Al Mashhour Omar Farouk, Ahmad Shamsul Abd Aziz, and Nor Azlina Mohd Noor. "Smart Contract as a Novel Method of Contracting: Many Unanswered Legal Questions," *Hasanuddin Law Review* 11 no. 1 (2025): 1-27. DOI: 10.20956/halrev.v11i1.5061

HasanuddinLawReview

Volume 11 Issue 1, April 2025
P-ISSN: 2442-9880, E-ISSN: 2442-9899

Smart Contract as a Novel Method of Contracting: Many Unanswered Legal Questions

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Abstract: Smart contracts have shed light on a new era of contract law, which necessitates a proper legal response to address their unique characteristics, including automation, self-enforcement, coded, immutability, and irreversibility. While these features offer significant legal and practical benefits, they raised critical legal questions. The study aims to identify the legal challenges resulting from the implementation of smart contracts through an in-depth examination of various key aspects. To achieve the intended objective, the study adopted qualitative research utilising the library method and analysing data descriptively and analytically. The study revealed that applying the current conventional contract laws is inadequate and would create a bundle of unprecedented legal questions related to all the life cycle of the contracts, such as legal existence, formation and enforcement, jurisdictional issue, mechanism, unlawful activities, as well as the third parties. The study recommended establishing a specialised framework to address various issues, including the establishment of a regulatory and supervisory body, legislative clarification on various aspects of smart contracts' such as exchange of will, place, and time, coding language and coding errors, essential functions, jurisdiction and enforcement, ADR, external partners such as Oracle and coding experts, in addition to other matters pertaining to validity and admissibility. Future studies may focus on using these questions as a way to measure the viability of their law to address the emergence of smart contracts.

Keywords: Blockchain; Decentralised; Legislation; Immutable; Self-enforced; Smart Contract

1. Introduction

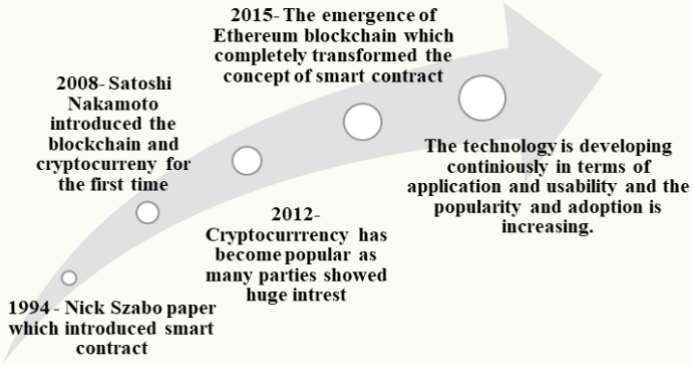
Smart contracts are a new and novel form of technology introduced by Nick Szabo in 1994.[1] It introduced a unique way in which parties can conclude a decentralised, pre-agreed, immutable, and self-enforcing contract using an algorithm: "If this, then that."[2] Despite the unique features offered, the lack of a secure database for deployment has impacted on the use of this unique technology. However, the actual implementation of smart contracts started with Satoshi Nakamoto's introduction of blockchain technology, which, for the first time, introduced a decentralised, immutable, and secure ledger that

[1] Nick Szabo, "Smart contracts: building blocks for digital markets," *EXTROPY: The Journal of Transhumanist Thought,(16)* 18, no. 2 (1996).
[2] Daniele Magazzeni, Peter McBurney, and William Nash, "Validation and verification of smart contracts: A research agenda," *Computer* 50, no. 9 (2017).

permitted the deployment of smart contracts while mitigating the risks associated with a normal or regular database and drastically reducing costs and time.[3] Since then, smart contracts have evolved to play a major, central role in the decentralised world.[4]

A report published by Flipside in March 2024, a blockchain platform, has stated that, since January 2022, around 637.8 million smart contracts have been deployed.[5] Moreover, the global market for smart contracts is expected to grow to reach around $73 billion by 2030, according to the report published by Grand View Research.[6] This shows a significant growth in the use of smart contracts. As a result of their capabilities and potential, smart contracts have attracted significant interest from a variety of industries and businesses. From a legal perspective, the application of smart contracts to current laws has grown recently to become one of the hot topics in the legal field.[7] Numerous studies have been conducted by legal scholars and international bodies to examine the legal status of smart contracts and the expected legal and practical challenges they face.

Figure 1. A simple explanation of the life cycle of the smart contract



Source: The researcher based on an observation of the old and current state of smart contracts.

Numerous reports have been issued by international bodies including the World Bank,[8] International Bar Association,[9] and United Nations Commission on International Trade

[3] Satoshi Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," *Decentralized business review* (2008).

[4] Vitalii Volynets, "Legal Aspects of Using Blockchain Technologies in the Field of E-Commerce on SDG's," *Journal of Lifestyle and SDGs Review* 4, no. 1 (2024): e01663.

[5] Flipside, *EVM Smart Contract Deployment Snapshot*, March 2024.

[6] Grand View Research, *Smart Contracts Market Size, Share, & Trends Analysis Report By Platform, By Blockchain Type, By Contract Type, By Enterprise Size, By End-use (BFSI, Retail), By Region, And Segment Forecasts, 2023 - 2030*, May 2023, https://www.grandviewresearch.com/press-release/global-smart-contracts-market.

[7] K. J. Yong, E. S. Tay, and D. W. Khong, "Application of Blockchain Smart Contracts in Smart Tenancies: A Malaysian Perspective," *Cogent Social Sciences* 8, no. 1 (2022): 2111850, https://doi.org/10.1080/23311886.2022.2111850.

[8] Ivor Istuk, Jeffrey Stephen Allen, and Oya Pinar Ardic Alper, *Smart Contract Technology and Financial Inclusion (English)*, FinTech note no. 6 (Washington, D.C.: World Bank Group). Available online from: http://documents.worldbank.org/curated/en/710151588785681400/Smart-Contract-Technology-and-Financial-Inclusion.

[9] Sibilla Grenon, *Codifying Code? Evaluating US Smart Contract Legislation* (London: International Bar Association, 2019), https://www.ibanet.org/Document/Default.aspx?DocumentUid=C8D2EBA4-57D1-4F01-8AA5-24C9CFF2B447;

Law (UNCITRAL).[10] These reports concurred in the potential of smart contracts, the necessity of specific legal intervention, and the need for more legally focused studies. For instance, the World Bank has confirmed that legal amendments are necessary due to the novel characteristics of smart contracts. However, they affirmed that the legal approaches would differ, as each jurisdiction possesses its own comprehension and interpretation of contract law, and they called for each country to address it independently, as a unified approach is missing. The International Bar Association agreed with the World Bank, stating that existing laws are insufficient to address the practical legal concerns of smart contracts and that some legal action will be necessary. The International Bar Association urged legislators to possess comprehensive knowledge of the matter and conduct a thorough inquiry of smart contracts to ensure adequate resolution of the issue. Also, the United Nations Commission on International Trade Law (UNCITRAL) and the International Institute for the Unification of Private Law (UNIDROIT) issued a collaborative report on the need for a prudent legislative framework that promotes technological advancement. The report addressed the lack of a unified international approach, the need to update existing laws to provide legal support for technology and adequate legal protection, particularly in relation to liability, enforcement, execution, and remedies, and proposed a legal change to facilitate the lawful use of smart contracts.

Legal scholars have also examined the impact of smart contracts under traditional contract law. A study concentrated on the compatibility of European contract law with smart contracts and found that while existing contract law can address certain concerns associated with smart contracts, several legal challenges remain that pertain to the distinctive attributes of smart contracts, rendering several laws incompatible.[11] The study recommended that all European countries commence the adoption of this new technology via legislative amendments and adjustments. Another study focused on the viability of the smart contract under Indonesian law. The study concluded that despite recent amendments identifying various shortcomings and providing suggestions for legal development, the law remains inadequate.[12] This underscores the necessity for greater clarity in identifying these legal challenges, as it can aid legislators in devising effective

Andreas Sherborne, *Blockchain, Smart Contracts and Lawyers* (London: International Bar Association, 2017), https://www.ibanet.org/Document/Default.aspx?DocumentUid=17badeaa-072a-403b-b63c-8fbd985d198b.

[10] United Nations Commission on International Trade Law (UNCITRAL) and International Institute for the Unification of Private Law (UNIDROIT), *Joint UNCITRAL/UNIDROIT Workshop on Legal Issues Arising from the Use of Smart Contracts, Artificial Intelligence, and Distributed Ledger Technology* (Rome: UNIDROIT, 2019); Sara Hourani, *Cross-Border Smart Contracts: Boosting International Digital Trade Through Trust and Adequate Remedies* (London: UNCITRAL, 2017), https://www.uncitral.org/pdf/english/congress/Papers_for_Programme/11-HOURANI-Cross_Border_Smart_Contracts.pdf.

[11] Maren K. Woebbeking, "The Impact of Smart Contracts on Traditional Concepts of Contract Law," *JIPITEC* 10 (2019): 106, https://www.jipitec.eu/issues/jipitec-10-1-2019/4880.

[12] W. Warianto, F. Y. P. Amboro, and L. Sudirman, "Pragmatism of Smart Contracts in Legal Perspective: A Comparative Analysis Between Indonesia and the United States," *Jurnal Mediasas: Media Ilmu Syari'ah dan Ahwal Al-Syakhsiyyah* 7, no. 1 (2024): 13–38, https://doi.org/10.58824/mediasas.v7i1.42.

solutions. This study was supported by another study confirming the uncertainty due to the lack of a specific regulatory framework that clarifies various issues related to the smart contracts' validity, protection, and enforcement.[13] The study also called for legal reform to provide a supportive environment for smart contracts. Another study examined the legal framework governing smart contracts in Uzbekistan.[14] The study identified numerous issues, including technological infrastructure and insufficient recognition and enforcement; however, the article failed to deliver a thorough analysis, resulting in a gap that necessitates a more detailed and comprehensive investigation to aid legislators in enhancing current legislation.

Moreover, a study was conducted to analyse the regulatory framework governing smart contracts in Malaysia through a comparative study with other jurisdictions, namely, the USA, Malta, Switzerland, and the United Arab Emirates.[15] The study presented the various approaches implemented by these countries and used them to propose recommendations for the Malaysian legislator. Despite the necessity for smart contracts to meet the main pillars outlined in the Contract Act 1950, the study concluded that current laws are inadequate in addressing various legal questions. It therefore called for urgent legislative intervention to provide clarity and promote technological advancement. This study has been supported by another study that addressed the existence of various legal obstacles, such as the enforcement and dispute resolution issues; however, the study advocated for a targeted legislative reform with strategic legal guidance to address these issues.[16] Researchers also conducted studies in various regions, including the Middle East, highlighting the absence of specific legislation and advocating for a legislative approach to mitigate the various risks associated with the use of smart contracts.[17]

The review of various legal studies reveals that smart contracts are still in their early stages in the legal field. The lack of a unified approach led to disparities. Legislators and scholars have various views on smart contracts, leading to uncertainty and showing the need for more in-depth legal research. Moreover, there is a dearth of comprehensive

[13] Happy Budyana Sari, Emmy Febriani Thalib, and Ni Putu Suci Meinarni, "Implementation of Smart Contracts in Indonesia: An Analysis of Financial Regulation, Taxation, and Consumer Protection," *Jurnal Notariil* 9, no. 2 (2024): 65–70, https://doi.org/10.22225/jn.9.2.2024.65-70.

[14] Sayokhat Akhrorova, "Navigating the Legal Landscape: Smart Contract Regulation in Uzbekistan," *International Journal of Artificial Intelligence* 4, no. 3 (2024): 326–328, https://www.academicpublishers.org/journals/index.php/ijai/article/view/607.

[15] Zulhazmi Bin Yusof et al., "Regulatory Framework on Smart Contracts: A Comparative Analysis," *Information Management and Business Review* 16, no. 2(I) (2024): 221–30, https://doi.org/10.22610/imbr.v16i2(I).3822.

[16] Judy Yueh Ling Song and Esther Tan, "Beyond Traditional Contracts: The Legal Recognition and Challenges of Smart Contracts in Malaysia and Singapore," *Journal of Law, Market & Innovation* 3, no. 3 (2024): 323–57, https://doi.org/10.13135/2785-7867/11334.

[17] Mohammad Omar Mohammad Alhejaili, "Integrating Smart Contracts into the Legal Framework of Saudi Arabia," *International Journal of Law and Management*, Vol. ahead-of-print, no. ahead-of-print (2024), https://doi.org/10.1108/IJLMA-03-2024-0086; Ghassan Adhab Atiyah, Nazura Abdul Manap, and Saidatul Nadia Abd Aziz, "Smart Contract in Iraq: A Legal Framework," *Journal of Positive School Psychology* 6, no. 4 (2022): 6385–6392.

studies on the challenges faced by smart contracts, with many focusing on specific aspects or discussing these challenges without conducting a thorough analysis. Hence, this study aims to address a serious legal gap by presenting a thorough study on the various challenges facing the traditional concept of contract. Identifying these legal issues would aid legislators in understanding and evaluating their legislation. To achieve the intended objective, the research will provide comprehensive explanations of all essential and core technologies, which will equip the reader with the necessary information to comprehend the main issue it poses.

2. Method

This study employs a qualitative approach and uses descriptive and analytical methods to explore the legal challenges faced by smart contracts. The qualitative approach was adopted due to the novel nature of the topic under the current legal study, hence allowing for more in-depth understanding of the nuances involved. The descriptive analysis was utilised to summarise the current knowledge, including the current legal framework and challenges.[18] The analytical method, on the other hand, was also used to critically examine the findings, uncovering the underlying assumptions and legal implications.[19] The data collection was conducted using a library research method that involved a comprehensive review of current literature in various reputable databases. The data collected primarily consisted of reports published by various institutions, scholarly textbooks, and journal articles authored by scholars to ensure the reliability of the research.

3. The Concept and Characteristics of Smart Contracts

Nick Szabo coined the term "smart contract" to refer to the rise of a new and unprecedented form of contractual agreement that ensures performance and makes breaches extremely costly by relying on an automated (self-enforcing), pre-determined, deterministic, and coded computer protocol.[20] Nick argues that smart contracts are a revolutionary form of a traditional contract, claiming that they are significantly more functional than their "inanimate paper-based ancestors." Szabo's intention, as stated in the latter explanation, was not merely to introduce a new technology but also to establish a connection and introduce smart contracts as a revolution in the traditional method of

[18] Hossein Nassaji, "Qualitative and Descriptive Research: Data Type Versus Data Analysis," *Language Teaching Research* 19, no. 2 (2015): 129–132, https://doi.org/10.1177/1362168815572747.

[19] Kimberley A. Frederick, "Using Forensic Science to Teach Method Development in the Undergraduate Analytical Laboratory," *Analytical and Bioanalytical Chemistry* 405 (2013): 5623–5626, https://doi.org/10.1007/s00216-013-6994-y.

[20] Ismatov Aslbek Ulug'bek o'g'li, "The Importance of Smart Contracts in This Digital Era," *Models and Methods for Increasing the Efficiency of Innovative Research* 3, no. 35 (2024).

contracting.[21] Nick defines a smart contract as "a set of promises, specified in digital form, including protocols within which the parties comply with these promises."[22] This definition stands out as 'the first definition' for smart contracts, characterizing it as a promise to the involved parties, a digital format, a computer protocol, and a self-determined and self-executing aspect.

Vitalik Buterin, the founder of Ethereum, has significantly transformed this technology by integrating smart contracts with blockchain. In his 2013 white paper, Vitalik Buterin defined a smart contract as "a mechanism involving digital assets and two or more parties in which assets are automatically redistributed among those parties in accordance with a formula based on certain data that is unknown at the time the contract is initiated."[23] Smart contracts now incorporate a number of fundamental blockchain characteristics, including decentralisation, immutability, and non-modification. This definition also elaborates on the process and mechanism but does not assert their legality. Zhiguo and Lin William Cong proposed an additional, significant definition. They described smart contracts as "digital contracts that allow terms contingent on decentralised consensus that are self-enforcing and tamper-proof through automated execution."[24] However, to ascertain whether the term "digital contract" qualifies as a contract, it is necessary to subject it to a legal examination in accordance with national contract law.

To elucidate the intricacies of the subject matter, the Free Dictionary has provided the following definition of smart contract: “a business agreement that is recorded on the blockchain in order to verify as well as enforce its intentions and financial arrangements.”[25] This definition limits the use of smart contracts to business transactions, which seems unfeasible considering the technology's current applications beyond commerce. Ancestral dictionaries, including Oxford, Cambridge, Merriam-Webster, and others, have thus far been unable to furnish a definition for smart contracts.

In relation to a legislative definition, the state of Tennessee characterises a smart contract as “an event-driven computer program that executes on an electronic, distributed, decentralised, shared, and replicated ledger that is used to automate transactions, including, but not limited to, transactions that (A) take custody over and instruct transfer of assets on that ledger; (B) create and distribute electronic assets; (C) synchronise

[21] Liudmila (Lyudmila) Efimova, Olga Sizemova, and Alexey Chirkov, "Smart Contracts: Between Freedom and Strict Legal Regulation," *Information & Communications Technology Law* 30, no. 3 (2021): 333–353.

[22] Szabo, "Smart Contracts: Building Blocks for Digital Markets". Footnote 1.

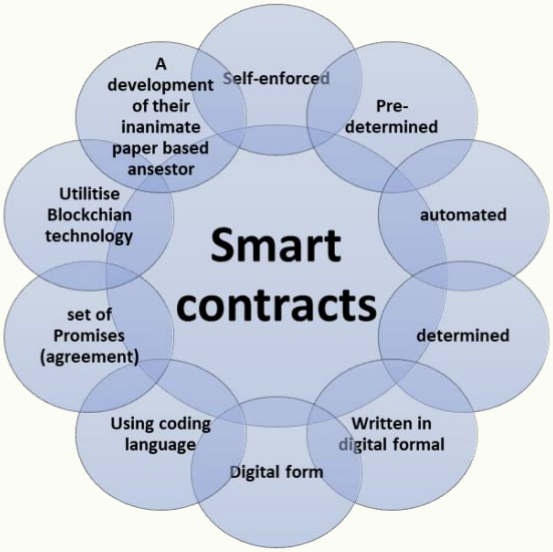
[23] Vitalik Buterin, "Daos, Dacs, Das and More: an Incomplete Terminology Guide", Blog, *Ethereum Blog*, 2014, Https://Blog.Ethereum.Org/2014/05/06/Daos-Dacs-Das-And-More-An-Incomplete-Terminology-Guide/.

[24] Lin William Cong and Zhiguo He, "Blockchain Disruption and Smart Contracts", *The Review of Financial Studies* 32, no. 5 (2019): 1754-1797, doi:10.1093/rfs/hhz007.

[25] "The Definition of Smart Contracts", The free dictionary, accessed 27 December 2020, https://encyclopedia2.thefreedictionary.com/Smart+contracts.

information; or (D) manage identity and user access to software applications."[26] Based on the characteristics that are shown in the figure below and derived from the definitions, a smart contract can be defined as a computer program that functions as a contract, executing predetermined tasks automatically and without third-party intervention, relying on a coding language that is complex to read, understand, or modify. Not every smart contract qualifies as a contract, and conversely, not every contract is a smart contract.

Figure 2. The attributes linked to the concept of smart contract



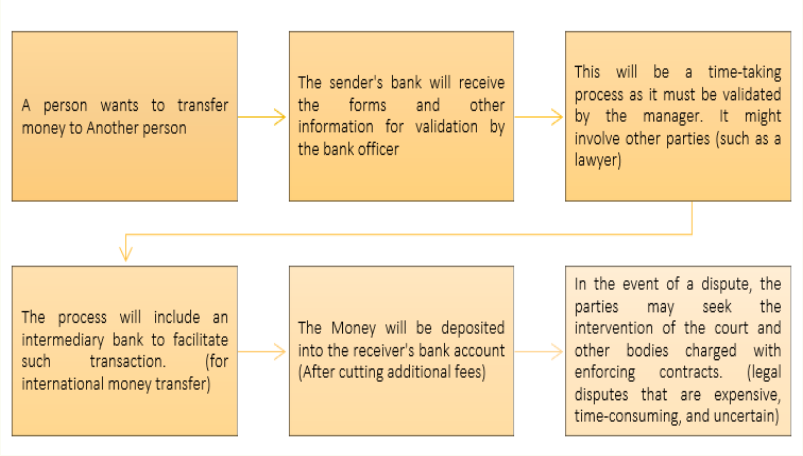
Source: The Researcher based on the definitions provided.

4. The Mechanism of Smart Contracts

Smart contracts operate through a distinct and proprietary mechanism that differs in several ways from traditional contracts. To practically illustrate the mechanism, if an individual wants to enter into a traditional conventional contract to purchase commodities from another party for USD 5000, they must rely on a conventional bank to transfer the funds, ensuring a secure and trustworthy transaction, and possibly a lawyer to handle the paperwork, safeguarding their rights and preventing potential violations. In the case of an international (cross-border) contract, the sender will require a substantial amount of paper to initiate an international money transfer (IMT) to the receiver's account. One or more intermediary banks will facilitate such transactions. As the figure below illustrates, this process is time-consuming and will increase the exchange rate's hidden costs.

[26] "How Have Different States in The United States Of America Enabled Blockchain Technology and Smart Contracts", Ikigai Law, accessed 6 August 2021, https://www.ikigailaw.com/how-have-different-states-in-the-united-states-of-america-enabled-blockchain-technology-and-smart-contracts/#acceptLicense.

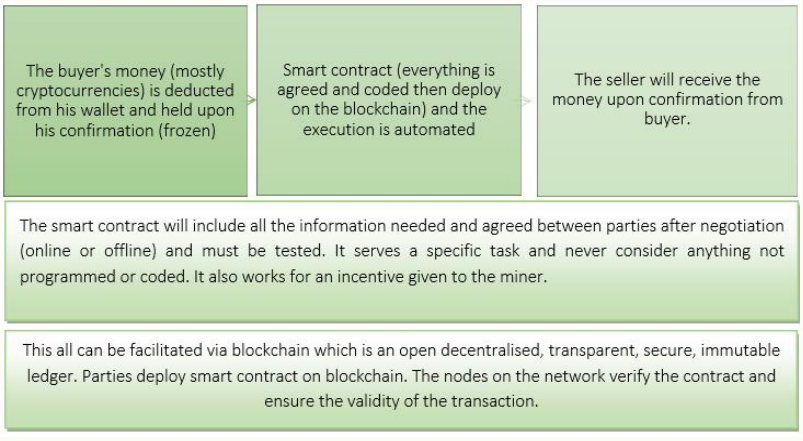
Figure 3. A simplified example of a transaction using a traditional contract.



Source: The Researcher

In the case of a smart contract, and after the deployment, the contract becomes immutable, and the amount (or the cryptocurrency equivalent) will be deducted from and frozen in the buyer's smart contract's wallet. On the other hand, the buyer receives the product and must verify its legitimacy before the money automatically transfers to the seller's (or receiver's) smart contract's wallet. Furthermore, the reusability of this novel contract for similar transactions enhances its benefits. Smart contracts, therefore, have automated the performance of the contract, increased efficiency and security, removed the possibilities of any human error, and eliminated the need for a third party to act as an intermediary.

Figure 4. A simplified explanation of the role of smart contract in a transaction



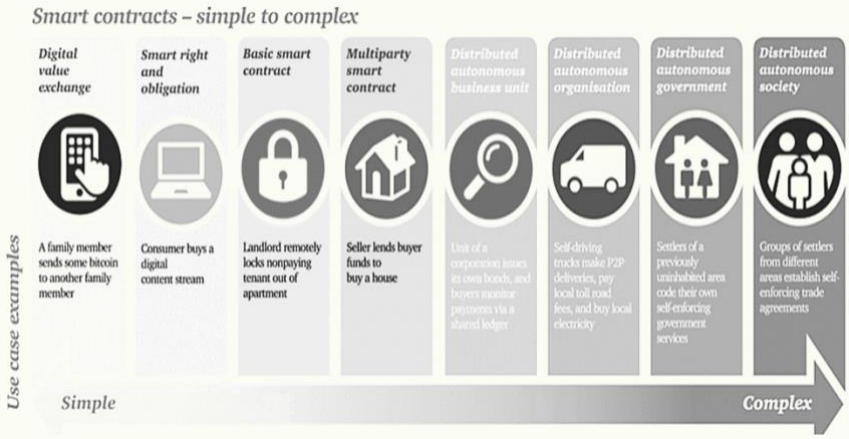
Source: The Researcher

5. The Uses of Smart Contracts

Smart contract applications are gradually gaining traction these days, as an increasing number of organisations investigate the potential benefits of using smart contracts to

improve their operations' performance and efficiency.[27] In addition to the straightforward (simple) use of smart contracts to execute financial transactions on a blockchain, businesses or distributed applications (DApps) utilize a variety of more complex smart contract applications. These include insurance (such as flight, crop, and car insurance), fundraising (to raise money), loan systems (like a flash loan), voting, and apps that provide goods or services.[28]

Figure 5. Some of the applications of smart contracts



Source: PricewaterhouseCoopers (PwC)

[27] Marco Iansiti and Karim R. Lakhani, "The Truth About Blockchain," *Harvard Business Review*, last modified 2017, https://hbr.org/2017/01/the-truth-about-blockchain; Jones Day Law Firm, "Blockchain For Business," *Jonesday*, last modified 2017, https://www.jonesday.com/Files/Upload/Blockchain%20for%20business%20white%20Paper2.Pdf; Guy Zyskind, Oz Nathan, and Alex 'Sandy' Pentland, "Decentralizing Privacy: Using Blockchain To Protect Personal Data," in *2015 IEEE Security And Privacy Workshops* (2015), 180-184; Benjamin Egelund-Müller et al., "Automated Execution Of Financial Contracts on Blockchains," *Business & Information Systems Engineering* 59, no. 6 (2017): 457-467; Florian Glaser, "Pervasive Decentralisation of Digital Infrastructures: A Framework For Blockchain Enabled System And Use Case Analysis," in *Proceedings of The 50th Hawaii International Conference on System Sciences* (2017), 1543–1552; Michael Nofer, Peter Gomber, and Dirk Schiereck, "Blockchain," *Business & Information Systems Engineering* 59, no. 3 (2017): 183–187; Juho Lindman, Virpi Kristiina Tuunainen, and Matti Rossi, "Opportunities And Risks Of Blockchain Technologies: A Research Agenda," in *Proceedings of The 50th Hawaii International Conference on System Sciences* (2017), 1533–1542; Atefeh Mashatan and Zachary Roberts, "An Enhanced Real Estate Transaction Process Based on Blockchain Technology," *AMCIS 2017 Proceedings* 11 (2017): 1-5; Alevtina Dubovitskaya et al., "Secure and Trustable Electronic Medical Records Sharing Using Blockchain," *AMIA Annual Symposium Proceedings* 2017 (2017): 650–659; Jun Dai and Miklos A. Vasarhelyi, "Toward Blockchain-Based Accounting And Assurance," *Journal Of Information Systems* 31, no. 3 (2017): 5-21; Saša Zupan Korže, "How Smart Tourism Embrace Blockchains And Smart Contracts," *Mednarodno Inovativno Poslovanje* 11, no. 2 (2019): 32-40; Balázs Bodó, Daniel Gervais, and João Pedro Quintais, "Blockchain and Smart Contracts: The Missing Link In Copyright Licensing?", *International Journal Of Law and Information Technology* 26, no. 4 (2018): 311-336; Valentina Gatteschi et al., "Blockchain and Smart Contracts for Insurance: Is The Technology Mature Enough?", *Future Internet* 10, no. 2 (2018): 20; Henry M. Kim and Marek Laskowski, "Toward an Ontology-Driven Blockchain Design for Supply-Chain Provenance," *Intelligent Systems in Accounting, Finance and Management* 25, no. 1 (2018): 18-27.

[28] Qi Yang et al., "Design and Implementation of a Loan System Based on Smart Contract," *Smart Blockchain* 11373 (2018): 22-31, doi:10.1007/978-3-030-05764-0_3; Xuechao Yang et al., "Decentralized Voting: A Self-Tallying Voting System Using a Smart Contract on the Ethereum Blockchain," *Web Information Systems Engineering – WISE 2018* 11233 (2018): 18-35, doi:10.1007/978-3-030-02922-7_2; Andreas Bogner, Mathieu Chanson, and Arne Meeuw, "A Decentralised Sharing App Running A Smart Contract on The Ethereum Blockchain," in *Proceedings Of The 6Th International Conference on The Internet Of Things*, 2016, 177–178, doi:10.1145/2991561.2998465.

Table 1. The breadth of smart contracts uses cases according to a report published by Deloitte US.

Sector	Use Case	What the Smart Contract Can Do
Financial services	Trade clearing and settlement	Manages approval workflows between counterparties, calculates trade settlement amounts, and transfers funds automatically.
	Coupon payments	Automatically calculates and pays periodic coupon payments and returns principal upon bond expiration.
	Insurance claim processing	Performs error checking, routing, and approval workflows, and calculates payout based on the type of claim and underlying policy.
	Micro-insurance	Calculates and transfers micropayments based on usage data from an Internet of Things-enabled device (e.g., pay-as-you-go automotive insurance).
Life sciences and healthcare	Electronic medical records	Provides transfer and/or access to medical health records upon multi-signature approvals between patients and providers.
	Population health data access	Grants health researchers access to certain personal health information; micropayments are automatically transferred to the patient for participation.
	Personal health tracking	Tracks patients' health-related actions through IoT devices and automatically generates rewards based on specific milestones.
Technology, media, and telecom	Royalty distribution	Calculates and distributes royalty payments to artists and other associated parties according to the contract.
Energy and resources	Autonomous electric vehicle charging stations	Processes a deposit, enables the charging station, and returns remaining funds when complete.
Public sector	Record-keeping	Updates private company share registries and capitalization table records and distributes shareholder communications.
Cross-industry	Supply chain and trade finance documentation	Transfers payments upon multi-signature approval for letters of credit and issues port payments upon custody change for bills of lading.
	Product provenance and history	Facilitates chain-of-custody process for products in the supply chain where the party in custody is able to log evidence about the product.
	Peer-to-peer transacting	Matches parties and transfers payments automatically for various peer-to-peer applications: lending, insurance, energy credits, etc.
	Voting	Validates voter criteria, logs vote to the blockchain and initiates specific actions as a result of the majority vote.

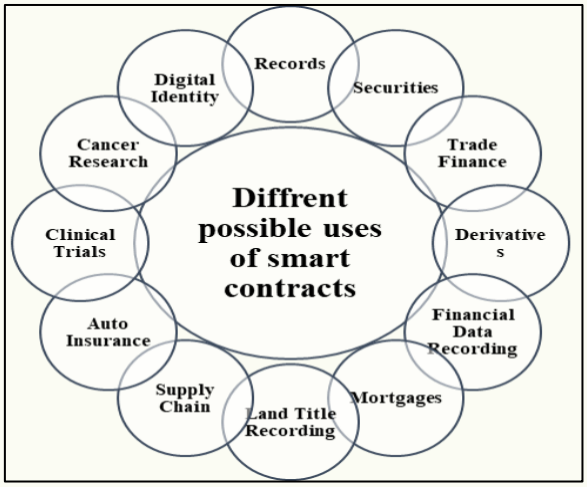
Source: https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/using-blockchain-for-smart-contracts.html

Numerous studies have been conducted to identify the diverse range of smart contract applications, such as the one published by Deloitte US, which identified some of the

current smart contract applications.[29] As illustrated in the table 1, the study introduced a table format that encompasses a variety of smart contract applications.

The Chamber of Digital Commerce also published a report by the Smart Contract Alliance and Deloitte, which presented twelve distinct applications for smart contracts.[30] The figure below illustrates the various applications identified by the research.

Figure 6. Another study shows a list of the possible uses of smart contracts



Source: https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/using-blockchain-for-smart-contracts.html

6. The Actual Legal Challenges Facing Smart Contracts

A smart contract is a distinct method of contracting for a variety of reasons that stem from its entire lifecycle. These distinctions raise numerous legal issues that must be addressed in order to distinguish smart contracts from other types of contracts and to determine their legal status under the law. This article will highlight the most significant legal issues by categorising them.

6.1. The Difficulties to Ensure the Compliance of Smart Contracts with the Existing Laws

Throughout the world's legal systems (whether common or civil), the law has permitted parties to negotiate the terms and conditions of a contract in order to arrive at a

[29] Deloitte, "Getting Smart About Smart Contracts CFO Insights," (London, United Kingdom: Deloitte, 2016), https://www2.deloitte.com/us/en/pages/finance/articles/cfo-insights-getting-smart-contracts.html; John Ream, Yang Chu, and David Schatsky, "Upgrading Blockchains Smart Contract Use Cases In Industry," (United States: Deloitte University Press, 2016), https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/using-blockchain-for-smart-contracts.html.

[30] Smart Contracts Alliance, "Smart Contracts: 12 Use Cases for Business & Beyond—A Technology, Legal & Regulatory Introduction —Foreword by Nick Szabo," (Washington, D.C.: The Chamber of Digital Commerce, 2016), http://digitalchamber.org/assets/smart-contracts-12-use-cases-for-business-and-beyond.pdf.

contractual agreement that meets their expectations and intentions.[31] However, each law contains requirements and prohibitions that should be either followed or avoided (such as entering into a contract for an illegal cause or violating public order). Another instance would be when a commercial contract violates some provisions or misses other legal requirements of the commercial code, consumer protection code, or any other applicable related law.[32] The same can also be applied to labour contracts where the contract's form is governed by labour law provisions (that contain a provision that sets requirements and others for prohibitions).[33] These examples show the need for compliance with the rules in order for the contract to be legally valid.

The real issue here is that smart contracts operate completely independently of any legal obligation or restriction, including applicable laws and legislation.[34] It doesn't abide by the provisions, or the requirements set by the civil code or other contract legislation provisions. To circumvent the issue, smart contracts must respect and adhere to applicable laws, legislation, and regulations in order to be regarded as valid legal contracts enforceable by law.[35] Regardless of whether the contract is a "smart legal contracts"[36] or an "Code-only smart contract,[37]" and regardless of whether it is on the blockchain or not, it is critical to ensure that all forms of smart contracts comply with the current legal framework.

Leaving this matter unresolved would complicate matters and increase the likelihood of future legal conflicts, as it is difficult to monitor every contract and identify a breached or void contract. Thus, a proactive legal strategy contributes to the protection of individuals' rights.[38] Additionally, some of the contractual (explicit or implicit) terms are difficult to be both represented (coded) or execute via a smart contract.[39] This also requires more in-depth examination by the law as it needs assistance from the physical words in order to interpret the results and input them into the smart contract.

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[31] E. Allan Farnsworth, "Comparative Contract Law," in *The Oxford Handbook of Comparative Law*, 2006, 911, doi:10.1093/oxfordhb/9780199296064.013.0029; Alexander Savelyev, "Contract Law 2.0: 'Smart' Contracts As The Beginning of the end of classic contract law," *Information & Communications Technology Law* 26, no. 2 (2017): 116-120, doi:10.1080/13600834.2017.1301036.

[32] ESMA, "The Distributed Ledger Technology Applied to Securities Markets," (Paris, France: The European Securities and Markets Authority, 2017), https://www.esma.europa.eu/sites/default/files/library/dlt_report_-_esma50-1121423017-285.pdf.

[33] Labour contract has specific requirements that must be taken into consideration when using smart contract for such kind of contracts

[34] Jerry I-H Hsiao, ""Smart" Contract on the Blockchain-Paradigm Shift for Contract Law?", *US-China Law Review* 14, no. 10 (2017), doi: 10.17265/1548-6605/2017.10.002.

[35] Weizhi Meng et al., "When Intrusion Detection Meets Blockchain Technology: A Review," *IEEE Access* 6 (2018): 10179-10188, doi:10.1109/access.2018.2799854.

[36] The contract in which a written contract exists

[37] There is no pre-written agreement, it is solely coded into smart contracts.

[38] Having a robust legal framework might represent a guidance for parties on how to form a legal and valid smart contract.

[39] Pablo Sanz Bayón, "Key Legal Issues Surrounding Smart Contract Applications," *KLRI Journal Of Law And Legislation* 9, no. 1 (2019): 63-93.

The situation may change in the future, particularly when law and technology (code and law) collaborate (rather than compete) to achieve ultimate mutual goals. Two suggestions can be provided to resolve this issue. In some cases, relying on the "oracle" to ensure compliance or providing a specific smart contract that satisfies the legal requirement and is pre-secured. Another possibility is to establish an authority that will act as a smart contact checkpoint, ensuring that parties enter into enforceable, valid contracts. These suggestions can be used to tackle the legal issues related to compliance.

6.2. The Jurisdictional Issue

The smart contract was not designed to be used in a single geographic location, but rather as a method for conducting cross-border transactions.[40] It enables individuals (who may or may not know one another) to enter into a smart contract regardless of time or place while maintaining elements of trust between them. This, however, creates the possibility of legal jurisdictional conflict in determining the applicable law to govern the contract and apply to the parties, particularly given that smart contracts may contain multiple international components.[41] The parties may be of different nationalities, reside in different countries, use different servers, and the contract's subject may be located in different locations. Typically, these issues are resolved through the private international law provisions (under the civil code) enacted for these purposes.[42]

Generally, traditional contracts (written or electronic) do not present any difficulties in identifying the applicable law by referencing the law's provisions (civil code or electronic contract legislation). However, the case of smart contracts will undoubtedly add a layer of complexity to the conflict. A smart contract is a collection of conditional terms stored on a decentralised, public ledger. This means that identifying the information necessary to resolve the conflict and establish jurisdiction has become a significant challenge.[43] The latter does not share the users' names[44] or the contract's or parties' location[45]. Additionally, while laws typically give parties the freedom to choose the applicable law to the contract, this clause (the applicable law to the contract) does not always allow parties to avoid the mandatory provisions of other countries laws.[46]

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[40] Bedrettin Gürcan, "Jurisdiction on the Blockchain," in *ICBEMM 2020 (Oxford) 11Th International Conference on Business, Economics, Management and Marketing*, 2020, 14-20.

[41] Rakesh Sharma, "What Is Smart Contract Dispute Resolution?", Investopedia, last modified 2022, https://www.investopedia.com/news/how-are-disputes-smart-contracts-resolved/.

[42] Steven Rares, "Commercial Issues in Private International Law," Federal Court of Australia, last modified 2018, https://www.fedcourt.gov.au/digital-law-library/judges-speeches/justice-rares/rares-j-20180216.

[43] Louis Lehot, "If Blockchain is the Next Big Tech Paradigm Shift, What Legal Issues Matter? - Fin Tech - United States," *Mondaq*, last modified 2020, https://www.mondaq.com/unitedstates/fin-tech/991184/if-blockchain-is-the-next-big-tech-paradigm-shift-what-legal-issues-matter.

[44] Rather, it replaces them with an address number

[45] Which might be split between three or four different servers.

[46] Geoffrey Cann and Emily Catmur, "Blockchain: Overview of the Potential Applications for the Oil and Gas Market and the Related Taxation Implications," *Deloitte*, London, United Kingdom, 2017,

Additionally, the time of concluding the contract is another issue, as the nature of smart contracts precludes specifying the time of acceptance or issuance of the offer. Even if the deployment time was assumed to coincide with the contract's conclusion, the exchange of wills, in this case, has yet to be determined. This issue is critical because it necessitates an immediate response within international private law in order to provide a legal solution to the future conflict posed by smart contracts. Due to the novel nature of smart contracts, case law is very limited. One of the very important examples showing jurisdictional issues is the 2016 Ethereum DAO hack. An attacker, after a vulnerability in the smart contract code was exploited, diverted cryptocurrency worth about $50 million from the Decentralised Autonomous Organization. The international and decentralised nature of the Ethereum blockchain imposed the issue of identifying applicable laws and jurisdictions. Questions arose whether such a hack was a breach of contract under U.S. law, a tortious act under European law, or even a legitimate action exploiting a flaw in the code under jurisdictions with less-developed cyber laws. This ambiguity delayed legal responses and highlighted the pressing need for harmonised cross-border regulations. This can be seen as a simple example to illustrate the risk of this legal issue.

6.3. The Formation of a Contract

The parties' free will is upheld and protected by legal systems worldwide.[47] Legislators have limited this freedom granted to a party to specific contracts that require a specific form to be concluded. This brings up one of the issues that must be addressed, particularly given that the law recognised electronic contracts as valid contracts and treated electronic writing via electronic contracts as if they were written.[48] While a smart contract is concluded electronically, its characteristics and features which is unprecedent in the field of contract law put it in different classification. It is programmed on a computer using a coding language and operates autonomously according to a pre-defined immutable and irreversible rule.

The language used to conclude the contract is also a matter of importance.[49] Contracts are usually concluded using readable and understandable language that can indicate all the terms of the contract and shows the intentions of the parties.[50] However, smart contracts are written and concluded using various computing programming languages (designed for smart contracts) that are coded into smart contracts to self-enforce in the

https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-oil-gas-blockchain-article.pdf.

[47] Jakub J. Szczerbowski, "Place of Smart Contracts in Civil Law. A Few Comments on Form and Interpretation," in *Proceedings of The 12Th Annual International Scientific Conference NEW TRENDS 2017*, 335, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3095933.

[48] In order for electronic contracts to adhere the formality of some contracts.

[49] As it represents part of the formation requirements of some contracts under the civil code.

[50] Amit Khurana, "Smart Contracts in Light of Indian Contract Law" (master's thesis, University of Oslo, 2020).

form of conditional statements.[51] As long as the smart contract is backed up by a written version of an old-fashioned contract, the latter form doesn't pose a problem.[52] All the terms in a smart contract are just a translation from a normal language into codes, and parties can go back to the original contracts to check and understand what's in the contract.

In addition, relying on a traditional contract while using a smart contract will also mean that the parties have read and agreed to all the terms and agreements before coding them into the contract. It also proves the validity of the smart contract as it is backed by a legal contract. This is what is referred to as "smart legal contracts." Despite all the facts mentioned above, the abilities of the parties to read and understand the contract codes as a smart contract represent another legal question that must be asked, especially if the contract copy has been destroyed or lost. It Also poses an issue if the codes did not reflect the real intentions of the parties.[53] These simple examples can create a bundle of legal challenges that can affect the validity and enforceability of smart contracts. Hence, the law still needs to interfere to identify the legal position of such smart contract and whether it is accepted and considered a contract or merely a method to execute the terms agreed upon.

Another question is whether those contracts (the formation of the contract) will be accepted by the law if it was not followed by a written contract conducted by a natural or legal person (code-only smart contract).[54] Even if a written contract exists, most of the law has never yet accepted smart contracts as a method of contracting or identifying their legal status. Hence, both cases open the door for ambiguity in terms of their legal status, validity and recognition. Additionally, the elements of smart contracts and the way it handles the contract (the entire procedure of smart contracts) also represent a highly important matter to evaluate whether smart contract can fit well within the current legal framework for contracts and meet the formation requirements.

6.4. The Validity and Enforceability of Smart Contracts

The validity of the smart contract is also a factor to consider. Without a third party to examine, attest to, or validate the contract, the aforementioned issues arise. By utilising blockchain technology to facilitate and store smart contracts, smart contracts eliminate

[51] Hoi Tak Leung, "Smart Contracts - Can Code Ever be Law?", *Ashurst*, last modified 2018, https://www.ashurst.com/en/news-and-insights/legal-updates/smart-contracts---can-code-ever-be-law/.

[52] As parties can rely on that specific contract to resolve any future dispute. James Gardiner Hazard and Helena Haapio, "Wise Contracts: Smart Contracts that Work for People And Machines," in *Proceedings Of The 20Th International Legal Informatics Symposium IRIS 2017*, 2017, 425–432, doi:10.2139/ssrn.2925871.

[53] Such as being coded mistakenly by the experts or where parties did not communicate their intention clearly to the experts who code the smart contracts.

[54] As no written agreement is to be used as a reference to show the intention of the parties via clear language.

the need for any third party.[55] However, there is some debate over the extent to which blockchain can take over the role of law and enforcement bodies in verifying the documents.[56] The "notary public" is a vital member of the legal profession, for example, empowered by the law to issue and verify contracts, public deeds, and other documents, as well as to provide a certified copy of documents stored with him.[57]

It is critical to understand the distinction between the roles of public notaries in civil and common law countries. While the role of the notary public in common law jurisdictions is limited to verifying facts, providing legal advice, and assisting parties in comprehending the contents of the documents, the notary public in civil law jurisdictions has a broader range of responsibilities, including preparing legal documents (such as contracts, public deeds, and other legal documents), identifying and authenticating transactions and documents (such as determining the legal status of a contract, validating a signature, or the part of a document).[58] Having the contract notarised is a very beneficial (and essential for certain contracts) as it enables the contract to be verified, accepted and enforceable under the law.[59] This is not possible with smart contracts, which represent an unresolved issue.

The agreement via a smart contract is enforceable between the parties but not against a third party.[60] A smart contract operates outside the sphere and is not comparable to a traditional contract, which can be converted into a public deed.[61] Smart contracts assert that the existence of a blockchain enables them to obviate the need for a notary.[62] This may be true in common law jurisdictions where the public notary's authority is limited. This is not the case in civil law jurisdictions, where the notary public is charged with a slew of duties.

The role of blockchain in facilitating and storing contracts and ensuring the system's integrity does not ensure the contract's legal status, the parties' capacity, the information added, or the contract's enforceability against third parties.[63] This means that it does not provide the same level of legal certainty as to legal certification or verification by a notary

[55] Marcella Atzori, "Blockchain Technology and Decentralized Governance: Is The State Still Necessary?", *Journal of Governance and Regulation* 6, no. 1 (2017): 45-62, doi:10.22495/jgr_v6_i1_p5.

[56] Pablo Sanz Bayón, "Key Legal Issues Surrounding Smart Contract Applications," footnote *39.*

[57] Leslie G. Smith, "The Role of The Notary in Secure Electronic Commerce" (Master of Information Technology, Queensland University of Technology, 2006).

[58] Ma - Junyu, "Notary According to Civil Law and Common Law that Related Strongly with International Civil Transactions," *Jurnal Akta* 7, no. 3 (2020): 285, doi:10.30659/akta.v7i3.11279.

[59]"Do Contracts Need to be Notarized," *Upcounsel*, accessed 22 May 2022, https://www.upcounsel.com/do-contracts-need-to-be-notarized.

[60] This is due to the fact that smart contracts don't require or allow any interference by third parties to verify, attest, or enforce, hence, the life cycle and implications of the contract will be entirely limited between the contracting parties.

[61] Marcella Atzori, "Blockchain Technology and Decentralized Governance: Is the State Still Necessary?" footnote 55

[62] Ibid.

[63] As most of the jurisdiction worldwide did not yet legally address smart contracts including other related issues such capacity and the object of the contract, as well as the enforceability of the contract by the court and other authoritative agencies.

or other authorised agency (such as court or other governmental bodies). Thus, this matter is another serious issue that needs to be addressed in order to include smart contracts within the realm of contract legislation.

6.5. The Principle of Autonomy of Contractual Will and The Freedom of Contract

Both of the inter-connected principles represent a protected and core concept of contract law in most jurisdictions world-wide as they accompany the contract in all its stages, starting from creation (expression and exchange of will) to execution (goodwill, cause, and the subject). Legislators, however, have imposed some limitations and restrictions over the contractual parties in certain circumstances and contracts.[64] For instance, parties have the freedom to create a contract and include any terms and conditions they agree on (relying on the freedom of contract and their will). Nevertheless, they must adhere to the requirements and restrictions imposed by the legislators under the contract legislation such as, the ones related to the formation of the contract, the content of the contract[65], or even when the law restricts the subject and cause of the contract to be lawful and in line with the law and public order.[66] In addition, the autonomous of will also allow the parties to amend, delay, or even terminate the contract whenever they agree (mutual agreement) to do so.[67] This might be one of the serious challenges facing smart contracts.

The form and characteristics of smart contracts (automation, pre-determined, immutability, and irreversibility) pose legal challenges in relation to these principles, as the contract cannot be freely amended, cancelled, or even delayed, as parties can only make the necessary modifications prior to deployment (After deployment, parties cannot make any amendments, modifications to the smart contracts).[68] In addition, smart contracts do not strictly adhere to or consider the formation and requirements imposed by contract law.[69] synchronizing these principles with smart contracts seem to be a serious legal challenge for all legislators across jurisdictions.

The law of contract in jurisdictions, on the other hand, has not addressed smart contracts. Contract legislation lacked any provision which legally clarifies or discusses the legal status of smart contracts, the relationship between smart contracts and these principles

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[64] Most of contract legislation have included some article that limit the contract freedom either because the law requires a specific formality for certain contract or prevent any contract that is violating the contract law or/and the public order. Hein Kötz, "Formalities," in *European Contract Law*, 2017, doi:10.1093/oso/9780198800040.003.0005.

[65] Such as what is called the “nominal contract”, where the law has given it a specific name, form, and content.

[66] . Hein Kötz, "Formalities," in *European Contract Law.* footnote 64

[67] Paul Catchlove, "Smart Contracts: A New Era of Contract Use," *SSRN Electronic Journal*, 2017, 9, doi:10.2139/ssrn.3090226.

[68] Martin Heckelmann, "Zulässigkeit Und Handhabung Von Smart Contracts," *Neue Juristische Wochenschrift: NJW* 71, no. 8 (2018): 504; Philipp Paech, "The Governance of Blockchain Financial Networks," *The Modern Law Review* 80, no. 6 (2017): 1082, doi:10.1111/1468-2230.12303; Reggie O'Shields, "Smart Contracts: Legal Agreements For The Blockchain," *NORTH CAROLINA BANKING INSTITUTE* 21, no. 1 (2017): 178.

[69] Pablo Sanz Bayón, "Key Legal Issues Surrounding Smart Contract Applications," *footnote 39.*

and the extent in which smart contract is accepted and applied (scope). A previous legal approach has been observed by most jurisdictions upon the emergence of electronic contracts can used. To address the emergence of electronic contracts, the legislators have addressed the legal issues by the enactment of a sperate act that recognised electronic contracts and recognised electronic writing as regular writing.

A similar legal movement is needed taking into consideration the distinct legal characteristics of smart contract compared to other forms of contract (in terms of its language, mechanism, supervision, etc.). Even if the law recognises a smart contract as a contract based on the principle of will and the freedom of contract, the validity and enforceability of smart contracts are still not identified, hence, legal steps to address these issues must harmonised and take into consideration all the aspects. Smart contracts are also required to adhere to the limitations and restrictions imposed by the law, which can be quite challenging in certain instances. An additional issue to be considered is that smart contracts restrict the parties' free will after the contract's deployment, demonstrating a legal gap between principles and smart contracts. As a consequence of the above-mentioned facts, these principles need to be taken into consideration before coming to a legal approach on smart contracts. In order to solve this legal problem, the law and technology must work to find a way to address this pressing legal issue.

6.6. Unlawful Activities

Smart contract is conducted, facilitated and executed mostly on blockchain, thus, the possibility of using such innovation to commit criminal activities is extremely high, especially looking at the decentralised, anonymous nature and the use of cryptocurrencies as a medium of exchange (which operate out of the legal sphere and supervision in most of the jurisdictions).[70] This link between these technologies and the high level of criminal activities via blockchain justifies the hesitation of the countries to allow the use of smart contracts until the moment. Many reports have been issued discussing the high level of criminal activities and cyber-attacks using these decentralised technologies due to the absence of the centralised governance over the system which makes it harder and more difficult for law enforcement agencies to detect any violation or illicit activities.[71] The role of law in removing the ambiguity and clarifying the legal and

[70] Ari Juels, Ahmed Kosba, and Elaine Shi, "The Ring Of Gyges," in *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security*, 2016, doi:10.1145/2976749.2978362.

[71] Such as the report issued in 2022 by Chainalysis and the one by Cipher trance. Chainalysis Team, "Crypto Crime Trends For 2022: Illicit Transaction Activity Reaches All-Time High in Value, All-Time Low In Share of all cryptocurrency Activity," *Chainalysis*, Last modified 2022, https://blog.chainalysis.com/reports/2022-crypto-crime-report-introduction/; CipherTrace, "Cryptocurrency Crime and Anti-Money Laundering Report, February 2021" (California, United States: CipherTrace, 2021), https://ciphertrace.com/wp-content/uploads/2021/01/CipherTrace-Cryptocurrency-Crime-and-Anti-Money-Laundering-Report-012821.pdf.

illegal activities cannot be overstated. Hence, the absence of a law represents an important legal gap and other justification for this high level of illicit activities.

Above that, forming void contracts that don't meet the legal requirements or contracts that violate the law or the public order is also possible without any detection or prevention method so far.[72] Therefore, the ability to form a smart contract for any cause (legal or illegal) using blockchain and cryptocurrencies (which are difficult to track) represents another legal concern.[73] Many incidents have happened reported before, indicating the need for interference from various parties (legal and technological experts) in order to come up with a proper collective solution to bring this technology into the safe zone and prevent wrongdoers from using innovation for illicit activities. Hence, this issue must not be ignored while creating a legal framework for smart contracts. Malta approach can be used as a guidance in which a specific legislation and authority (the Malta Digital Innovation Authority) has been formed to legally focus on blockchain and smart contracts activities. This existence of a specific body will add a layer of protection and prevention for any person wishing to use smart contract for illegal purposes.

6.7. The Legal Responsibility of The Technical Experts

As previously stated, due to the technical nature and complexity of smart contracts, the parties frequently rely on the expertise of a third party to draught the smart contract.[74] These experts benefit from the technical expertise required to incorporate the smart contract's terms into the contract's code. Some of them provided a "template or format" for smart contracts to follow. In some cases, it is possible for the experts to make a coding error or any other technical error that alters what the parties intended to agree on in the first place or fails to perform as intended by the parties.[75] Additionally, the developer may be running or participating in an illegal scheme.[76]

As a result, the parties may face a significant risk; as such, they may be entitled to compensation for the consequences of this critical situation, as well as an equitable allocation of risks and liabilities among themselves.[77] This legal responsibility derives from the developer core role in developing a smart contract which cannot be ignored. As a result, developers who make an error, create a smart contract for illegal purposes or even

[72] Gernot Fritz and Lukas Treichl, "What's in A Smart Contract," *Lexology*, accessed 24 May 2022, https://www.lexology.com/library/detail.aspx?g=bac0889f-b321-444b-8227-7d3a904a83d2.

[73] Jonathan Herpy, "Council Post: Smart Contracts and The Law: What you Need To Know," *Forbes*, Last modified 2022, https://www.forbes.com/sites/forbesbusinesscouncil/2022/03/17/smart-contracts-and-the-law-what-you-need-to-know/?sh=27b230543d03.

[74] Mark Giancaspro, "Is A 'Smart Contract' Really A Smart Idea? Insights From A Legal Perspective," *Computer Law & Security Review* 33, no. 6 (2017): 825-835, doi:10.1016/j.clsr.2017.05.007.

[75] Jelena Madir, "Smart Contracts: (How) Do They Fit Under Existing Legal Frameworks?", *SSRN Electronic Journal*, 2018, doi:10.2139/ssrn.3301463.

[76] Pablo Sanz Bayón, "Key Legal Issues Surrounding Smart Contract Applications," *footnote 39*.

[77] Ibid.

conduct an illegal scheme utilising smart contracts may need to consider their legal liability.

Commissioner Brain Quintenz provided an example of the movement toward identifying the issues when he stated that developers of smart contract codes may be held liable for aiding and abetting violations of the Commodity Futures Trading Commission's rules. He stated that "developers of smart contracts" may be held liable if "they could reasonably foresee, at the time the code was created, that it would be used illegally by United States persons."[78] The liability of the developer, however, is still debatable and might according to some researcher, limit the innovation and technological development.[79] On the other hand, their role and responsibility cannot be completely ignored. Thus, the legal responsibility of the developer is another legal issue that must be taken into consideration to preserve parties' rights and avoid this excuse being used to circumvent one of the parties' obligations by referring the matter to the developer. Thus, the law must be amended to clarify the developer's obligations and responsibilities.

6.8. Legal Dispute After Deployment (ex-ante Vs. ex-post)

The effectiveness of smart contracts opens the door for various legal issues. One of these major issues is the possibility of any legal dispute, which is possible and unavoidable in any contract regardless of its form or characteristics.[80] The majority of the contractual disputes are resolved in court or through ADR, with the judge making the final decision after hearing the facts of the case. Smart contract, however, is automated, pre-defined, and self-enforced, focusing on the ex-ante (Before the event) in which the parties code all the terms into the smart contract and let the code become the law between the parties (Code is law). These characteristics have improved the effectiveness and performance of dealings. However, it creates a serious legal challenge in the event that a future dispute arises during or after the performance.[81]

This means that in the event of fraud, duress, legal capacity, damage to the subject, or any other issue, the law has no method for protecting the rights of the parties or addressing the self-enforcement nature of smart contracts. The inability of the enforcement bodies to modify or cancel such contracts after deployment demonstrates

[78] Andrew Lom, Lillian A. Cardona, and Rachael Browndorf, "CFTC Commissioner Brian Quintenz Warns Smart Contract Code Developers May be Held Liable for Violations of CFTC Regulations," *Regulation Tomorrow*, Last modified 2018, https://www.regulationtomorrow.com/us/cftc-commissioner-brian-quintenz-warns-smart-contract-code-developers-may-be-held-liable-for-violations-of-cftc-regulations/.

[79] Predrag Cvetković, "Liability in the Context of Blockchain-Smart Contract Nexus: Introductory Considerations," *Zbornik Radova Pravnog Fakulteta Nis* 59, no. 89 (2020): 83-100, doi:10.5937/zrpfn0-28637.

[80] Amy J. Schmitz and Colin Rule, "Online Dispute Resolution for Smart Contracts," *Journal of Dispute Resolution* 2 (2019): 103, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3410450.

[81] Ibid.

the absence of legal oversight over this technology.[82] In addition, the absence of legislation to guide contractors prior to deployment and to regulate the life cycle of smart contracts deprived the authority of both the ex-ante and ex-post. Therefore, this must be taken into account when addressing the legal issues surrounding smart contracts. The power of the court and other enforcement agencies must be restored and exist as disputes are unavoidable.

7. Conclusion

The implementation of smart contracts introduces various legal challenges that require immediate attention. These include aligning smart contracts with traditional contract principles, resolving jurisdictional conflicts, ensuring enforceability, managing dispute resolution and mitigating risks of unlawful activities. Legislative action is crucial, either through amending existing laws or enacting specific legislation. A regulatory sandbox could also provide a controlled environment to evaluate the effectiveness of smart contract frameworks.

Other key legal measures must be considered including the establishment of a specialised regulatory body to issue certifications for cryptographic signatures, set standards for smart contracts, resolve disputes, and enforce decisions. Moreover, embedding jurisdictional parameters within the code can enhance legal certainty and facilitate conflict resolution. Additionally, recognizing smart contracts as valid methods of creating obligations and treating coding language as a representation of intent can clarify their legal standing.

In the same vein, laws should address issues such as coding errors, force majeure, and unforeseen circumstances by integrating safeguards like external bodies or oracles. Courts must also have authority to enforce or rectify smart contracts using mechanisms such as kill switches or freeze functions. Decentralised alternative dispute resolution (ADR) should also be considered, given its growing relevance in the decentralised space. Furthermore, third-party contributors, such as service providers and code developers, must be accountable for their roles. Future studies should explore these challenges in-depth to develop tailored solutions for diverse jurisdictions.

References

Akhrorova, Sayokhat. "Navigating the Legal Landscape: Smart Contract Regulation in Uzbekistan." *International Journal of Artificial Intelligence* 4, no. 3 (2024): 326–328.

Alhejaili, Mohammad Omar Mohammad. "Integrating Smart Contracts into the Legal Framework of Saudi Arabia." *International Journal of Law and Management*. Vol.

[82] Tanash Utamchandani Tulsidas, "Smart Contracts from a Legal Perspective," Degree in Law, Universidad de Alicante, 2018.

ahead-of-print, no. ahead-of-print (2024). https://doi.org/10.1108/IJLMA-03-2024-0086.

Atiyah, Ghassan Adhab, Nazura Abdul Manap, and Saidatul Nadia Abd Aziz. "Smart Contract in Iraq: A Legal Framework." *Journal of Positive School Psychology* 6, no. 4 (2022): 6385–6392.

Atzori, Marcella. "Blockchain Technology and Decentralized Governance: Is the State Still Necessary?" *Journal of Governance and Regulation* 6, no. 1 (2017): 45-62. doi:10.22495/jgr_v6_i1_p5.

Bayón, Pablo Sanz. "Key Legal Issues Surrounding Smart Contract Applications." *KLRI Journal of Law and Legislation* 9, no. 1 (2019): 63-93.

Bodó, Balázs, Daniel Gervais, and João Pedro Quintais. "Blockchain and Smart Contracts: The Missing Link in Copyright Licensing?" *International Journal of Law and Information Technology* 26, no. 4 (2018): 311-336. doi:10.1093/ijlit/eay014.

Bogner, Andreas, Mathieu Chanson, and Arne Meeuw. "A Decentralised Sharing App Running a Smart Contract on the Ethereum Blockchain." In *Proceedings of the 6th International Conference on the Internet of Things*. 2016, 177-178. doi:10.1145/2991561.2998465.

Buterin, Vitalik. "DAOs, DACs, DAs and More: An Incomplete Terminology Guide." Blog. *Ethereum Blog*, 2014. https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide/.

Cann, Geoffrey, and Emily Catmur. "Blockchain: Overview of the Potential Applications for the Oil and Gas Market and the Related Taxation Implications." Deloitte, London, United Kingdom, 2017. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-oil-gas-blockchain-article.pdf.

Catchlove, Paul. "Smart Contracts: A New Era of Contract Use." *SSRN Electronic Journal*. 2017, 9. doi:10.2139/ssrn.3090226.

Chainalysis Team. "Crypto Crime Trends for 2022: Illicit Transaction Activity Reaches All-Time High in Value, All-Time Low in Share of All Cryptocurrency Activity." *Chainalysis*. Last modified 2022. https://blog.chainalysis.com/reports/2022-crypto-crime-report-introduction/.

CipherTrace. "Cryptocurrency Crime and Anti-Money Laundering Report, February 2021." California, United States: CipherTrace, 2021. https://ciphertrace.com/wp-content/uploads/2021/01/CipherTrace-Cryptocurrency-Crime-and-Anti-Money-Laundering-Report-012821.pdf.

Cong, Lin William, and Zhiguo He. "Blockchain Disruption and Smart Contracts." *The Review of Financial Studies* 32, no. 5 (2019): 1754–1797. doi:10.1093/rfs/hhz007.

Cvetković, Predrag. "Liability in the Context of Blockchain-Smart Contract Nexus: Introductory Considerations." *Zbornik Radova Pravnog Fakulteta Nis* 59, no. 89 (2020): 83-100. doi:10.5937/zrpfn0-28637.

Dai, Jun, and Miklos A. Vasarhelyi. "Toward Blockchain-Based Accounting and Assurance." *Journal of Information Systems* 31, no. 3 (2017): 5-21. doi:10.2308/isys-51804.

Deloitte. "Getting Smart About Smart Contracts CFO Insights." London, United Kingdom: Deloitte, 2016. https://www2.deloitte.com/us/en/pages/finance/articles/cfo-insights-getting-smart-contracts.html.

Dubovitskaya, Alevtina, et al. "Secure and Trustable Electronic Medical Records Sharing Using Blockchain." *AMIA Annual Symposium Proceedings* 2017 (2017): 650-659. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5977675/.

Efimova, Liudmila (Lyudmila), Olga Sizemova, and Alexey Chirkov. "Smart Contracts: Between Freedom and Strict Legal Regulation." *Information & Communications Technology Law* 30, no. 3 (2021): 333-353. doi:10.1080/13600834.2021.1889759.

Egelund-Müller, Benjamin, et al. "Automated Execution of Financial Contracts on Blockchains." *Business & Information Systems Engineering* 59, no. 6 (2017): 457-467. doi:10.1007/s12599-017-0507-z.

ESMA. "The Distributed Ledger Technology Applied to Securities Markets." Paris, France: The European Securities and Markets Authority, 2017. https://www.esma.europa.eu/sites/default/files/library/dlt_report_-_esma50-1121423017-285.pdf.

Farnsworth, E. Allan. "Comparative Contract Law." In *The Oxford Handbook of Comparative Law*. 2006, 911. doi:10.1093/oxfordhb/9780199296064.013.0029.

Flipside. *EVM Smart Contract Deployment Snapshot*. March 2024.

Fritz, Gernot, and Lukas Treichl. "What's in a Smart Contract." *Lexology*. Accessed 24 May 2022. https://www.lexology.com/library/detail.aspx?g=bac0889f-b321-444b-8227-7d3a904a83d2.

Gatteschi, Valentina, et al. "Blockchain and Smart Contracts for Insurance: Is the Technology Mature Enough?" *Future Internet* 10, no. 2 (2018): 20. doi:10.3390/fi10020020.

Giancaspro, Mark. "Is a 'Smart Contract' Really a Smart Idea? Insights from a Legal Perspective." *Computer Law & Security Review* 33, no. 6 (2017): 825-835. doi:10.1016/j.clsr.2017.05.007.

Glaser, Florian. "Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain Enabled System and Use Case Analysis." In *Proceedings of the 50th Hawaii International Conference on System Sciences*. 2017, 1543-1552.

Grand View Research. *Smart Contracts Market Size, Share, & Trends Analysis Report By Platform, By Blockchain Type, By Contract Type, By Enterprise Size, By End-use (BFSI, Retail), By Region, And Segment Forecasts, 2023 - 2030*. May 2023. https://www.grandviewresearch.com/press-release/global-smart-contracts-market.

Grenon, Sibilla. *Codifying Code? Evaluating US Smart Contract Legislation*. London: International Bar Association, 2019. https://www.ibanet.org/Document/Default.aspx?DocumentUid=C8D2EBA4-57D1-4F01-8AA5-24C9CFF2B447.

Gürcan, Bedrettin. "Jurisdiction on the Blockchain." In *ICBEMM 2020 (Oxford) 11th International Conference on Business, Economics, Management and Marketing*. 2020, 14-20.

Hazard, James Gardiner, and Helena Haapio. "Wise Contracts: Smart Contracts That Work for People and Machines." In *Proceedings of the 20th International Legal Informatics Symposium IRIS 2017*. 2017, 425-432. doi:10.2139/ssrn.2925871.

Heckelmann, Martin. "Zulässigkeit und Handhabung von Smart Contracts." *Neue Juristische Wochenschrift: NJW* 71, no. 8 (2018): 504.

Herpy, Jonathan. "Council Post: Smart Contracts and the Law: What You Need to Know." *Forbes*. Last modified 2022. https://www.forbes.com/sites/forbesbusinesscouncil/2022/03/17/smart-contracts-and-the-law-what-you-need-to-know/?sh=27b230543d03.

Hourani, Sara. *Cross-Border Smart Contracts: Boosting International Digital Trade Through Trust and Adequate Remedies*. London: UNCITRAL, 2017. https://www.uncitral.org/pdf/english/congress/Papers_for_Programme/11-HOURANI-Cross_Border_Smart_Contracts.pdf.

Hsiao, Jerry I-H. "“Smart” Contract on the Blockchain-Paradigm Shift for Contract Law?" *US-China Law Review* 14, no. 10 (2017). doi:10.17265/1548-6605/2017.10.002.

"How Have Different States in the United States of America Enabled Blockchain Technology and Smart Contracts." *Ikigai Law*. Accessed 6 August 2021. https://www.ikigailaw.com/how-have-different-states-in-the-united-states-of-america-enabled-blockchain-technology-and-smart-contracts/#acceptLicense.

Iansiti, Marco, and Karim R. Lakhani. "The Truth About Blockchain." *Harvard Business Review*. Last modified 2017. https://hbr.org/2017/01/the-truth-about-blockchain.

Istuk, Ivor, Jeffrey Stephen Allen, and Oya Pinar Ardic Alper. *Smart Contract Technology and Financial Inclusion (English)*. FinTech note no. 6. Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/710151588785681400/Smart-Contract-Technology-and-Financial-Inclusion.

Jones Day Law Firm. "Blockchain for Business." *Jonesday*. Last modified 2017. https://www.jonesday.com/Files/Upload/Blockchain%20for%20business%20white%20Paper2.Pdf.

Juels, Ari, Ahmed Kosba, and Elaine Shi. "The Ring of Gyges." In *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security*. 2016. doi:10.1145/2976749.2978362.

Junyu, Ma. "Notary According to Civil Law and Common Law That Related Strongly with International Civil Transactions." *Jurnal Akta* 7, no. 3 (2020): 285.

Khurana, Amit. "Smart Contracts in Light of Indian Contract Law." Master's thesis, University of Oslo, 2020.

Kim, Henry M., and Marek Laskowski. "Toward an Ontology-Driven Blockchain Design for Supply-Chain Provenance." *Intelligent Systems in Accounting, Finance and Management* 25, no. 1 (2018): 18-27. doi:10.1002/isaf.1424.

Korže, Saša Zupan. "How Smart Tourism Embrace Blockchains and Smart Contracts." *Mednarodno Inovativno Poslovanje. Journal of Innovative Business and Management* 11, no. 2 (2019): 32-40. doi:10.32015/jibm/2019-11-2-4.

Kötz, Hein. "Formalities." In *European Contract Law*. 2017. doi:10.1093/oso/9780198800040.003.0005.

Lehot, Louis. "If Blockchain Is the Next Big Tech Paradigm Shift, What Legal Issues Matter? - Fin Tech - United States." *Mondaq*. Last modified 2020. https://www.mondaq.com/unitedstates/fin-tech/991184/if-blockchain-is-the-next-big-tech-paradigm-shift-what-legal-issues-matter.

Leung, Hoi Tak. "Smart Contracts - Can Code Ever Be Law?" *Ashurst*. Last modified 2018. https://www.ashurst.com/en/news-and-insights/legal-updates/smart-contracts---can-code-ever-be-law/.

Lindman, Juho, Virpi Kristiina Tuunainen, and Matti Rossi. "Opportunities and Risks of Blockchain Technologies: A Research Agenda." In *Proceedings of the 50th Hawaii International Conference on System Sciences*. 2017, 1533-1542. doi:10.24251/hicss.2017.185.

Lom, Andrew, Lillian A. Cardona, and Rachael Browndorf. "CFTC Commissioner Brian Quintenz Warns Smart Contract Code Developers May Be Held Liable for Violations of CFTC Regulations." *Regulation Tomorrow*. Last modified 2018. https://www.regulationtomorrow.com/us/cftc-commissioner-brian-quintenz-warns-smart-contract-code-developers-may-be-held-liable-for-violations-of-cftc-regulations/.

Madir, Jelena. "Smart Contracts: (How) Do They Fit Under Existing Legal Frameworks?" *SSRN Electronic Journal*. 2018. doi:10.2139/ssrn.3301463.

Magazzeni, Daniele, Peter McBurney, and William Nash. "Validation and Verification of Smart Contracts: A Research Agenda." *Computer* 50, no. 9 (2017): 50-57.

Mashatan, Atefeh, and Zachary Roberts. "An Enhanced Real Estate Transaction Process Based on Blockchain Technology." *AMCIS 2017 Proceedings* 11 (2017): 1-5. https://aisel.aisnet.org/amcis2017/OrganizationalIS/Presentations/11/.

Meng, Weizhi, et al. "When Intrusion Detection Meets Blockchain Technology: A Review." *IEEE Access* 6 (2018): 10179-10188. doi:10.1109/access.2018.2799854.

Nakamoto, Satoshi. "Bitcoin: A Peer-to-Peer Electronic Cash System." *Decentralized Business Review* (2008).

Nofer, Michael, Peter Gomber, and Dirk Schiereck. "Blockchain." *Business & Information Systems Engineering* 59, no. 3 (2017): 183-187. https://aisel.aisnet.org/bise/vol59/iss3/7/.

O'Shields, Reggie. "Smart Contracts: Legal Agreements for the Blockchain." *North Carolina Banking Institute* 21, no. 1 (2017): 178.

Paech, Philipp. "The Governance of Blockchain Financial Networks." *The Modern Law Review* 80, no. 6 (2017): 1082. doi:10.1111/1468-2230.12303.

Rares, Steven. "Commercial Issues in Private International Law." *Federal Court of Australia*. Last modified 2018. https://www.fedcourt.gov.au/digital-law-library/judges-speeches/justice-rares/rares-j-20180216.

Ream, John, Yang Chu, and David Schatsky. "Upgrading Blockchains Smart Contract Use Cases in Industry." United States: Deloitte University Press, 2016.

https://www2.deloitte.com/us/en/insights/focus/signals-for-strategists/using-blockchain-for-smart-contracts.html.

Sari, Happy Budyana, Emmy Febriani Thalib, and Ni Putu Suci Meinarni. "Implementation of Smart Contracts in Indonesia: An Analysis of Financial Regulation, Taxation, and Consumer Protection." *Jurnal Notariil* 9, no. 2 (2024): 65–70. https://doi.org/10.22225/jn.9.2.2024.65-70.

Savelyev, Alexander. "Contract Law 2.0: 'Smart' Contracts as the Beginning of the End of Classic Contract Law." *Information & Communications Technology Law* 26, no. 2 (2017): 116-120. doi:10.1080/13600834.2017.1301036.

Schmitz, Amy J., and Colin Rule. "Online Dispute Resolution for Smart Contracts." *Journal of Dispute Resolution* 2 (2019): 103. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3410450.

Sharma, Rakesh. "What Is Smart Contract Dispute Resolution?" *Investopedia*. Last modified 2022. https://www.investopedia.com/news/how-are-disputes-smart-contracts-resolved/.

Sherborne, Andreas. *Blockchain, Smart Contracts and Lawyers*. London: International Bar Association, 2017. https://www.ibanet.org/Document/Default.aspx?DocumentUid=17badeaa-072a-403b-b63c-8fbd985d198b.

Smart Contracts Alliance. "Smart Contracts: 12 Use Cases for Business & Beyond—A Technology, Legal & Regulatory Introduction —Foreword by Nick Szabo." Washington, D.C.: The Chamber of Digital Commerce, 2016. http://digitalchamber.org/assets/smart-contracts-12-use-cases-for-business-and-beyond.pdf.

Smith, Leslie G. "The Role of the Notary in Secure Electronic Commerce." Master of Information Technology, Queensland University of Technology, 2006.

Song, Judy Yueh Ling, and Esther Tan. "Beyond Traditional Contracts: The Legal Recognition and Challenges of Smart Contracts in Malaysia and Singapore." *Journal of Law, Market & Innovation* 3, no. 3 (2024): 323–57.

Szabo, Nick. "Smart Contracts: Building Blocks for Digital Markets." *EXTROPY: The Journal of Transhumanist Thought*, (16) 18, no. 2 (1996): 28.

Szczerbowski, Jakub J. "Place of Smart Contracts in Civil Law. A Few Comments on Form and Interpretation." In *Proceedings of the 12th Annual International Scientific Conference New Trends 2017*, 335.

"The Definition of Smart Contracts." *The Free Dictionary*. Accessed 27 December 2020. https://encyclopedia2.thefreedictionary.com/Smart+contracts.

Tulsidas, Tanash Utamchandani. "Smart Contracts from a Legal Perspective." Degree in Law, Universidad de Alicante, 2018.

UNCITRAL and UNIDROIT. *Joint UNCITRAL/UNIDROIT Workshop on Legal Issues Arising from the Use of Smart Contracts, Artificial Intelligence, and Distributed Ledger Technology*. Rome: UNIDROIT, 2019.

Ulug'bek o'g'li, Ismatov Aslbek. "The Importance of Smart Contracts in This Digital Era." *Models and Methods for Increasing the Efficiency of Innovative Research* 3, no. 35 (2024).

Volynets, Vitalii. "Legal Aspects of Using Blockchain Technologies in the Field of E-Commerce on SDG's." *Journal of Lifestyle and SDGs Review* 4, no. 1 (2024): e01663. https://doi.org/10.47172/2965-730X.SDGsReview.v4.n00.pe01663.

Warianto, W., F. Y. P. Amboro, and L. Sudirman. "Pragmatism of Smart Contracts in Legal Perspective: A Comparative Analysis Between Indonesia and the United States." *Jurnal Mediasas: Media Ilmu Syari'ah dan Ahwal Al-Syakhsiyyah* 7, no. 1 (2024): 13–38. https://doi.org/10.58824/mediasas.v7i1.42.

Woebbeking, Maren K. "The Impact of Smart Contracts on Traditional Concepts of Contract Law." *JIPITEC* 10 (2019): 106. https://www.jipitec.eu/issues/jipitec-10-1-2019/4880.

Yang, Qi, et al. "Design and Implementation of a Loan System Based on Smart Contract." *Smart Blockchain* 11373 (2018): 22-31. doi:10.1007/978-3-030-05764-0_3.

Yang, Xuechao, et al. "Decentralized Voting: A Self-Tallying Voting System Using a Smart Contract on the Ethereum Blockchain." *Web Information Systems Engineering – WISE 2018* 11233 (2018): 18-35. doi:10.1007/978-3-030-02922-7_2.

Yong, K. J., E. S. Tay, and D. W. Khong. "Application of Blockchain Smart Contracts in Smart Tenancies: A Malaysian Perspective." *Cogent Social Sciences* 8, no. 1 (2022): 2111850. https://doi.org/10.1080/23311886.2022.2111850.

Yusof, Zulhazmi Bin, et al. "Regulatory Framework on Smart Contracts: A Comparative Analysis." *Information Management and Business Review* 16, no. 2(I) (2024): 221–30. https://doi.org/10.22610/imbr.v16i2(I).3822.

Zyskind, Guy, Oz Nathan, and Alex 'Sandy' Pentland. "Decentralizing Privacy: Using Blockchain to Protect Personal Data." In *2015 IEEE Security and Privacy Workshops*. 2015, 180-184. doi:10.1109/spw.2015.27.

Conflict of Interest Statement: The author(s) declares that the research was conducted in the absence of any commercial or financial relationship that could be construed as a potential conflict of interest.

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