

ESSAYS



SMART CONTRACTS IN THE NEW ERA OF CONTRACT LAW

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Abstract

This essay examines whether smart contract innovation is capable of displacing the orthodox adherence to traditional contracts. This examination is underpinned by an analysis of the legality of smart contracts, through which it is exemplified that smart contracts ought to be considered legally binding instruments. The essay proceeds to explore the superiority of smart contracting on a technical and theoretical basis. The advantages generated through smart contract automaticity and enforceability present a concrete basis for undermining reliance on traditional contracts. Blockchain Technology also enhances the benefits of smart contracts by acting as a smart contract enabler through guaranteed performance and enforceability. Nevertheless, such novel technologies inevitably suffer from several shortcomings. This essay considers examples which illustrate the inflexibility of smart contracting. Apart from being susceptible to hacking and code exploitation, smart contracting is unable to deal with ambiguities and potential modifications. Overall, this suggests that the advantages of smart contract practice are currently confined to some specified limited scenarios. Smart contracts perform a different function to traditional contracting by merely guaranteeing technical enforceability as opposed to legal enforceability. This essay thus concludes that, for the time being, it is best to regard smart contracting as a supplement to traditional contracts rather than an outright displacement.

Keywords

smart contracts, blockchain, coding, artificial intelligence, automated legal instruments, decentralised autonomous organisations

Conflict of interest

The author declares no conflict of interest.

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СМАРТ-КОНТРАКТЫ КАК НОВАЯ ТЕНДЕНЦИЯ ДОГОВОРНОГО ПРАВА

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Аннотация

В эссе рассматриваются смарт-контракты как одно из оснований возникновения обязательств наряду с классическими договорами. Автоматическое исполнение с использованием технологии блокчейн как особенность конструкции является явным преимуществом по сравнению с традиционными договорными механизмами. В то же время такие новые технологии неизбежно имеют ряд недостатков. В эссе рассматриваются примеры, иллюстрирующие отсутствие гибкости смарт-контрактов. Кроме того, они подвержены взлому и эксплуатации кода и не могут справиться с двусмысленностями и потенциальными модификациями. Автор приходит к выводу о том, что в настоящее время новая популярная конструкция все же не может вытеснить классические договорные формы, а находит свое применение лишь в ограниченных сферах.

Ключевые слова

смарт-контракты, блокчейн, код, искусственный интеллект, автоматизированные правовые инструменты, децентрализованные автономные организации

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The changes will never be as fast as some may predict, but changes there will be, and they will surely disrupt the way we are used to working.¹

Smart contracts are the tech topic du jour, having the ability to disrupt the practice of traditional contracting. Szabo envisioned smart contracts as a means to “combine protocols with user interfaces to formalize and secure relationships over computer networks. Objectives and principles for the design of these systems are derived from legal principles, economic theory, and theories of reliable and secure protocols.”² More than twenty years later, Szabo’s vision remains the foundation for an array of literature, although no agreement has yet been reached on a coherent and consistent meaning to smart contracts which accurately reflects their current and potential functionality. This is mainly due to the advent of the blockchain network which transformed smart contracts into what they are today.³ Nevertheless, most academics and practitioners would agree that “a smart contract is an automatable and enforceable agreement. Automatable by computer, although some parts may require human input and control.”⁴ This definition accurately encapsulates the essence of smart contracts, whilst being careful not to suggest anything beyond their existing capabilities.

Following this line of thought, this paper will start by analysing the legal status of smart contracts compared to traditional contracts. The view expressed in this work is that smart contracts constitute legally binding and enforceable contracts. This analysis will lead to a critical examination of whether the functionality of traditional contracts has been displaced by the emergence of smart contracts. It will be demonstrated that smart contracts have the potential to challenge the orthodox adherence to traditional contracting. Smart contracts’ automatic execution and self-enforceability offer both a practical and theoretical basis for this challenge. This paper will then explore how the emergence of the blockchain network has affected smart contracting and examine whether this offers the necessary qualities to displace the functionality of traditional contracts. It will be argued that although the blockchain network generates a multitude of advantages, it cannot significantly advance the practice of smart contracting given that it suffers from limitations itself. Subsequently, this paper will turn to consider the range of possible smart contract applications stemming from their versatility as legal instruments. The analysis will show that even though smart contracts show great potential, this has not yet been achieved. Smart contract technology is underdeveloped and the dependence on the code gives rise to systemic risks. Moreover, smart contracts represent an inflexible substitute to traditional contracts, and regarding the outstanding issues of contractual ambiguity, imperfect performance, and contractual modification, in addition, inadequate solutions have been proposed to address them. This discussion will highlight the overarching thesis of this paper: although, in theory, smart contracts appear to be functional legal instruments, they are currently limited in practice. Overall, this work regards smart contracts as currently supplementing traditional contract practice in limited scenarios, rather than displacing traditional functionality.

¹ Sir Vos, G. (2019, November 12). *Future proofing for commercial lawyers in an unpredictable world*. Annual combar lecture 2019. The Commercial Bar Association. www.judiciary.uk/wp-content/uploads/2019/11/COMBAR.lecture2019.final_.pdf

² Szabo, N. (1997). Smart contracts: Formalizing and securing relationships on public networks. *First Monday*, 2(9). Article 1. <https://doi.org/10.5210/fm.v2i9.548>

³ Koulou, R. (2016). Blockchains and online dispute resolution: Smart contracts as an alternative to enforcement. *Scripted. A Journal of Law, Technology & Society*, 13(1), 40–69. <http://doi.org/10.2966/scrip.130116.41>

⁴ Clack, C. D., Bakshi, V. A., & Braine, L. (2016). *Smart contract templates: Foundations, design landscape and research directions*. arXiv. <http://arxiv.org/abs/1608.00771>

The Legal Status of Smart Contracts

For an agreement to constitute an enforceable legally binding contract, common law requires four elements to be present, namely: (i) offer; (ii) acceptance; (iii) consideration and (iv) intentions to create legal relations. The law takes an exceptionally broad approach and will enforce any promise, whatever its form, if the above criteria are met and if there are no vitiating factors such as duress or misrepresentation to taint the agreement.⁵ In practical terms, a contract will be concluded upon the agreement of a future contractual performance, which then generates rights and obligations for all parties.⁶

A lingering question frequently tackled by literature is whether smart contracts carry the same legal validity as traditional contracts. Although this question warranted a definitive and authoritative answer, instead it instigated a never-ending debate amongst academics and practitioners. Some academics have strained every nerve to overestimate the power and authority of smart contracts. For example, Savelyev articulated the radical view that “smart contracts don’t need a legal system to exist: they may operate without any overarching legal framework. De facto, according to Savelyev, they represent a technological alternative to the whole legal system.”⁷ In contrast, practitioners voiced concerns about the legal status of smart contracts since, unlike traditional contracts, the contract is not given force through natural language but rather through computer data and rules.⁸ Although this concern is justifiable, this paper suggests that the prevalent view ought to be that smart contracts have the same legal validity as traditional contracts. This is because “the data-oriented label simply suggests that the parties have decided that some subset of key terms or conditions would benefit from being represented as computer processable data.”⁹ This argument is sensible, since “anything from a verbal agreement to an email conversation can become a contract at law, if the basic elements of a contract can be found.”¹⁰

The prevalent view rests on the premise that the function of a traditional contract is to alter the parties’ rights and obligations. Hence, smart contracts ought to be treated like other contracts, given that they operate themselves as voluntary mechanisms to alter the rights and duties of the parties.¹¹ The legal statement of the UK Jurisdiction Taskforce (hereinafter “UKJT”) reinforces this line of thought. The UKJT reasoned that smart contracts are capable of constituting legally binding contracts provided that the common law requirements for contract formation are satisfied.¹²

⁵ Jones, I. (2019, November 22). *Legal statement on cryptoassets and smart contracts – The breakdown*. Lexology. Collyer Bristow LLP. <https://www.lexology.com/library/detail.aspx?g=002956de-cd49-46ab-9218-f80a1cc92ad3#:~:text=The%20UK%20jurisdiction%20taskforce%20of,are%20enforceable%20by%20the%20courts>

⁶ Cutts, T. (2019). Smart contracts and consumers. *West Virginia Law Review*, 122(2), 389–446. <https://researchrepository.wvu.edu/wvrl/vol122/iss2/4>

⁷ Savelyev, A. (2017). Contract law 2.0: Smart contracts as the beginning of the end of classic contract law. *Information and Communications Technology Law*, 26(2), 116–134. <https://doi.org/10.1080/13600834.2017.1301036>

⁸ Harley, B. (2017, August 01). *Are smart contracts contracts? Talking Tech looks at the concept and realities of smart contract*. Talking Tech. <https://talkingtech.cliffordchance.com/en/emerging-technologies/smart-contracts/are-smart-contracts-contracts.html>

⁹ Surden, H. (2012). Computable contracts. *UC Davis Law Review*, 46(2), 629–700. https://lawreview.law.ucdavis.edu/issues/46/2/Articles/46-2_Surden.pdf

¹⁰ Stark, J. (2016, June 4). *Making sense of blockchain smart contracts*. CoinDesk. www.coindesk.com/making-sense-smart-contracts

¹¹ Werbach, K., & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(2), 313–382. <https://scholarship.law.duke.edu/dlj/vol67/iss2/2>

¹² Jones, 2019.

Sir Geoffrey Vos advocated that “a smart contract can be identified, interpreted and enforced using ordinary and well-established [common law] principles.”¹³ Disappointingly, however, the importance of this legal statement has been underestimated in relevant literature on the basis that it does not represent a statement of law. To fully comprehend the importance of the legal statement, it must be acknowledged that the UKJT is made up of highly respected practitioners, government experts, and members of the judiciary. In addition, the statement was heavily relied upon in the recent High Court decision of *AA v. Persons Unknown*.¹⁴ Mr. Justice Bryan acknowledged that the judicial members of UKJT “neither in their judicial capacity were responsible for the drafting of the legal statement, nor have either in their judicial capacities endorsed that legal statement.”¹⁵ Nonetheless, in delivering his judgment, he was greatly influenced by the conclusions of the legal statement. This shows that the statement may not in fact constitute legal authority, but it remains highly persuasive. In sum, in line with the UKJT and various academics, this work concludes that smart contracts are contracts on the basis that they represent “agreements to shift legal rights and responsibilities no less than an agreement between two parties physically exchanging goods for payment over a counter.”¹⁶

The legal validity of smart contracts entails a further layer of complexity which merits consideration: unless smart contracts become internationally recognised, they have the propensity to disturb the application of private international law.¹⁷ International legal systems require different elements for contract formation. A critical distinction, for example, is between civil and common law systems in which the latter requires consideration for a legally binding contract to be formed. Therefore, the validity of a smart contract hinges upon the jurisdiction's willingness to recognise and enforce it. This represents a major impediment in smart contract practice given that they are placed on the blockchain network which in turn does not acknowledge international borders. Thus, the lack of an internationally co-ordinated effort to recognise the legality of smart contracts may prove to be challenging. It is not possible to predict the outcome of a private international law dispute where one jurisdiction recognises the contract as a valid legal instrument but the other does not. This, however, should not preclude the conclusion that smart contracts ought to constitute legally binding contracts. Therefore, it is prudent to explore the features which may enable smart contracts to displace the functionality of traditional contracts.

Automaticity and Enforceability

The vital characteristics of smart contracts are automaticity and enforceability. The essence of automaticity lies in the contract being performed automatically, without the need of human intervention.¹⁸ This contributes towards a decrease in the marginal cost of contracting and enhances

¹³ Sir Vos, G. (2019, November 18). *The launch of the legal statement on the status of cryptoassets and smart contracts. Annual Combar Lecture 2019*. The Commercial Bar Association. www.judiciary.uk/wp-content/uploads/2019/11/Legal-StatementLaunch.GV_2.pdf

¹⁴ *AA v. Persons Unknown*, 3556 EWHC (2019).

¹⁵ *AA*, 2019.

¹⁶ Werbach & Cornell, 2017.

¹⁷ Janssen, A., & Durovic, M. (2018). The formation of smart contracts and beyond: Shaking the fundamentals of contract law? In L. Di Matteo, M. Cannarsa, & C. Poncibo (Eds.) *Smart contracts and blockchain technology: Role of contract law*. Cambridge University Press. Forthcoming <https://www.researchgate.net/publication/327732779>

¹⁸ Jones, 2019.

the speed with which contractual relationships can be executed.¹⁹ Counterparties are able to enter multiple contracts in minutes, saving on negotiation and organisational costs as well as facilitating everyday commerce. By removing reliance on paper and administrative processes and thus executing the contract in real time, smart contracts prove to be a more efficient and cost-saving method of concluding agreements.²⁰ Hence, it is evident that the efficiencies generated by automatic execution provide great incentives for counterparties to switch to smart contracting.

More importantly, automatic execution represents a key benefit accruing from smart contracting, with it also being “a pre-emptive form of self-help because no recourse to a court is needed for the machine to execute the agreement.”²¹ Taking enforcement out of the hands of the courts is considered particularly important for parties engaging in smart contracting; after all, resolving disputes through litigation has long been criticised as a costly, inefficient, and time-consuming procedure. Indeed, Raskin has argued that “resorting to the court system is a resource intensive process”²² and smart contracting achieves “the lowering of costs through the ensuring of performance without recourse to the courts.”²³ This represents an important incentive for contracting parties to use smart contracts as they will be able to avoid burdensome litigation costs. Arguably, this implies that smart contracts offer the possibility of rendering courts virtually obsolete, since they serve the same function with greater efficiency and customisation.²⁴

Smart contracts also offer law firms the opportunity to allocate resources in a more efficient manner. Heavy manpower is unavoidably required to draft long standardised documents for countless transactions. Rather than dozens of lawyers drafting and reviewing long boilerplate provisions, however, smart contracts offer the advantage of a machine, instead, having to read and verify each term. This would provide the opportunity for lawyers to merely identify non-boilerplate clauses that should be implemented into code and focus their precious time on more intellectually demanding tasks.²⁵ Therefore, smart contracts provide the ability to save on both the resources of counterparties as well as to unlock more efficient allocations of lawyers within law firms.

In addition to providing a less resource-intensive process, smart contract enforceability is able to deliver greater contractual certainty in two interconnected ways. Firstly, smart contracts address the opacity of legal drafting stemming from the inherent ambiguity of natural language. Natural language may be given a multitude of interpretations and thus often represents the subject of a court dispute. However, smart contracts are not capable of understanding and interpreting natural language. As a consequence, smart contracting avoids unnecessary litigation on linguistic interpretations and rather enforces the terms of the agreement.²⁶ Closely associated with this argument is the advantage that, through guaranteeing contractual performance, smart contracts ensure that counterparties are bound to their respective obligations under the agreement. This function is stressed by Werbach and Cornell, who suggest that “smart contracts are like specific performance on steroids and without

¹⁹ Wright, A., & De Filippi, P. (2015). Decentralized blockchain technology and the rise of lex cryptographia. *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.2580664>

²⁰ Wright & De Filippi, 2015.

²¹ Raskin, M. (2017). The law and legality of smart contracts. *Georgetown Technology Review*, 1(2), 305–341. <https://georgetownlawtechreview.org/wp-content/uploads/2017/05/Raskin-1-GEO-L-TECH-REV-305-.pdf>

²² Raskin, 2017.

²³ Raskin, 2017.

²⁴ Wright & De Filippi, 2015.

²⁵ Wright & De Filippi, 2015.

²⁶ Wright & De Filippi, 2015.

the state's coercive machinery."²⁷ Hence, smart contracts are able to uphold contractual certainty by incorporating legal provisions (wet code) into code (dry code), ensuring that counterparties abide by their duties and obligations under the contract.²⁸ In turn, guaranteed contractual performance will incentive individuals to opt for smart contracting. Contracting parties are assured that the terms of the contract will not be subject to judicial scrutiny, avoiding the risk of a term being stricken down or misinterpreted by the courts. Undoubtedly, this would solve "a longstanding puzzle and problem of e-commerce: courts' longstanding refusal to enforce contract terms proffered by consumers. If courts will not protect consumers, robots will."²⁹

The Harm Principle

On a more theoretical level, automatic execution and enforceability fuel the "subordination of state authority to individual autonomy."³⁰ This view reveals a connection between the much-celebrated harm principle and smart contracting. The harm principle as articulated by Mill mandates that "the only purpose for which power can be rightfully exercised over any member of a civilised community, against his will, is to prevent harm to others."³¹ In this sense, the harm principle is inextricably linked with principles of party autonomy and freedom of contract. Arguably, the harm principle finds itself in tension with contract law if the latter is understood as an enforcement of promises; court intervention to interpret contracts and enforce contractual promises is not initiated to prevent harm to others. Indeed, Bix pointed out that some prominent commentators believe that "contract law may involve the state in inappropriately enforcing morality in circumstances where there is no concern about third-party harms."³² In reinforcing this argument, Smith summarised the objection as being "illegitimate for the state to enforce promises qua promises, and thus the state must be doing something other than enforcing promises when it enforces contracts."³³ Unlike traditional contracts, however, smart contracts prevent external interference. They are able to use technology to enforce party autonomy in a more effective manner whilst also maintaining consistency with the harm principle. Consequently, the functionality of smart contracts, both on a practical and theoretical level, has the propensity to disrupt the strict adherence to traditional contracting. To unravel the magnitude of this disruption, one must also consider smart contracts as placed on the blockchain network.

The Blockchain Network: Facilitator or Fallacy?

It has been demonstrated that the attractiveness of smart contracts lies in their automatic execution of tasks and guaranteed contractual performance through eliminating the human element *ex post*. Counterparties enjoy the fruits of contractual certainty through the assurance that the contract will be automatically performed. These gains in efficiency, however, have to be balanced against their lack of agency. Indeed, performance certainty comes at the expense of interpretation uncertainty. This is because an "independent third party must interpret the contract in accord with the

²⁷ Werbach & Cornell, 2017.

²⁸ Wright & De Filippi, 2015.

²⁹ Fairfield, J. (2014). Smart contracts, bitcoin bots, and consumer protection. *Washington and Lee Law Review Online*, 71(2), Article 3. <https://scholarlycommons.law.wlu.edu/wlulr-online/vol71/iss2/3>

³⁰ Raskin, 2017.

³¹ Mill, J. S. (1859). *On Liberty*. John W. Parker & Son.

³² Bix, B. H. (2012). Theories of contract law and enforcing promissory morality: Comments on Charles Fried. *Suffolk Law Review*, 45, 719–734. https://scholarship.law.umn.edu/faculty_articles/204

³³ Smith, S. A. (2004). *Contract theory*. Oxford University Press.

intentions of the parties.”³⁴ In the absence of a court to interpret the terms of a smart contract, a solution is presented by blockchain technology. Blockchain is a decentralised ledger used to record transactions verified by members of a peer-to-peer network. Blockchain, therefore, offers a kind of independent agency.³⁵ In essence, the terms and any issues relating to contractual performance will be fed to the blockchain, and if verified by the nodes, the contract will be deemed as having been performed.

The advent of blockchain technology provided the means for transforming Szabo’s vision of smart contracts into something more than a mere curiosity.³⁶ Indeed, “it is only in blockchain networks that there is truly no ex post review of contractual duties after contract formation.”³⁷ This is because blockchain crowdsources the transaction, thus eliminating the threat of counterparty control and the option to frustrate performance.³⁸ One cannot deny that “humans, especially bankers and judges, are seen as fallible and not trustworthy.”³⁹ This consensus gentium is fuelled by the possibility of unconscious bias by the judiciary when resolving disputes and the drive of financial institutions to maximise profit. On the other hand, technology is “objective, infallible and trustworthy.”⁴⁰ The computer merely executes a code, acting without the influence of opinions, emotions, or unintentional biases. Consequently, counterparties may find themselves switching to smart contracting, especially if they are wary of counterparty or external interference with the performance of the contract. The “trustless” blockchain network addresses these concerns “because it creates and confirms a certain state of affairs and replaces the need to trust third parties with the ability to trust the technology itself.”⁴¹

This line of argument demonstrates that “blockchain technology renders the execution of smart contracts truly unstoppable, which means that, in the absence of built-in circuit breakers, all human discretion is excised from the execution and enforcement of contractual duties.”⁴² Nevertheless, one may reasonably question whether this direction is desirable: for example, should legal interpretations be crowdsourced rather than rely on expert judges? Blockchain has proven to be a critical facilitator of the increased reliance on smart contracts, mainly due to the decentralised advantages it offers. Nevertheless, it is an open secret amongst individuals in the industry that blockchain is not as independent as it may seem. In fact, data demonstrates that five large corporations control the majority of the mining process through their mining pools and generate billions in revenue.⁴³ A network cannot be truly decentralised if the majority of the process is conducted by a handful of corporations. The centralisation of the mining process and control over the blockchain network by these corporations may act as a disincentive for counterparties to opt for smart contracting. As a corollary, this also destabilises the balance between the efficiency gains generated by smart contracting and their lack of agency. Even though smart contracts eliminate external interference, by placing the

³⁴ Raskin, 2017.

³⁵ Stark, 2016.

³⁶ Werbach & Cornell, 2017.

³⁷ Paech, P. (2017). The governance of blockchain financial networks. *The Modern Law Review*, 80(6), 1073–1110. <https://doi.org/10.1111/1468-2230.12303>

³⁸ Cutts, 2019.

³⁹ Mik, E. (2017). Smart contracts: Terminology, technical limitations and real world complexity. *Law, Innovation and Technology*, 9(2), 269–300. <https://doi.org/10.1080/17579961.2017.1378468>

⁴⁰ Mik, 2017.

⁴¹ Mik, 2017.

⁴² Paech, 2017.

⁴³ CINDX. (2018, September 1). *Top-5 largest bitcoin mining firms in the world*. <https://medium.com/@cindx/top-5-largest-bitcoin-mining-firms-in-the-world-bb98a1537aad>

blockchain network in the hands of large corporations it can no longer be said that they truly lack agency. Rather, they fall prey to the control of these businesses. This inevitably hinders the displacement of the functionality of traditional contracts.

On the other hand, this may in fact address one major impediment to the widespread adoption of smart contracts. It has been argued that the blockchain network may not be equipped to cope with the potential scalability of smart contracts.⁴⁴ Similarly, Vos predicted smart contracts, when they eventually achieve wider adoption, will become essential in the financial services industry, thus urging the legal community to be prepared.⁴⁵ If there is a surge in the usage of smart contracts, it is not certain whether blockchain has the capacity to facilitate and verify every transaction. Yet, if control of the network rests with several industry giants, they may be able to coordinate and cope with the increased demand. Equally, legal practitioners must prepare and coordinate their efforts to ensure that they can respond to an influx of smart contract litigation. As a result, even though blockchain may not be as decentralised as it was envisaged to be, this could nevertheless facilitate the successful expansion of smart contracts rather than obstruct it. That successful expansion, however, is also contingent upon the blockchain network being safe itself.

The blockchain network portrays itself as an impenetrable environment to conduct transactions. Nonetheless, the Mt. Gox bitcoin exchange hack has demonstrated otherwise. In 2014, following a malicious hack, almost 850 000 bitcoins owned by customers and 100 000 owned by the exchange itself were raided by hackers. Inevitably, the exchange subsequently filed for bankruptcy.⁴⁶ Customers lost all their bitcoin investments along with their trust in the blockchain network. This indicates that contracting parties will be sceptical before choosing to engage in smart contracting. Consequently, it could also be argued that this undermines the scale of efficiency gains against the lack of agency. The blockchain network generates efficiencies for smart contracting parties as long as it remains safe and reliable. Nevertheless, such events prove that the network may be significantly exposed. If all smart contracting gains risk being diverted to malicious hackers, then there is no advantage generated by engaging in smart contracting at all.

The argument in favour of crowdsourcing legal interpretations is therefore already premised on unstable foundations. Blockchain offers a controversial decentralised network that may not be as impenetrable as developers suggest. Sklaroff contributes further to this debate, reasoning that “by shifting dispute resolution to an online system that relies on an ever-changing, unpredictable, unaccountable, and opaque group of decisionmakers, decentralised adjudication cannot generate contract public goods like performance standards, which emerge through the stable application of interpretation rules by courts.”⁴⁷ When delivering judgments, the judiciary shapes the law and provides certainty and clarity to counterparties to determine whether a course of action or inaction would be permissible under a contract. However, by crowdsourcing legal interpretations, the law is deprived of essential guidance and authority that would otherwise emerge from judicial decisions.

⁴⁴ Peters, G. W., & Panayi, E. (2015). Understanding modern banking ledgers through blockchain technologies: Future of transaction processing and smart contracts on the Internet of money. *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.2692487>

⁴⁵ Sir Vos, G. (2019, May 14). *Lawtech, smart contracts and artificial intelligence*. Bundesministerium der Justiz und für Verbraucherschutz [Ministry of Justice]. www.judiciary.uk/wp-content/uploads/2019/05/CHC-speech-LawTech-Smart-Contracts-and-Artificial-Intelligence.pdf

⁴⁶ Norry, A. (2020, March 31). *The history of the Mt Gox Hack: Bitcoin's biggest heist*. Blockonomi. <https://blockonomi.com/mt-gox-hack>

⁴⁷ Sklaroff, J. (2017). Smart contracts and the cost of inflexibility. *University of Pennsylvania Law Review*. 166(1), 263–303.

Closely linked to this argument is the notion that smart contracts merely provide technical contractual enforceability rather than legal enforceability. The judiciary ensures legal enforceability through awarding damages for non-performance to the complainant or legally ordering a performance in cases in which the complainant claims payment of a sum due.⁴⁸ In contrast, smart contracts fail to make this critical distinction. Smart contracts simply recognise that the execution of a contract entails contractual performance; they fail to contemplate for the possibility of legal enforceability through awarding damages. Therefore, by equating enforceability with perfect contractual performance, smart contracts deny counterparties damages that would have been traditionally awarded for non-performance. Overall, this supports the conclusion that the efficiency gains arising out of smart contracts may not be as fruitful when balanced against the lack of a centralised judicial authority to supervise, interpret, and enforce them.

The Potential Versatility of Smart Contracts

This work has demonstrated that smart contract practice is, at the very least, controversial. Nevertheless, this does not negate its effectiveness in a variety of transactions. The versatility of smart contracts as legal instruments suggests that they can be successfully relied upon in many circumstances. In acknowledging this potential, Mik remarked that “what started as a niche phenomenon in such areas as financial derivatives and prediction markets, is now poised to challenge the entire legal landscape and ‘revolutionise’ commerce.”⁴⁹ For example, Vos submitted that “[smart contracts] use in shipping, aviation, energy, telecoms and pharmaceuticals is predictable, because they can provide immutable data, providing huge advantages in terms of certainty and reducing the factual scope of everyday disputes.”⁵⁰ It is evident, therefore, that the potential application of smart contracts is vast.

More specifically, smart contracts could prove to be an invaluable tool in financial market transactions such as share transfers or derivatives contracts. Stark accurately submits that “articulating these contracts in code could allow financial markets to become more automated and simplify many process-intensive systems related to trading and servicing of financial instruments.”⁵¹ In such circumstances the efficiency gains arising from smart contracts trump the lack of agency. This due to the fact that financial transactions are widely used on a standardised basis by sophisticated counterparties and therefore the need for adjudication is minimal.

In addition, through guaranteed contractual performance, counterparty and settlement risks, which are deep-rooted in these contracts, are reduced or even eliminated.⁵² For example, it has been reported that the World Bank authorised CBA to issue a blockchain-based bond; that bond will be governed by smart contracts which will underlie and facilitate the bond transactions.⁵³ Paech observed that a smart contract underpinning a blockchain-based bond “automatically executes interest payments on the payment date, and the amount to be paid is determined on the basis of data retrieved from a predefined, reliable Internet source.”⁵⁴ This will incentivise greater activity in the

⁴⁸ Mik, 2017.

⁴⁹ Mik, 2017.

⁵⁰ Sir Vos, 2019.

⁵¹ Stark, 2016.

⁵² Paech, 2017.

⁵³ Global Banking & Finance Review. (2018, August 23). *Smart contracts and a future of financial operations*. www.globalbankingandfinance.com/smart-contracts-and-a-future-of-financial-operations

⁵⁴ Paech, 2017.

financial industry by reducing the risk of counterparties failing to make timely interest payments. Accordingly, through guaranteed performance and real-time execution, the CBA initiative may prove to be a catalyst in transforming the financial markets industry.

Similarly, smart contracts may also reduce dependence on financial market infrastructures such as CCPs and minimise the risk of default, thereby improving the financial services industry.⁵⁵ For example, in a transaction concerning security collateral held in a blockchain network, the smart contract could automatically transfer the securities to the creditor if the debtor has not paid on time.⁵⁶ Overall, this suggests that the benefits offered by the application of smart contracts in the financial industry are substantial. The lack of agency does not seem to impact the financial sector negatively; rather, the efficiencies generated promote the expansion of financial markets and contribute to the overall development of the economy.

Smart contracts can also be used to execute corporate governance rules, reinforcing the argument of versatility. Decentralised Autonomous Organisations (hereinafter “DAO”) use smart technology to execute corporate governance rules. Slock.it, a German blockchain startup, developed the open source coding framework for the DAO and ultimate control was granted to the shareholders on a blockchain. Slock.it envisioned “build[ing] a humanless venture capital firm that would allow the investors to make all the decisions through smart contracts. There would be no leaders, no authorities.”⁵⁷ This vision was founded on the idea that centralised and hierarchical organisations are inherently inefficient. This is because they lack flexibility to evolve, burdened with unnecessary administrative processes and often suffering from corruption.⁵⁸ Therefore, the thrust of DAOs lies in the belief that by granting directorial power to DAO owners, the ability of directors to misdirect and waste investors’ funds is eliminated. Indeed, the DAO contributed towards the removal of managerial costs⁵⁹ and provided a completely transparent process since everything was run by the code. The desirability of smart contracts in this context rests with their aim “to provide full transparency of the transaction and to grant a high degree of privacy contemporaneously.”⁶⁰ Consequently, they establish DAOs as autonomous and self-sufficient corporate governance tools, requiring users to place trust to the underlying code rather than the organisation itself.⁶¹ Overall, the DAO contributes to the conclusion that smart contracts are versatile legal instruments, offering valuable advantages that traditional contracts are simply not equipped to provide.

Errors in Smart Contract Code: The DAO Experience

Nevertheless, that is only part of the story. Soon after the DAO raised more than \$150 million, an individual discovered a loophole in the code and diverted almost \$70 million worth of ether.⁶² Raskin

⁵⁵ Lord Hodge. (2019). *The potential and perils of financial technology: Can the law adapt to cope?* The First Edinburgh FinTech Law Lecture. University of Edinburgh. www.supremecourt.uk/docs/speech-190314.pdf

⁵⁶ Paech, 2017.

⁵⁷ Kar, I., & Wong, J. I. (2016, July 18). *Everything you need to know about the Ethereum “hard fork”*. Quartz. <https://qz.com/730004/everything-you-need-to-know-about-the-ethereum-hard-fork>

⁵⁸ Atzori, M. (2017). Blockchain technology and decentralized governance: Is the state still necessary? *Journal of Governance and Regulation*, 6(1), 45–62. http://dx.doi.org/10.22495/jgr_v6_i1_p5

⁵⁹ Raskin, 2017.

⁶⁰ Janssen & Durovic, 2018.

⁶¹ Wright & De Filippi, 2015.

⁶² Madeira, A. (2019, March 12). *The DAO, the hack, the soft fork and the hard fork*. CryptoCompare. www.cryptocompare.com/coins/guides/the-dao-the-hack-the-soft-fork-and-the-hard-fork

observed that “the hacker did not hack” the code in a malicious way, but rather used the terms of the existing smart contracts to accomplish something others later found objectionable, i.e. the diversion of their money.⁶³ This demonstrates that smart contracts also suffer from material shortcomings. A mere error or vulnerability in the code may bring about systemic consequences. This is due to the fact that a single error harms every transaction conducted on that code, not only the isolated transaction. The DAO saga, therefore, represents a lacuna in smart contracting which merits greater consideration.

The aftermath of the DAO hack found developers divided. The funds could have been returned through a “hard-fork” which in essence forced developers to create a new smart contract with different rules to reimburse the stolen funds. The division was between proponents of fairness and justice who wanted to see the funds reverted back, versus the “code is king” purists who favoured adherence to the smart contracts’ programming. Eventually, the developers intervened using a “hard-fork” which, in turn, completely undermined the objective of DAO as a decentralised and immutable platform.⁶⁴ The DAO developers may have embarked on a “slippery slope” given that by intervening once they opened up the possibility of more interventions. Similarly, the supposed decentralised nature of the network gets undermined further when one considers the fact that, although DAO was an open source network, Slock.it had a considerable influence in its development.⁶⁵ This fuels the argument that the idea of a decentralised blockchain and the removal of the human element ex post is not an accurate representation of these technologies. It is therefore prudent to wonder that “if contracts held to be inviolable can effectively be overturned by a collective decision to run new software, what guarantee do financial institutions have that their transactions and funds are secure?”⁶⁶ The answer is none. This gets at the heart of the functionality of smart contracts. If financial institutions base all their transactions on these technologies, a decision to run new software would generate uncertainty and affect the value of these transactions, causing global systemic effects in financial markets.

It is evident that the systemic risks exposed by the DAO hack raise several concerns about the functionality of smart contracts. More broadly, the hack reveals that the foundational characteristics which make smart contracts attractive ought to be questioned. Unlike traditional contracts where parties may resort to courts to resolve disputes, the automaticity embedded in smart contracts means that the contract will be performed irreversibly, even though the code is prone to errors or exploitation. As a result, since “the possibility of computer errors affecting the manner in which the smart contract operates cannot be eliminated, it is impossible to claim that self-enforcement guarantees perfect performance.”⁶⁷ Inevitably, the outcome will not be one contemplated by the contracting parties, but the contract will be deemed as being performed to their detriment. This represents merely one, albeit fundamental, aspect of the inflexible nature of smart contracts.

The Inflexible Nature of Smart Contracting

It must be acknowledged that smart contract codes lack certain necessary human qualities that might prevent contracting parties from relying on smart contracts. Murray observed that smart contracts “attempt to remove the human elements of contextualization and perhaps even compassion

⁶³ Raskin, 2017.

⁶⁴ Kar & Wong, 2016.

⁶⁵ Janssen & Durovic, 2018.

⁶⁶ Kar & Wong, 2016.

⁶⁷ Mik, 2017.

or the concept of ‘justice’ as opposed to simply interpretation and enforcement from the process.”⁶⁸ Machines cannot develop a sense of empathy, fairness, or justice; with such qualities absent, parties may be reluctant to engage in smart contracting. The force of law lies in the power of the judiciary to apply flexible rules whilst also considering the surrounding circumstances such as the position and relationship of the contracting parties. In contrast, machines are ill-equipped to conduct such an assessment since they are “rigid, deterministic and insulated from their commercial context.”⁶⁹ Equally, machine learning has not reached the stage of understanding and enforcing natural language and is still limited to executing code. This limitation provided the foundation for Clack et al to doubt whether smart contracts are able to address the scenario of parties having a different understanding of the agreed terms.⁷⁰ By failing to grasp the meaning of a contractual term and strictly execute the code, the actual output of the smart contract may not be desirable, since it “may differ from the intentions of the parties.”⁷¹ This inadequacy is highlighted further when considering the situation of the smart contract code not being written by the parties themselves. In fact, Mik argued that the person writing the code may fail to correctly input the parties’ intentions and the parties, not being computer programmers, will not be able to verify the code themselves.⁷² As a result, machines will give effect to a smart contract even though the outcome is not desirable. Courts, on the other hand, through knowledge and experience, are able to assess the intention of the parties to a particular contract unlike machines. This inevitably supports the notion that smart contracts are inflexible self-enforcing instruments, whereas traditional contracts are more flexible.⁷³

It logically follows that opting for smart contracting requires “trade-offs between precision and certainty on one hand and ambiguity and flexibility on the other.”⁷⁴ This trade-off, however, is arguably made redundant if one unpacks further the inflexibility of smart contracting. Mik correctly recognised that “the elimination of human judgment and the automation of choice can easily evolve into a situation where the contracting parties effectively lose the ability to choose whether and how to exercise their rights.”⁷⁵ Smart contracting parties may, thus, find themselves bound to a contractual agreement that does not generate the rights that they intended to gain. If contracting parties take into account these concerns in their decision to opt for smart contracts, then it is likely that they will revert back to traditional contracts. Overall, this fuels the conclusion that the functionality of traditional methods has not been displaced by the emergence of smart contracts.

Ambiguity and Contractual Modification

The inflexible nature of smart contracts is underlined by two additional factors. Courts are unable to affect smart contract performance and the contracts themselves are not susceptible to modifications.⁷⁶ Commercial parties often conclude contracts on ambiguous terms because the cost of

⁶⁸ Murray, A. (2019). *Information technology law* (4th ed.). Oxford University Press.

⁶⁹ Mik, 2017.

⁷⁰ Clack, C. D., Bakshi V. A., & Braine L. (2016). *Smart contract templates: Foundations, design landscape and research directions*. arXiv. <http://arxiv.org/abs/1608.00771>

⁷¹ Raskin, 2017.

⁷² Mik, 2017.

⁷³ Janssen & Durovic, 2018.

⁷⁴ Mik, 2017.

⁷⁵ Mik, 2017.

⁷⁶ O’Shields, R. (2012). Smart contracts: Legal agreements for the blockchain. *North Carolina Banking Institute*, 21(1), 177-191. <https://scholarship.law.unc.edu/ncbi/vol21/iss1/11>

negotiating is too high or the contract itself is regarded as a mere formality and thus they decide not to agree on everything.⁷⁷ This poses an issue for smart contracting parties, since “humans are very good at working with ambiguity [whereas] machines are not.”⁷⁸ If there is an ambiguity in the code, it is hard to see how a smart contract can be executed. Courts in most jurisdictions recognise and give effect to imperfect contractual performance, yet a computer programme is unable to do so, since this possibility was not contemplated and recorded by the parties.⁷⁹ Consequently, this indicates that “smart contracts are not smart enough to adjust as events unfold”⁸⁰ given that they would be unable to cope with vague contract terms.

Furthermore, not only are smart contracts incapable of dealing with contractual ambiguity, but they are also unable to deal with contractual modification. If a traditional contract cannot be performed due to unforeseeable circumstances, non-performance is excused. The contract becomes frustrated in the event of an unanticipated occurrence that renders performance impossible, meaning that neither party incurs liability for non-performance.⁸¹ On the other hand, a smart contract cannot make sense of any contractual modification. The immutability of smart contracts prevents parties from modifying any contractual term and the possibility of any interference with performance is eliminated even in unprecedented circumstances⁸² (for example, how could one pre-empt in a contract the possibility of a respiratory virus dooming the world?). Nevertheless, a traditional contract could be modified or frustrated to take into account such unforeseeable circumstances, whereas a smart contract is not equipped to handle these situations, and thus the parties will have to fall back to traditional dispute resolution.⁸³

In an attempt to address this deficiency, Raskin offered two solutions to this problem: (i) a publicly available jurisdictional database which contracting parties can feed into the programme to remain updated on evolving legal rules; and (ii) ex post policing of the parties by placing the burden on the parties or their agents to update the code.⁸⁴ Even though these solutions seem viable, there have not yet been any attempts to implement them. More importantly, however, the question should be whether it is even desirable to adopt them. Ex post policing of a smart contract is arguably as inefficient as ex post reviews by courts and judges; this is because it would take time, effort and money to constantly review and update the code. Therefore, it is evident that the efficiency justifications for relying on smart contracts gradually start being eroded as soon as the impracticalities of their application are unpacked.

Paech offered a more practical solution to smart contract immutability. This involves a combination of smart and dumb contracts. Dumb contract terms would encompass parts of the agreement that are excluded from the blockchain and thus are modifiable. The rest of the agreement would be recorded on the blockchain and would be immutable.⁸⁵ Accordingly, this solution would allow parties to modify certain parts of the agreement and address the contractual implications of any unforesee-

⁷⁷ Levy, K. E. C. (2017). Book-smart, not street-smart: Blockchain-based smart contracts and the social workings of law. *Engaging Science, Technology, and Society*, 3, 1–15. <https://doi.org/10.17351/ests2017.107>

⁷⁸ Murray, 2019.

⁷⁹ Raskin, 2017.

⁸⁰ Werbach & Cornell, 2017.

⁸¹ *Taylor v. Caldwell*, EWHC QB J1 (1863).

⁸² Paech, 2017.

⁸³ Xiao, D. (2016, June 18). *In bits we trust (?)*. Medium. <https://medium.com/@coriacetic/in-bits-we-trust-4e464b418f0b>

⁸⁴ Raskin, 2017.

⁸⁵ Paech, 2017.

able circumstances. On the other hand, one may reasonably submit that this is contrary to the heart and the spirit of smart contracting. Combining dumb and smart contracts would certainly take more time and may also contribute to increased costs. This would also create difficulties in determining what terms should fall within the smart or dumb part of the contract. Thus, this solution will generate inefficiencies which will disincentivise contracting parties from using smart contracts. After all, why would contracting parties opt for a combination of smart and dumb contracts when they could simply rely on a consistent and trustworthy traditional contract? Counterparties certainly prefer a contracting method that is easy, efficient, and cost-effective. Consequently, the solutions proposed to address smart contract modifications do not portray smart contracts as a viable alternative that can displace the functionality of traditional contracting.

Lastly, this argument is augmented if one explores the possibility that smart contracts may in fact generate greater costs than traditional contracts. Widespread adoption hinges upon the theory that smart contracts are efficient, inter alia eliminating drafting and litigation costs. Nonetheless, Sklaroff remarked that smart contracts may turn out to be more expensive and less efficient than traditional contracts. This argument is premised on the fact that smart contracts “must be written in precise, fully defined computer code; they are unmodifiable once executed; and they favour anonymous and one-off transactions.”⁸⁶ In contrast, traditional contracting practice is often straightforward and merely requires the skillset of an elementary lawyer. This supports the conclusion that smart contracts have not displaced adherence to traditional contracts, given that no active steps have been taken to ameliorate the difficulties they present.

Smart Contracts: Sound in Theory, Limited in Practice?

This essay has steadily demonstrated that, although smart contracts seem sound in theory, the complexities embedded in their execution limit their practice. If one examines various types of contractual arrangements and their possible translation to smart contracts, this picture becomes even clearer. For example, the obligation to exercise reasonable care and skill underpins the majority of goods and services contracts; if these are translated to smart contracts, “it may be difficult to reduce them to sequences of steps and to provide objective benchmarks against which they can be evaluated.”⁸⁷ Indeed, it is hard to imagine how a smart contract code can make a factual inquiry to determine whether reasonable care has been exercised and to evaluate what amounts to reasonable care in the circumstances. More generally, not all contractual terms can be deduced to computer code and fed into a machine,⁸⁸ hindering the predictions of widespread adoption put forwards by smart contract proponents. This implies that smart contracts are currently incapable of displacing outright the functionality of traditional contracts.

Furthermore, it could be argued that, even in those transactions that smart contracts ought to have been conducting flawlessly (such as financial instruments), the results have been disappointing. In 2016 Barclays tested a way to trade derivatives using smart contracts and blockchain technology, but despite this endeavour, that has not been implemented successfully⁸⁹; more crucially, had such a method been implemented, what would be the outcome if Barclays would remove itself from

⁸⁶ Sklaroff, J. (2017). Smart contracts and the cost of inflexibility. *University of Pennsylvania Law Review*, 166(1), 263–303.

⁸⁷ Mik, 2017.

⁸⁸ Mik, 2017.

⁸⁹ Allison, I. (2018, April 26). *Barclays, Goldman champion ISDA standard for blockchain derivatives*. CoinDesk. www.coindesk.com/barclays-goldman-champion-isd-standard-blockchain-derivatives

the transaction? Lord Hodge submitted that if financial institutions were to walk away from such transactions, that would have a systemic effect on the commercial world.⁹⁰ His Lordship therefore urged that “if there is to be a contract drafted or adapted by machines, there will have to be significant development to our law of contract which will require careful and imaginative consideration.”⁹¹ Nevertheless, even if such a contract law is adapted accordingly, the technology underlying smart contracts remains underdeveloped. Although a speculative technological advancement may address concerns regarding smart financial instruments, it does not address concerns in other transactions. Until artificial intelligence is developed significantly to be able to understand and enforce contractual terms, the effectiveness of smart contracts remains disappointing. As a result, current efforts to utilise smart contracts in areas such as real estate or intellectual property provide a false sense of hope given that the technology itself must be brought up to speed.

This naturally leads to the last shortcoming. Even in areas in which smart contracts are successfully relied upon and operate efficiently, they may fall short of providing adequate protection to contracting parties. Smart contracts are not set to render the contract void or non-enforceable if one of the contracting parties is, for example, a victim of duress, misrepresentation, or undue influence of its counterparty.⁹² Similarly, there is no evidence to suggest that smart contracting parties are guarded from unfair contract terms which would otherwise be subject to a statutory test of reasonableness.⁹³ In addition, smart contracting provides a limited, possibly non-existent, remedial infrastructure. Cutts correctly submitted that parties have to rely on their counterparties to remedy any wrong, and that is also contingent upon parties knowing the identity of their counterparty, which will not often be the case.⁹⁴ Hence, Cutts concluded that “without the many safeguards implemented by traditional intermediaries, parties are more exposed to harm, and without the remedial mechanisms of intermediation, most parties will be wholly unable to fix that harm.”⁹⁵ This is a realistic conclusion given that there is no incentive for the wrongdoer to remedy the wrong, especially if they have no connection to the counterparty. Overall, by failing to shield counterparties from harm, smart contracts merely represent a useful innovation in limited transactions rather than providing a viable alternative to traditional contracts.

Concluding Remarks

The reality is that smart contracts have not managed to acquire the widespread adoption that many programmers, lawyers, and academics predicted. Rather, “so far smart contracts have mostly been focused on transactions involving financial instruments and investment instruments as these tend to be more easily reducible to code.”⁹⁶ In line with various academics and the UKJT, this essay took the view that smart contracts carry the same legal validity as traditional contracts. Additionally, it has been acknowledged that the automaticity and self-enforcement advantages provided by smart contracts certainly amplify the scope of certain commercial transactions. Through utilising block-

⁹⁰ Lord Hodge, 2019.

⁹¹ Lord Hodge, 2019.

⁹² Wright & De Filippi, 2015.

⁹³ Unfair Contract Terms Act (1977).

⁹⁴ Cutts, T. (2019). Smart contracts and consumers. *West Virginia Law Review*, 122(2), 389–446. <https://researchrepository.wvu.edu/wvlr/vol122/iss2/4>

⁹⁵ Cutts, 2019.

⁹⁶ Murray, 2019.

chain technology, smart contracts have established themselves as prominent legal instruments; however, the inherent limitations of the blockchain network, which undermine both its immutability and decentralisation benefits, preclude smart contracts from achieving their full potential. Although they may have a potentially versatile application, smart contracts have not been so successful as to disrupt society's preference for traditional contracting. Individuals trust the court process and the protections guaranteed by the legal system. Machines, on the other hand, are susceptible to errors, exploitation, and hacking. They are unable to process natural language or provide solutions to code ambiguities and contractual modifications. Importantly, they also fail to protect contracting parties from counterparty wrongdoing. Overall, the underlying technology is relatively underdeveloped to fully function at its envisaged applications of smart contracting. This essay, therefore, supports the view that "smart contracts may or may not transform the world, but they provide real benefits and seem likely to enjoy significant adoption over time ... they will not, however, replace contract law."⁹⁷ This is because smart contracts are currently limited to performing a different function to traditional contracts. The former guarantees technical contractual enforceability, whilst the latter provides legal enforceability by looking backwards to recognise and remedy grievances.⁹⁸ Consequently, it is prudent to conclude that smart contracts currently serve as a supplement to traditional contracting and the road towards displacing traditional contract practice is uphill. Nonetheless, it is never too early to prepare for the upcoming smart contract revolution, and "the real prize will be to persuade the coders to include a simple English law and UK jurisdiction clause in their algorithmic engagements."⁹⁹

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⁹⁷ Werbach & Cornell, 2017.

⁹⁸ Janssen & Durovic, 2018.

⁹⁹ Sir Vos, G. (2019, November 12). *Future proofing for commercial lawyers in an unpredictable world. Annual Combar Lecture 2019*. The Commercial Bar Association. www.judiciary.uk/wp-content/uploads/2019/11/COMBAR.lecture2019.final_.pdf