelihood of a breach or non-performance is greatly decreased because, once conditions are

[14] Raskin, M. (2016). The law and legality of smart contracts, Geo. L (Jan. 29, 2025, 8:00 P.M.), https://georgetownlawtechreview.org/wp-content/uploads/2017/05/Raskin-1-GEO.-L.-TECH.-REV.-305-.pdf

[15] Tomaino, J. (2018). "Smart Contracts and Blockchain Technology: An Overview." *The Journal of International Law & Practice*, (Jan. 29, 2025, 8:00 P.M.) https://www.researchgate.net/publication/368500729_Smart_Contracts_in_Blockchain_Technology_A_Critical_Review.

[16] Kemmoe, V. Y., Stone, W., Kim, J., Kim, D., & Son, J., Recent advances in smart contracts: A technical overview and state of the art. IEEE Xplore (Jan. 29, 2025, 8:00 P.M.), https://ieeexplore.ieee.org/document/9125932.

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met, the contract is implemented immediately and without intervention. Smart contracts provide a simplified, automated method that guarantees all parties abide by the conditions as intended, in contrast to traditional contracts, where human involvement and possible mistakes or misunderstandings can disrupt enforcement.[17].

The predictability that smart contracts offer is one of its main benefits. There is minimal opportunity for misunderstanding or ambiguity because the contract's terms are encoded straight into the code. All network members may see and understand the predetermined circumstances and actions. All parties are aware of the precise conditions and ramifications of the agreement, which promotes compliance. Since the code and the logic it contains decide the execution process, there is no need for subjective interpretation or outside adjudication.

By taking advantage of blockchain technology's immutability, smart contracts increase mutual trust. The provisions of a contract cannot be changed once it is implemented on a blockchain, guaranteeing that no party may unilaterally alter the agreement to their benefit. This immutability builds confidence in the contract's execution, as parties can be certain that the agreed-upon terms will be upheld throughout the process, barring any predetermined contingencies. It is important to combine automation, clarity, and immutability, smart contracts that not only ensure compliance with *pacta sunt servanda* but also introduce a new level of reliability and trust in the execution of agreements.[18]

4.2 Challenges to Traditional Jurisprudence:

Smart contracts, while revolutionary in automating and securing transactions, pose significant challenges to traditional legal principles, particularly regarding intent, consent, and remedies. These challenges arise due to the code-driven nature of smart contracts, which can create complexities in applying conventional contract law concepts.

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Intent and Consent:

[17] Meyer, O., & Ortolani, P. (2023). The Unidroit Principles and the inflexibility of code as law: reconciling smart contracts with general clauses. Radbound University, (Jan. 29, 2025, 8:00 P.M.), https://repository.ubn.ru.nl/handle/2066/306501.

[18] Amironesei, A. E. (2021). Blockchain Technology in the Performance on Online Advertising Contracts. Analele Stiintifice Ale Universitatii Alexandru Ioan Cuza Din Iasi, (Jan. 29, 2025, 8:00 P.M.), https://pub.law.uaic.ro/en/sumarul-fascicolelor/2021/anale-uaic-tomul-lxvii-tiine-juridice-copeji/aura-amironesei-tehnologia-blockchain-in-executarea-contractelor-de-publicitate-comercial-online

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The establishment and enforcement of agreements are heavily reliant on the intent and permission of the parties, according to classical contract law. A key component of a contract's legitimacy is the knowledge that both parties enter into it voluntarily and knowingly. However, with smart contracts, the process is automated and driven by code, potentially disconnecting the parties from fully understanding or consciously agreeing to every encoded term. Smart contracts are written in programming language, and while the terms may be clear to those with technical expertise, they may not be fully accessible or comprehensible to all parties involved. This raises concerns about whether parties genuinely consent to every condition outlined in the contract. For instance, in complex agreements, non-technical parties may not fully appreciate the implications of certain coded clauses or the execution mechanics, leading to a mismatch between their intent and the contract's actual operation. Additionally, the use of automated systems can create situations where parties unknowingly agree to terms that they do not fully grasp, potentially undermining the voluntary nature of consent that traditional contract law requires[19].

Remedies and Flexibility:

Another challenge is the limited flexibility of smart contracts in terms of remedies and judicial discretion. Traditional contract law allows courts to intervene in situations where unforeseen circumstances arise, such as in cases of force majeure, frustration of purpose, or breach of contract. Courts can offer equitable remedies, such as rescission, modification, or damages, based on the principles of fairness, justice, and the specific intent of the parties.[20].

Smart contracts, on the other hand, are inflexible, self-executing contracts that adhere to preset guidelines that are stored in the blockchain. The provisions of the contract are automatically performed without the option of court intervention, and once deployed, they cannot be changed. This lack of adaptability causes problems when outside influences or shifting conditions alter the parties' initial intentions. For example, if an external event invalidates one of the terms or if a party faces an unexpected hardship that makes performance impossible, a traditional contract could be modified or canceled by a court. However, with a smart contract, there is no

[19] Shafi'i, A., Amirzadeh Jirkoli, M., & Kazemi Golvardi, M. (2023). Critical study of traditional jurisprudence approach to women's rights (foundations and challenges). Fiqh and Usul, (Jan. 29, 2025, 8:00 P.M.), https://jfiqh.um.ac.ir/article_40303.html?lang=en.

[20] Allen, D. W., Lane, A. M., & Poblet, M. (2019). The governance of blockchain dispute resolution. Harvard Journal, (Jan. 29, 2025, 8:00 P.M.), https://journals.law.harvard.edu/hnlr/wp-content/uploads/sites/91/75-allen-et-al.pdf.

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built-in mechanism for such adjustments, and the contract will execute strictly according to the terms encoded into it, regardless of new developments.[21]

The flexibility found in conventional contract law, where judges can interpret agreements or offer equitable remedies depending on the particular facts and circumstances of each case, stands in stark contrast to this rigidity. Smart contracts' rigidity raises questions about their capacity to adjust to the complexity of the actual world or settle conflicts in an equitable and just way. Smart contracts offer significant benefits in terms of automation, efficiency, and trust; they also challenge traditional legal principles of intent, consent, and judicial discretion. Their rigidity and the technical nature of their implementation raise questions about how well they align with the human-centered approach of conventional contract law, highlighting the need for careful consideration and potential reforms to integrate smart contracts into existing legal frameworks.[22].

5. Jurisprudential Implications:

5.1 Redefining Consent and Autonomy

Smart contracts introduce a fundamental shift in how consent is understood and applied in contractual relationships. The reliance on code to define and enforce terms necessitates a rethinking of traditional notions of consent, as parties may not fully comprehend the technical aspects of the contract. Unlike conventional contracts, which are written in natural language and are typically accompanied by explanations or legal counsel, smart contracts are encoded in programming languages that may be inaccessible to non-technical parties. This disparity creates a gap in understanding, raising concerns about whether consent is genuinely informed and voluntary.[23].

To address these challenges, *enhanced transparency* is essential. Parties entering into a smart contract must have a clear understanding of the terms and conditions encoded into the contract, including how specific actions will trigger automated execution. This requires not only that the terms be made transparent but also that the parties comprehend the logic and operations behind

[21] Haskins, M., & Green, E. (2020). "Regulation of Smart Contracts: Insights for the Future." Journal of International Business Law, (Jan. 29, 2025, 8:00 P.M.), https://www.researchgate.net/publication/377262573_Legal_and_Regulatory_Aspects_of_Smart_Contracts_A_Systematic_Review

[22] Drazdauskas, S. (2024). Intention to be Bound when Forming Contracts by Automated Means, SSRN (Jan. 29, 2025, 8:00 P.M.), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4810172

[23] Scott, J., Informed Consent and Respect for Autonomy Doctoral dissertation, University of Sunderland (Jan. 29, 2025, 8:00 P.M.), https://sure.sunderland.ac.uk/id/eprint/3561/1/John_Scott.pdf.

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the contract's execution. For this, there may be a need for tools or mechanisms that translate the code into plain language or provide clear explanations of how the contract works, ensuring that all participants are fully informed.

Pre-contractual disclosure becomes a key aspect of ensuring valid consent. Legal frameworks should be adapted to mandate the disclosure of smart contract terms before execution, similar to how traditional contracts require disclosures of key terms or potential risks. By ensuring that parties are informed of the implications of entering into a smart contract, including the automated nature of its execution and any potential consequences, legal systems can uphold the principle of informed consent. This approach would reinforce the transparency of smart contracts, ensuring that consent is not only given but given with full knowledge of the terms and their execution, aligning with traditional contractual principles of fairness and accountability[24].

6. Enforcement and Remedies:

The automated execution of smart contracts adheres to the standard of *pacta sunt servanda* by ensuring that agreed-upon terms are carried out without delay or human intervention. This automation presents significant challenges when it comes to enforcing or addressing disputes, especially in cases of errors or unforeseen circumstances.

One of the primary challenges is *irreversibility*. Blockchain's immutable nature means that once a smart contract is deployed and executed, the terms cannot be easily altered or undone. While this immutability ensures that contracts are tamper-proof and secure, it also creates difficulties when errors are made in the code or when unexpected events occur that render the contract's terms unfair or impractical. For example, if a smart contract's conditions were coded incorrectly or if external factors—such as changes in law or unforeseen events—affected the parties' ability to fulfill their obligations, the contract would still execute according to the predetermined code. The inability to modify or rescind the contract once deployed makes it

[24] Lotz, M., Sexual Autonomy, Consent, and Reproductive Control. In The Routledge Handbook of Philosophy of Sex and Sexuality, Routledge. (Jan. 29, 2025, 8:00 P.M.), https://www.routledge.com/The-Routledge-Handbook-of-Philosophy-of-Sex-and-Sexuality/Earp-Chambers-Watson/p/book/9781032261010?srsltid=AfmBOoo4qwSGE6pLHI67B189hwju-_7UPy7y8lzDCQXCp0cK_qe-9wLm.

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difficult to rectify such situations, potentially leading to unjust outcomes for one or more parties involved.[25].

It is also pivotal to understand that judicial *intervention* becomes a critical issue in resolving disputes that arise from the rigid execution of smart contracts. Traditional contract law allows courts to interpret terms, provide remedies for breaches, and adapt agreements based on the circumstances. However, judges' ability to step in is limited by the automated structure of smart contracts and their absence of an internal dispute resolution process. Courts must come up with new methods to resolve disputes resulting from coding flaws or unanticipated events, which may include looking at the code, conducting technical audits, and deciding whether equitable remedies are necessary. This creates a challenge for the legal system, as it needs to evolve and develop new frameworks to handle the complexities of smart contract enforcement while maintaining fairness and flexibility.[26]

7. Ethical and Policy Considerations:

The advent of smart contracts brings with it a host of ethical and policy considerations that go beyond traditional jurisprudence, particularly in the realms of autonomy, human oversight, and equitable access to technology. These concerns are crucial as society navigates the intersection of law, technology, and human rights.

The balance between human autonomy and the effectiveness of automation is one of the most significant ethical issues raised by smart contracts. Smart contracts are made to automatically carry out commitments in response to predetermined conditions that are encoded into the contract. Significant advantages of this automation include decreased wait times, the removal of middlemen, and increased productivity. However, this raises questions about how human oversight is becoming less important in decision-making. In traditional contracts, individuals can renegotiate, amend, or challenge terms, often with the aid of legal counsel or judicial intervention. With smart contracts, once the code is deployed, its execution is rigid and irreversible, leaving little room for adjustments based on changing circumstances or human

[25] Lobeiras, M. J. V. (2024). Rethinking with Onora O'Neill the Kantian Concept of Autonomy in Biolaw, Research Gate (Jan. 29, 2025, 8:00 P.M.), https://www.researchgate.net/publication/384468369_Rethinking_with_Onora_O%27Neill_the_Kantian_Concept_of_Autonomy_in_Biolaw.

[26] Patryn, R., & Zagaja, A., Value of substitute consent and autonomy of research participants in Regulation (EU) No 536/2014. Journal of Pre-Clinical and Clinical Research, (Jan. 29, 2025, 8:00 P.M.), https://www.jpccr.eu/Value-of-substitute-consent-and-autonomy-of-research-participants-in-Regulation-EU,131221,0,2.html.

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judgment. The risk is that automated systems may not always capture the nuance or intent behind human agreements, leading to unfair or unintended outcomes. Therefore, ethical questions arise about whether automation should entirely replace human discretion in contractual matters or if there should be safeguards that allow for human intervention in cases of dispute or unforeseen circumstances.[27].

The digital gap, or the differences in access to technology, knowledge, and legal remedies that may prevent some parties from fully benefiting from smart contracts, is the other main issue. Although blockchain technology and smart contracts provide impressive efficiency, not all people or enterprises may have equal access to this advanced technology. Non-technical users, in particular, can find it difficult to comprehend or utilize smart contracts, which could disadvantage them in contract negotiations or execution. Those in less developed regions or without adequate digital infrastructure may find themselves excluded from the opportunities presented by blockchain-based systems. This exclusion raises questions about fairness and equity in the digital economy. Furthermore, if a dispute arises over a smart contract, the complexity of resolving such issues may require specialized knowledge and legal expertise, which might not be easily accessible to everyone, particularly in jurisdictions with limited legal resources or digital literacy.[28]

Policymakers must address these ethical issues to make sure smart contracts don't worsen already-existing disparities. This includes promoting digital literacy, providing access to legal recourse for all parties, and considering mechanisms for human oversight in smart contract execution. Legal frameworks may need to be adapted to account for these new challenges, ensuring that everyone, regardless of their technical expertise or geographic location, can benefit from the efficiencies of smart contracts while still protecting their rights and access to justice. To guarantee fair participation and stop the digital divide from widening a concentrated effort should also be made to make the underlying technology more open and accessible.[29]

[27] Prokůpek, M., Legal and Ethical Considerations. In Financial Management in Museums, Routledge, (Jan. 29, 2025, 8:00 P.M.), https://www.routledge.com/Financial-Management-in-Museums-Theory-Practice-and-Context/Jung-Shane-Wells/p/book/9781032310916?srsltid=AfmBOooj-p_RTYrEwAT40Q85pQoRDDBR2GtJQPQVoAMLUcO8y5GoroJH

[28] Lemieux, F., Moral and Ethical Considerations. In Intelligence and State Surveillance in Modern Societies, Emerald Insight (Jan. 29, 2025, 8:00 P.M.), https://www.emerald.com/insight/publication/doi/10.1108/9781835490976.

[29] Smith, J. (2019). "Smart Contracts: A Legal Perspective." *Journal of Digital Legal Studies*, (Jan. 29, 2025, 8:00 P.M.) https://www.um.edu.mt/library/oar/bitstream/123456789/73833/1/Christine%20Borg%20-

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8. Case Studies and Jurisprudential Trends:

8.1 Legal Recognition of Smart Contracts

The recognition of smart contracts within legal systems varies across jurisdictions, with countries and regions taking different approaches to integrate these automated agreements into their existing frameworks. In the United States, some states have taken significant strides in recognizing the enforceability of blockchain-based contracts under traditional contract law. States like Arizona and Nevada have passed legislation explicitly stating that contracts executed via blockchain technology are legally valid and enforceable. Arizona, for example, passed a law in 2017 that affirms the legal status of blockchain records, ensuring that smart contracts created and executed using blockchain technology are considered binding. Similarly, Nevada passed laws that recognize blockchain-based transactions, clarifying that these digital contracts meet the criteria for validity under the state's contract law, provided they meet the standard requirements of offer, acceptance, and consideration.[30] These efforts reflect a broader trend in the U.S., where individual states are attempting to create clear legal guidelines for the use of blockchain in commercial agreements, recognizing the efficiency and security benefits blockchain offers while ensuring that these contracts comply with existing legal principles. However, at the federal level, there is still a lack of comprehensive regulation specifically addressing blockchain contracts, leading to some uncertainty in cross-border transactions.[31].

In the European Union, the approach to smart contracts is similarly progressive, with initiatives underway to integrate blockchain-based agreements into the broader legal framework. The European Union has recognized the potential of blockchain technology to streamline legal processes and enhance transparency, particularly within the scope of digital services. Under the Digital Services Act (DSA), the EU is taking steps to regulate and provide a legal framework for the use of blockchain technology in contracts and transactions. This initiative is part of a broader effort to create a unified digital marketplace where blockchain-based contracts can be used effectively and securely. The DSA, along with other legislative efforts like the

%20M.Sc.%20Blockchain%20and%20Distributed%20Ledger%20Technologies%20%28Law%20and%20regulation%29.pdf.

[30] Karafyllis, N., & Gurevich, A. (2017). "Legal Challenges of Smart Contracts." Harvard Journal of Law & Technology, (Jan. 29, 2025, 8:00 P.M.) https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/.

[31] Song, J. Y. L., & Tan, E. (2024). Beyond traditional contracts: the legal recognition and challenges of smart contracts in Malaysia and Singapore. Journal of Law, Market & Innovation, (Jan. 29, 2025, 8:00 P.M.), https://ojs.unito.it/index.php/JLMI/article/view/11334.

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European Blockchain Partnership and the European Commission's work on the Regulation on the Use of Blockchain for Digital Identity, aims to foster the adoption of blockchain technology while ensuring legal certainty and consumer protection. These efforts are designed to create a clean legal environment where smart contracts can be recognized as legitimate tools for conducting business, ensuring that parties are protected and disputes can be addressed under existing legal principles.[32] Both the U.S. and EU are working towards ensuring that blockchain-based contracts are recognized in ways that are consistent with the legal frameworks of their respective jurisdictions while also encouraging innovation and providing legal clarity to businesses and consumers using this emerging technology.

8.2 Judicial Interpretations:

Emerging case law emphasizes the necessity of judicial adaptation to successfully handle issues specific to these blockchain-based agreements as the use of smart contracts grows. Smart contracts are efficient and secure, but they also present complicated problems that call for new methods of interpretation and enforcement by the courts.[33]

One of the key issues in smart contract cases is *coding errors*. Smart contracts are written in programming languages that, while precise, can inadvertently contain bugs or flaws that lead to unintended consequences. Since smart contracts are immutable once deployed on the blockchain, a coding error can result in the automatic execution of terms that may not align with the original intent of the parties. This issue is compounded by the fact that the parties involved in a smart contract may not fully understand the technical aspects of the code. In such cases, courts may face the difficult task of determining whether the contract should be enforced as written despite the presence of errors or whether equitable principles should allow for the contract to be adjusted. Judicial intervention may be required to decide whether the party's original intent should be prioritized over the strict terms encoded in the contract, potentially setting new precedents for handling such errors in the context of automated agreements.[34].

[32] Basu, P. (2022). Digital Transformation With Smart Contracts-Demystification, Legal Recognition, Next and Beyond. The Management Accountant Journal, (Jan. 29, 2025, 8:00 P.M.), https://icmai-rnj.in/index.php/maj/article/view/169277?articlesBySimilarityPage=3.

[33] Reijers, W., et al. (2016). "Blockchain in the Legal Industry." International Journal of Law and Information Technology, (Jan. 29, 2025, 8:00 P.M.), https://academic.oup.com/policyandsociety/article/41/3/358/6529327.

[34] Pathak, R. (2024). Interoperability, Legal Interpretation and Application of Smart Contracts, DLT & Blockchain in India, SSRN (Jan. 29, 2025, 8:00 P.M.), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4964942.

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Courts may encounter challenges regarding the *interpretation of complex encoded terms*. While the terms of a smart contract are encoded in software, they must still be interpreted to resolve disputes, especially in cases where the language of the code is not easily understood by non-technical parties. Courts may need to determine whether the terms are ambiguous or if a dispute arises over how the code should be applied. Unlike traditional contracts, where a judge can interpret natural language and consult evidence to clarify intent, smart contracts present the challenge of interpreting a programming language, often without access to the human context or the original negotiating intentions. This could require courts to rely on expert testimony or technical analysis to understand how the contract was meant to function, leading to potentially new roles for technical experts in legal proceedings.

One of the major challenges is *balancing efficiency with equitable outcomes* in the judicial interpretation of smart contracts. While smart contracts are designed for efficiency, speed, and automation, their rigidity may lead to outcomes that seem unjust or inequitable, especially when unforeseen events or changing circumstances make the original terms less fair. Traditional contract law allows courts to provide remedies like rescission, modification, or damages in such cases, but smart contracts, by their nature, do not offer the flexibility for such judicial intervention. Courts must find a way to balance the desire for efficiency—often championed by the use of smart contracts—with the need for fairness and justice, ensuring that automated systems do not produce outcomes that disproportionately disadvantage one party. This may require the development of new legal principles or frameworks that address the unique characteristics of smart contracts while maintaining equitable outcomes for all parties involved.[35].

Smart contracts have become more common in both commercial and legal contexts; judicial interpretation will need to evolve to address the complexities introduced by coding errors, interpretation challenges, and the balance between efficiency and fairness. Courts will play a crucial role in shaping the legal landscape for these automated agreements, ensuring that the benefits of smart contracts can be fully realized while still upholding core principles of justice.

[35] Fulena, V., Examining Smart Contracts Within Mauritian Contract Law: Assessing Their Compatibility with Existing Legal Frameworks. In International Conference on Society, Research Gate (Jan. 29, 2025, 8:00 P.M.), https://www.researchgate.net/publication/384864267_Examining_Smart_Contracts_Within_Mauritian_Contract_Law_Assessing_Their_Compatibility_with_Existing_Legal_Frameworks.

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9. CONCLUSION AND SUGGESTIONS:

The pacta sunt servanda principle—that agreement must be upheld—remains fundamental to contractual law in the age of blockchain and smart contracts, but it also brings with it new opportunities and problems. By automating contract execution, decreasing human error, and doing away with middlemen, these technologies improve compliance and enforceability. This aligns with the core tenet of ensuring that agreed-upon obligations are fulfilled. However, the rise of smart contracts challenges traditional jurisprudence by raising questions about the nature of intent and consent. The reliance on code to define and execute terms can obscure the true intent of the parties, especially when technical errors or unforeseen circumstances arise. Furthermore, the rigidity of automated execution limits judicial discretion in cases where fairness or equity might require modification of the terms.[36] As such, while blockchain and smart contracts enhance efficiency and security, they also necessitate an evolution in legal frameworks and judicial interpretation to address these new complexities. The principle of *pacta sunt servanda* must, therefore, be reinterpreted in light of these technological advancements, ensuring that while agreements are honored, they remain adaptable to the changing landscape of law, technology, and human rights.

9.1 Suggestions

Legal systems must develop by carefully integrating and adapting blockchain and smart contracts into conventional frameworks in order to fully realize their potential while addressing their drawbacks. Here are five detailed suggestions for achieving this balance:

1. Adopting Comprehensive Regulatory Frameworks:

Legal systems must create clear and comprehensive regulations that recognize and validate smart contracts. This includes defining their legal status, ensuring that they meet essential criteria for enforceability, and establishing clear guidelines for their formation, execution, and dispute resolution.[37] Regulatory frameworks should not only recognize blockchain-based contracts as legally binding but also address specific challenges such as jurisdictional issues, security standards, and technical errors. Laws should clearly distinguish between different

[36] Christensen, C. M., & Raynor, M. E. (2013). The Innovator's Solution: Creating and Sustaining Successful Growth. Harvard Business Review Press, (Jan. 29, 2025, 8:00 P.M.), https://www.hbs.edu/faculty/Pages/item.aspx?num=15473.

[37] De Filippi, P., & Wright, A. (2018). Blockchain and the Law: The Rule of Code. Harvard University Press, (Jan. 29, 2025, 8:00 P.M.), https://www.hup.harvard.edu/books/9780674241596.

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types of smart contracts, those with purely financial applications versus those involving more complex terms, and ensure they are integrated into existing contract law, facilitating their use in both domestic and international transactions.

2. Developing Judicial Mechanisms for Disputes and Remedies:

As smart contracts automate execution, there is a reduced role for traditional judicial interpretation. However, in the case of disputes or unforeseen circumstances, courts must be equipped to handle issues related to coding errors, ambiguous terms, or changes in external conditions. Legal systems need to develop specialized judicial mechanisms or tribunals that understand the technicalities of blockchain technology and smart contracts. These mechanisms should offer remedies that go beyond the rigid execution of contract terms, such as providing opportunities for human oversight when there are errors in the code or when fairness needs to be ensured.[38] This might include adapting existing legal principles, like equitable remedies, to account for the rigidity of automated contracts and ensuring that parties have access to effective dispute resolution.

3. Ensuring Equitable Access and Transparency:

One of the challenges of smart contracts is the digital divide, which can limit access to these technologies for certain groups, particularly those lacking digital literacy or infrastructure. Legal systems must ensure that blockchain and smart contracts are accessible to all, including small businesses and individuals in underdeveloped regions.[39] This involves promoting digital literacy through education and ensuring access to the tools needed to engage with smart contract technology. Legal frameworks should also require transparency in how these contracts are implemented and enforced, with clear and understandable disclosures to all parties involved. This would ensure that all participants are informed and consent to the terms, addressing concerns about autonomy and the potential exploitation of non-technical users.

4. Establishing Standards for Code Auditing and Security:

[38] Bernstein, D. (2017). Blockchain for Law and Lawyers. CRC Press, (Jan. 29, 2025, 8:00 P.M.) https://www.legaler.com/wp-content/uploads/2018/12/Blockchain-for-Lawyers-eBook.pdf.

[39] Nick Szabo, "Smart Contracts: Building Blocks for Digital Markets," Semantic scholars (Jan. 29, 2025, 8:00 P.M.) https://www.semanticscholar.org/paper/Smart-Contracts%3A-Building-Blocks-for-Digital-Szabo/9b6cd3fe0bf5455dd44ea31422d015b003b5568f.

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Given the technical nature of smart contracts, it is essential that legal systems establish standards for the auditing of contract code before deployment. These standards would ensure that smart contracts are free from errors and vulnerabilities that could lead to unintended consequences.[40] Implementing mandatory auditing processes, either through licensed third parties or using built-in industry standards, would help mitigate risks associated with coding flaws, bugs, or security vulnerabilities.[41] Legal frameworks should also encourage transparency in the auditing process, allowing for public inspection of smart contract codes to ensure that all parties are protected from exploitation and fraud. This would build trust in the technology and ensure that it functions as intended, enhancing the stability of blockchain-based agreements.

5. Creating Hybrid Legal Models for Smart Contracts:

While smart contracts offer automation and efficiency, they may not be well-suited to handle complex or subjective legal issues that require human judgment. A potential solution is the development of hybrid legal models, where smart contracts operate alongside traditional contracts, offering a balance between automation and human oversight. In such models, critical decisions, such as the interpretation of ambiguous terms or the resolution of disputes, can still involve human intervention or judicial review, while routine execution of contractual obligations can remain automated.[42] This approach could involve the creation of legally recognized mechanisms where smart contracts trigger certain predefined actions, but courts or arbitrators step in when there are legal ambiguities or issues of fairness. Hybrid models would preserve the efficiency of smart contracts while maintaining traditional legal protections for the parties involved.

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[40] Wright, A., & De Filippi, P. (2015). "Decentralized Blockchain Technology and the Rise of Lex Cryptographia." SSRN Electronic Journal, (Jan. 29, 2025, 8:00 P.M.) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.

[41] Finck, M. (2018). "Blockchain and the Law: A Challenge for Legal Systems." European Journal of Law and Technology, (Jan. 29, 2025, 8:00 P.M.), https://www.europarl.europa.eu/RegData/etudes/STUD/2019/634445/EPRS_STU(2019)634445_EN.pdf

[42] Tapscott, D., & Tapscott, A. (2016). Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World. Penguin, (Jan. 29, 2025, 8:00 P.M.), https://www.scirp.org/reference/referencespapers?referenceid=2566443.

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