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Smart Contracts: A Remedial Analysis

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Keywords: Smart Contracts; Blockchain; Technology; Contract; Remedy; Restitution; Equity

Abstract

The perpetual script of a smart contract, that executes an agreement machine-to-machine without prejudice, guarantees performance of 'contractual terms' enabling the exchange or transaction of cryptoassets and other forms of property. Yet, smart contracts as recognisable or valid legal instruments within the boundaries of contract or property law remain uncertain and contentious. Contrary to perceptions of contractual streamlining and efficiency, understanding the uncertainty smart contracts produce lies in the technology's failure to meet many of the fundamental principles of contract law and theory concerning, for example, breach of promise and remedy for breach. Smart contracts appear to reduce contracting to a form and standard well below that developed by contract law and theory over many centuries in both civil and common law jurisdictions. Including elements of the law of restitution, this article's remedial analysis will examine smart contracts considering 'traditional' contract law to understand and, where possible, test the legal legitimacy of this post-human technology, and explore the potential of smart contracts to supplement or, in time, supersede traditional contract law.

Introduction

Traditional contracts are described as agreements creating obligations enforceable by law[1], or as the law 'based on liability for breach of promise'[2]. At the heart of such definitions is the implication that contracting does not only involve the creation of cross-party obligations but also the need to provide mechanisms when promises are not performed, or expectations based on a promise are not met. Contract law is, in other words, an imperfect and imprecise legal institution and process that co-exists with constant threats of transactional frustration and

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* Senior Lecturer in Law. This article was presented at the SLSA 2019 as 'Smart Contract Performance and the Rise of Restitution'. The author would like to thank the organisers of the Information Technology, Law and Cyberspace stream, and the participants of the stream for their invaluable questions and feedback on the subject matter of the article. The article continues the author's legal survey of blockchain applications and develops themes discussed in the EU Commission's Blockchain Observatory & Forum draft report *Legal Recognition of Blockchain Registries and Smart Contracts*, published December 2018. https://www.eublockchainforum.eu/knowledge (accessed 24 April 2019).

[1] Quoting an 'elegant definition' derived from Cornell Law School to begin his analysis of smart contracts, Adam Greenfield relies on this definition. (Adam Greenfield. 2018. Radical Technologies: The Design of Everyday Life. London: Verso, p.151). The definition echoes that set out in the Proposed Regulation on a Common European Sales Law, which defines 'contract' as 'an agreement intended to give rise to obligations or other legal effects' (Hugh Beale (ed.) 2018. *Chitty on Contracts*. 33rd Edition. London: Sweet & Maxwell, at 1-025)

[2] H.G. Beale, W.D. Bishop, and M.P. Furmston. 2008. *Contract Cases and Materials*. 5th Edition. Oxford: Oxford University Press, p.3

failure. This claim can be made with confidence because, like all law, the shear weight of case-law and legislation accrued over the centuries in common and civil law jurisdictions alike, required *inter alia* to tidy-up contract formation and deal with contractual processes that go wrong by providing remedies, shows it to be so.

Evolution and reform of contract law and theory to meet the shortcomings of contracting practices never ceases. In the midst of the twenty-first century information age that evolution has brought the institution to what is arguably a key stage in its modern evolution with the emergence of so-called "smart contracts". This stage, if indeed it proves to be sufficiently transformative to warrant a "stage", may be characterised, succinctly, as a technological and post-human "solution" to "problems" of traditional contract law caused by the messiness of human dealings. Problems that are *inherently human* and which technologies are directed towards mitigating or preventing. Post-humanism in this context 'implies that law, or control, which was generally perceived as something outside of both individual humanity and individual things instead may be designed into objects or even entire environments', maintains Jannice Käll, in an echo of the work of Donna Haraway and Gilles Deleuze[3]. Käll continues, bringing the matter back into the realm of smart contract definition, that this 'type of law embedded into products is a typical effect of automated or 'smart' objects, as the rules for how they communicate with each other are coded into the objects themselves'[4]. By focusing on remedies, including elements of the law of restitution, this article's remedial analysis will examine smart contracts in light of "traditional" contract law with the aim of understanding and, where possible, testing the legal legitimacy of this post-human technology. Furthermore, with the aim of exploring and understanding the potential of smart contracts to supplement or, in time, supersede traditional contract law.

[3] Jannice Käll. 2018. Blockchain Control. *Law & Critique*. Vol. 29, Issue 2 (July), p.136
[4] Käll, 2018, p.136

Smart contracts might be considered ideal insofar as they appear impervious to the vagaries of classical agreement-making and help assuage counterparty concerns over the risks of performance. If something is too good to be true, however, it almost certainly is. In truth, smart contracts are far from ideal because they do not defeat either latent problems in traditional or existing agreement-making, or risks concerning performance. Perhaps above all, it is the far-reaching insistence and adaptability of a variety of remedies available to parties when agreements fail that makes traditional contracting more that the mere execution of a transaction. The threat of errors and bugs in smart contract design makes it prudent for the technology not to exceed basic agreements, but this means they continue to be incapable of reflecting the depth and variety of contract law and theory[5]. Of course, it is absurd and untrue to say that traditional contract drafting does not suffer from errors, but that is precisely why remedies play such a vital role in the overall landscape of contract law, and why they matter, equally, in the domain of smart contracts.

Smart contracts as representative of a posthuman, techno-legal utopia is not exactly where we find ourselves, however. As if to highlight this fact it is abundantly clear that smart contracts (like many "smart" technologies) are riddled with bugs that pose what Werbach and Cornell suggest is a 'significant limitation in replacing human enforcement of agreements with software running on the blockchain'; things, they rightly say, 'simply do not always go according to plan'[6]. Consequently, the opportunity to change or stop electronic agreements that cease to reflect the consent or reasonable expectations (good faith) of the parties seems more important than ever, especially regarding one of the most significant consequences of rescission, namely, treating the contract as though it never came into existence[7]. Furthermore,

[5] The Consensys Github page dealing with Ethereum smart contract best practice suggests that designers keep contracts simple because 'complexity increases the likelihood of errors' (https://consensys.github.io/smart-contract-best-practices/general_philosophy/ (accessed 4 February 2019))
[6] Kevin Werbach and Nicolas Cornell. 2017. Contracts Ex Machina. 67 *Duke Law Journal* 313, p.365
[7] As per Lord Wilberforce in *Johnson v Agnew* [1980] AC 367

remedial orders such as rescission that enable the unwinding of agreements are common sense not an inefficient burden on the path of techno-legal progress[8].

Definitions

Above I briefly introduced smart contracts through characterisation of the technology, if not precisely a definition, which demonstrates tensions between messy, human "traditional" contract law and theory (the "problem") and technological, post-human "smart" contracts (the "solution"). Judgment on character is important, I claim, because the rush to (attempted) definition of smart contracts risks overlooking the salience of the problem/solution dichotomy established as a new frontier of techno-legal thought and practice. Moving forward, therefore, the working definitions of smart contracts discussed here, which are vital to any critique, remain linked indelibly to the issue of character. To that end, smart contracts fall into two broad categories that reflect different depths of legal character and definition. Firstly, disclaimers of the functional legality of smart contracts in favour of a status as programming conventions: 'Although the word "contract" is used in the DAO's framework code, the term is a programming convention and is not being used as a legal term of art. The term is a programming convention, not a representation that the code is in and of itself a legally binding and enforceable contract'[9]. Ethereum founder Vitalik Buterin, speaking in 2016, maintained that, 'a smart contract is a computer programme that directly controls some digital asset'[10] - a definition that recalls the causality of algorithms ("if x, then y"). Yet, it is a causality unfamiliar to traditions of contract (as well as property) law and theory, in which the contingency of inter-

[8] Cardozo J in his judgement in the New York Court of Appeals in *Beatty v Guggenheim Exploration Co* (1919) 225 NY 380 maintained: 'Those who make a contract, may unmake it. The clause which forbids a change, may be changed like any other. The prohibition of oral waiver, may itself be waived. Every such agreement is ended by the new one which contradicts it'.

[9] Slockit/DAO. Decentralized Autonomous Organization (DAO) Framework. https://github.com/slockit/DAO (accessed 1 February 2019)

[10] Vital Buterin. 2016. "Panel 1: Law 2.0 Understanding Smart Contracts". *Chamber of Digital Commerce*. 8th November. https://www.youtube.com/watch?time_continue=463&v=ZuHZOryZ_f0 (accessed 9 November 2018)

party negotiations forms the backdrop to contractual processes[11]. Further, definitions of smart contracts that eschew any explicit legal character or framework at all, thereby foregrounding the question of why legal status should be attributable to them at all, for example: 'A piece of EVM [Ethereum Virtual Machine] Code that may be associated with an Account or an Autonomous Object'[12].

But disclaimers and non-legal definitions do not dispel the fact that, as instruments of promise and agreement, smart contracts produce legal effects that may need to be enforced. Hence, secondly, we find a spectrum of definitions that take the legality of smart contracts seriously. For example, as described in a new blockchain Act in the Illinois General Assembly: 'a contract stored as an electronic record which is verified by the use of a blockchain'[13]. At first blush this suggests that a smart contract is nothing other than a record of a contract existing outside of any system or network, which could mean a traditional contract written to and verified by a blockchain, or, indeed, a hash of a promissory note or even an agreement written on a napkin, scanned, recorded, and verified on a blockchain[14]. In this instance a blockchain does not make the contract any smarter than a conventional contract and may better be described akin to a clerk maintaining a database of contracts, rather than a bottom-up redefinition of contract law. The contract itself does not rely on blockchain to bring it into existence and as such is as likely to be a traditional contract as one deserving of the prefix "smart".

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[11] A case in point is *incomplete contracts*. Complete contracts are 'contracts where everything that can ever happen is written into the contract. There may be some incentive constraints arising from moral hazard or asymmetric information but there are no unanticipated contingencies. Actual contracts are not like this, as lawyers have realized for a long time. They are poorly worded, ambiguous, and leave out important things. They are incomplete' (Oliver Hart. 2016. *Incomplete Contracts and Control*. Nobel Prize Lecture. 8 December. https://www.nobelprize.org/uploads/2018/06/hart-lecture.pdf (accessed 16 November 2018), pp. 372-373). See also: Scott and Triantis. 2006.

[12] Micah Dameron. 2019. *Beigepaper: An Ethereum Technical Specification*. https://github.com/chronaeon/beigepaper/blob/master/beigepaper.pdf (accessed 2 April 2019)

[13] *IL-HB553 Blockchain Technology Act*. http://www.ilga.gov/legislation/ (accessed 9 November 2018)

[14] This echoes what is referred to in the joint Linklaters and International Swaps and Derivatives Association (ISDA) whitepaper, *Smart Contracts and Distributed Ledger – A Legal Perspective*, as the "external model". https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf (accessed 12 November 2019)

The Wyoming State legislature, in a draft Bill on digital assets, adopts an approach to definition that appears to apply legal parameters to Buterin's definition: '"smart contract" means an automated transaction […] or any substantially similar analogue, which is comprised of code, script or programming language that executes the terms of an agreement, and which may include taking custody of and transferring an asset, or issuing executable instructions for these actions, based on the occurrence or nonoccurrence of specified conditions'[15]. Similarly, the wording applied by the Arizona State Legislature takes a rigorous techno-legal approach: '"Smart contract" means an event-driven program, with state, that runs on a distributed, decentralized, shared and replicated ledger and that can take custody over and instruct transfer of assets on that ledger'[16]. Meanwhile, the law firm Norton Rose Fulbright add important legal qualifications in their definition: 'Smart contracts will often be used to document bilateral obligations between a User and a Counterparty. Smart contracts inherently deal with issues of evidence and intention that are behind some formality requirements – but, until legal systems add rules dealing specifically with smart contract, these formalities will still need to be satisfied'[17].

New Wine in Old Bottles?

Initial conceptualizations of smart contracts maintained that the two variations, smart and traditional, were not necessarily expected to perform the same tasks and, therefore, achieve the same legal outcomes[18]. This raises two fundamental issues, both of which question adoption of problem/solution approaches to smart contract design and development: firstly, if smart

[15] *Senate File No. SF0125 - Digital assets-existing law.* https://www.wyoleg.gov/Legislation/2019/SF0125 (accessed 4 February 2019)
[16] Title 44 – Trade and Commerce, Chapter 26: Electronic Transactions, Article 5, 44-7061. *Arizona Revised Statutes*. https://www.azleg.gov/arsDetail/?title=44 (accessed 9 November 2018)
[17] Adam Sanitt and Ian Grigg. 2018. Legal analysis of the governed blockchain. *Norton Rose Fulbright*. http://www.nortonrosefulbright.com/knowledge/publications/167968/legal-analysis-of-the-governed-blockchain (accessed 9 November 2018)
[18] Nick Szabo. 1997. Formalizing and Securing Relationships on Public Networks. *First Monday*, Vol. 2, No. 9 (September). https://firstmonday.org/ojs/index.php/fm/article/view/548/469-publisher=First (accessed 12 November 2018)

contracts are not challenging, or are incapable of challenging, traditional contract law and theory, then what is the point of them? Secondly, smart contracts may prove little more than a niche intervention that will improve cost effectiveness and efficiency in a limited array of contractual scenarios. Looking across both issues, Massimiliano Granieri claims that, 'the massive emergence of technology in the realm of contracts and contract law has been interpreted mainly in terms of transaction costs reduction, since technology is instrumental to form agreements in a more expeditious way, regardless of the distance between contractors'[19].

If smart contracts are tailored solely towards efficiency gains but d not fundamentally change the character of existing contracting forms and practices, therefore, it is perhaps correct to view them as a subtle evolution of very particular types of agreement-making. For instance, where do smart contracts sit in relation to bargained-for-exchange transaction contracts and standard form contracts, otherwise known as "boilerplate". The suggestion here is that smart contracts are more like, and certainly in the immature form we presently find them, boilerplate than complex varieties of contract that rely on more contingent flexibility. But smart contracts as boilerplate inherit and risk the proliferation of a range of issues that surround such agreements. Margaret Jane Radin points to a fundamental consumer concern with boilerplate which, I suggest, could equally describe smart contracts, not least because the context in which boilerplate agreements are most pervasive is online or in peer-to-peer digital networks. Radin states that, 'many of the interactions that are called "contracts" these days are very far from the traditional notion of contract, the idea of bargained exchange by free choice, that still holds sway in our imaginations. Contract reality belies contract theory in many situations where

[19] Massimiliano Granieri. 2017. Technological Contracts. *Comparative Contract Law*. Edited by Pier Giuseppe Monateri. Cheltenham: Edward Elgar Publishing Ltd., p.408

consumers receive paperwork that purports to alter their legal rights. In these situations, contract theory becomes contract mythology'[20].

Contracts are best classified in and by context, with two broad taxonomies being consumer and commercial, both of which can be further subdivided depending on purpose, application, mode of regulation, and so on. There has long been a tension between consumer protectionism and the forces of market individualism, especially in English contract law, which has been instrumental in shaping modern contracting practices within capitalism in terms that support both consumer and commercial interests and demands[21]. It would be wrong, therefore, to think that technology will alleviate longstanding tensions. On the contrary, emerging as they do from a blockchain ecosystem built around the premise of enhancing individual and corporate economic and market engagement, smart contracts are more likely to amplify market individualism and exacerbate tensions presently in play.

This likelihood becomes more apparent when considering how smart contracts fit around determinations of *static* and *dynamic* market individualism, where the former maintains 'the principal function of contract law as being to establish a clear set of ground rules within which a market can operate'; and the latter, 'a more flexible approach, guided by the practices and expectations of the contracting community (particularly the commercial community)'[22]. As will be discussed later in this article, flexibility is not a strong attribute of smart contracts, although this is being addressed in a variety of ways in smart contract design. Accordingly, the relevance to smart contracts of the flexibility inherent in dynamic market individualism comes from the onus on market agility demanded by commercial actors. Coupled with the

[20] Margaret Jane Radin. 2014. *Boilerplate: The Fine Print, Vanishing Rights, and the Rule of Law*. Princeton: Princeton University Press, p.12
[21] See, for example, Michael Furmston (ed.). 2017. *The Law of Contract*. 6th Edition. London: LexisNexis, at 1.105
[22] *The Law of Contract*, 2017, at 1.108 and 1.109

market-supporting principles of static market individualism that can be coded into smart contracts, the ability of commercial (or private) market actors to process transactions at speed and with greater efficiency than traditional contracting is what potentially makes smart contracts an attractive option for securing future agreements.

Efficiency is, unquestioningly, a key definitional marker (and desirable attribute) of electronic agreements. On the one hand it describes an objective shift in technological function that continues to leave unadulterated human capabilities in its wake. On the other hand, it describes ideological determinations of socioeconomic primacy: what it means for society to be good begins with well-organized, systematic information management. Efficiency, therefore, can be and is defined and interpreted in a variety of ways by different actors. However, it is the brute capabilities of the "electronic" or "automated" to surpass human cognitive capacity and agility where efficiency makes its most obvious and impactful statements. In a 1995 article on the interrelationship between cognition and contract, Melvin Aron Eisenberg described how, while most actors did not want to expend significant amounts of energy or money on perfecting contracts, it was really a matter of human cognitive deficiency ('rational ignorance') that was a basis for flawed contracts, albeit flaws that were accepted as the norm[23]. '[O]ur abilities to process information and solve problems are constrained by limitations of computational ability, ability to calculate consequences, ability to organize and utilize memory, and the like', claimed Eisenberg, 'hence, actors will often process imperfectly even the information they do acquire. Such imperfections in human processing ability increase as decisions become more complex and involve more permutations'[24].

[23] Melvin Aron Eisenberg. 1995. The Limits of Cognition and the Limits of Contract. *Stanford Law Review*, Vol. 47 (January), p.214
[24] Eisenberg, 1995, p.214

A presumed efficiency gain, therefore, resides in the ability of smart contracts or other types of electronic agreement to solve the sorts of deficiencies Eisenberg highlights, and thus draw nearer to a perfect form of contract. Unfortunately, the type of perfection smart contracts is supposed to represent is only defined within limits that, I suggest, do not extend anywhere near the complexity required of contract law and theory. In other words, smart contracts represent a very limited statement on efficiency. Smart contracts are good at what they do and can undoubtedly surpass human cognition on the range of task and objectives set for them, but what they are designed to do is far too simple with respect to the demands of contract law. Where efficiency arguments in respect of smart contracts develop further, however, is in the ability for the agreements to be self-enforcing, in the sense that arbitration and litigation clauses can be included in the function of the contract, thus saving time and money on classic litigation issues of, for example, truth-finding[25].

Autonomous contracts

Lawyer and technologist Nick Szabo's introduction to smart contracts relied on the simple mechanism of a 'humble vending machine' to help define a new species of electronically enabled transaction[26]. In Szabo's scenario the contract relates to a basic and straightforward transaction between a human actor and a machine. Let's briefly revisit the scenario. The role the purchaser using the vending machine plays is two-fold: they select a desired product and insert money to cover its advertised price both as payment but more importantly to satisfy the necessary stage of contracting known as consideration. At which point the vending machine accepts and processes the payment, and where the payment matches the advertised price releases the product selected to the purchaser, in doing so the vending machine completes performance of the contract. Vending machines perform simple, automated and often seamless

[25] For an analysis of efficiency gains in contract design, see: Robert E. Scott and George G. Triantis. 2006. Anticipating Litigation in Contract Design. *Yale Law Journal*. Vol. 115, Issue 4 (January), pp.814-879
[26] Szabo, 1997

transactions. Yet such transactions leave open questions of enforcement if the machine fails to convey the product selected by a purchaser – something, as will be discussed shortly, which is of concern regarding restitutionary damages relating to unenforceable contracts. The vending machine/smart contract model accounts for unproblematic agreements and transactions properly performed, but not necessarily instances of mistake, illegality, indefiniteness, change of circumstances, or other traditional grounds for remedy and restitution.

A fundamental problem with the vending machine *qua* smart contract model is it ignores a truism at the heart of traditional contract law by seeking to redefine who or what are the basic stakeholders of the contracting process. Traditionally property does not contract, people do, but the categorical performance of smart contracts embedded in machine-to-machine property and asset transactions, which can be established but not necessarily overseen by parties to an agreement, turns the truism on its head and renders uncertain the nature of any liabilities that may accrue during the life of the contract. Another way to see this is that the electronic agreement makes rights vanish, as previously described by Radin regarding boilerplate. This truism turns on a significant presumption that embedding contracts in digitally controlled property or assets, as both Szabo and more recently Buterin have suggested, negates the possibility of breach of contract occurring, at least not within terms founded in principles of traditional contract law.

Asset embedded contracts aim to remove altogether or at best place at a safe distance from the performance of the agreement any problematic, frustrating self-interests of the parties. The parties instead set in motion the perpetual script of the agreement and await the desired outcome. Depending on the number of smart contracts involved (DAOs, as we shall see shortly, comprise bundles of smart contracts), this may constitute a single operation or multiple operations that need to be completed prior to the outcome and the point at which the agreement can, at law or in equity, be said to have been fully performed and therefore discharged. The

problem is, some if not all operations may be invisible to the parties because they occur machine-to-machine, an issue that will be amplified by AI and the ability for novel yet still invisible decisions to be made amid the performance of the agreement. Once again, does this not ensure, for at least one party, a vanishing of rights *a la* boilerplate? Radin maintains that the, 'notion that a coerced or deceptive or completely covert divestment of an entitlement [e.g. to money, property or a legal right] might qualify as a "contract" is paradoxical', and yet smart contracts operating behind the scenes, so to speak, whilst an elegantly utopian vision of contractual efficiency, do risk paradox of this kind[27].

Whilst there are obvious efficiency gains to be made from allowing autonomous or semi-autonomous machine-to-machine transactions from the point of view of traditional contract law embeddedness of this sort risks obfuscating and rendering uncertain the position of the parties with respect to a dispute. Together embeddedness and invisibility make it unclear upon what grounds a remedy could be found, or the form that remedy should take. Reflecting on this issue Kevin Werbach and Nicolas Cornell refer to a change in 'the posture of litigation'[28]. 'Rather than complaining parties seeking fulfilment of alleged promissory obligation', Werbach and Cornell explain, 'complaining parties will seek to undo or reverse completed transactions'[29]. This may certainly be one option, but others are equally possible as the following section of this article will discuss. Further, given the question-marks that presently surround smart contract legality, it is not unreasonable to suggest that the agreements smart contracts represent will adopt an extra-legal complexion rather than seek to adjust to the constraints of traditional contract law[30].

[27] Radin, 2014, p.19
[28] Werbach and Cornell, 2017, p.376
[29] Werbach and Cornell, 2017, p.376
[30] Preference for extra-legality is not a new posture in commercial (contractual) transactions. See, for example: Lisa Bernstein. 1992. Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry. *Journal of Legal Studies*. Vol. 21 (January), pp. 115-157

Szabo's account further concludes that: 'Smart contracts go beyond the vending machine in proposing to embed contracts in all sorts of property that is valuable and controlled by digital means. Smart contracts reference that property in a dynamic, often proactively enforced form, and provide much better observation and verification where proactive measures must fall short'[31]. The major caveat in Szabo's account is the need for property to be controlled by digital means. This raises the question of how effective smart contracts can be in a world where property is not controlled by digital means at all, or by digital means that are compatible or interoperable, or where there is a clear disjuncture between on- and off-line activities or motivations. This means it is not possible to guarantee that smart contracts can or will reasonably align with the real world to make them valid.

This is what is known as the "oracle problem", which relates to the legitimacy and viability of various data sources, as well as mechanisms for gathering and consolidating data such as readings from ambient or atmospheric sensors. For example, a meteorological station that can supply a smart contract with accurate weather data in instances of insurance claims against an airline for a cancelled flight. The oracle service ChainLink describe providing 'secure middleware' for smart contracts as requiring 'the use of multiple inputs to prove contractual performance, as well as multiple outputs to affect outside systems and/or send payment to complete the smart contract[32]. Importantly, the oracle problem poses questions of who or what ultimately controls and manages vital and potentially valuable input data in these instances. Realistically there are three common and largely unsurprising options: public state control; private individual or commercial control; or a hybrid of private/public control. To continue the example above, the Met Office, a part public part commercial meteorological company, may be deemed the oracle responsible for supplying weather data to the insurance industry for

[31] Szabo, 1997
[32] https://chain.link/features/ (accessed 30 November 2018)

a whole range of consumer contract claims, including storm damage to homes or disruption to sea or air freight.

Blockchains hold the key to further options, namely, decentralized autonomous organizations (DAOs) or corporations (DACs), although both remain modes of private, that is, non-state, data control and management[33]. A DAO can be described as a framework governed by code written immutably to the blockchain[34]. In effect a DAO is a bundle of smart contracts, each of which serves a purpose in creating and supporting the governance framework, including providing the means for value ('digital fuel') to be injected into (sent to and received by) the DAO for it to function and perform the project it has been chosen for[35]. The aim of a DAO is to formulate a prescribed governance initiative around a purpose or set of purposes, underscored by smart contracts, and without the need for human, operative interventions, and it is the governance capabilities that distinguish DAOs from mere crowdsourcing projects. As founder of Slockit, one of the initial developers of the DAO ideal, Christoph Jentzsch claims, a DAO 'stores ether and other Ethereum based tokens and transmits them based on the DAO's code. It does not do much else. It cannot build a product, write code or develop hardware. It requires a "Contractor" to accomplish these and other goals. A DAO selects a Contractor by accepting a Contractor's proposal'[36].

It will be noted that Jentzsch places *contractor* in quotes. This arguably distances structural smart contracts within DAOs from those associated with contractors, implying a two-tier contractual state in DAOs: one involving sets of instructions that the DAO relies on to function

[33] DAOs remain a prominent area of discussion and debate with respect to the future evolution of smart contract use, in spite of the fact that the notion was famously devalued in 2016 when a hack exploiting a software vulnerability drained a fund of approximately $50 million in cryptocurrency. From a legal standpoint the 'theft' from the fund did not arguably breach any rights (was not, therefore, a *de facto* fraudulent act) because the smart contract at the heart of the organization executed as it was supposed to.
[34] Slockit/DAO
[35] As a framework built on the Ethereum blockchain, a DAO requires the Ethereum cryptocurrency, Ether, to 'fuel' it. Christoph Jentzsch. Decentralized Autonomous Organization to Automate Governance: Final Draft - Under Review https://download.slock.it/public/DAO/WhitePaper.pdf pp.1-2.
[36] Jentzsch, p.2

as a coherent and valuable entity; the other a legally binding tendering arrangement involving something akin to traditional notions of offer and acceptance in contract law. Despite the inference of a legally enforceable arrangement however, the Slockit Github page, although it now appears to have been mothballed, is replete with disclaimers concerning the legal validity of smart contracts, such as: 'Your use of the Software does not, in and of itself, create a legally binding contract in any jurisdiction and does not establish a lawyer-client relationship. Your communication with a non-lawyer will not be subject to the attorney-client privilege and (depending on your jurisdiction) may not be entitled to protection as confidential communication'[37].

Whilst it is prudent for Slockit to include such disclaimers, the disclaimer itself does not necessarily negate the potential for a smart contract to have legal force if the parties to it intend it to be legally binding and enforceable[38]. This is a concern, not least because it reveals within DAO thinking, among other things, a fetishization of the perfectibility of the contractual form that sees agreements and promises, but not a realistic threat of breach or dispute, as the central point of interest in governance design. It does, in other words, recreate the sort of agreement considered absolute and inviolable, with what little negotiation there is allowed on individual (coded) terms or, indeed, the nature of the agreement, collapsing into a powerful yet highly contestable notion that promises, any promises, can or must never be broken. But like traditional contracts or other promissory formats and systems (fiat currency for example), the ultimate value of smart contracts must derive from both a belief and knowledge that others will accept them as part of a process of enforceable transaction and exchange that is never stable, meaning they can never be perfect or complete legal forms, only adjustable and porous modes of governance.

[37] Slockit/DAO
[38] At the time of writing there is no case law in England and Wales that has tested smart contracts in this way.

Within a DAO in which the making and executing of agreements becomes a perpetual, machine-to-machine task rendered invisible to human stakeholders, the question of whether stakeholders constitute promisees or promisors to most agreements, or only beneficiaries of a final, deliverable outcome, remains an open legal question. Traditional approaches to contract and remedy under such circumstances may be brought into question for the simple reason of the diminished role played by human actors and the way the DAO promotes remoteness that would ordinarily disqualify any or all claims for breach or failure to discharge the contract. But still, the legal validity of a smart contract or DAO ought to look at the nature of the agreement and the conduct the agreement creates. If it looks like a contract, and smells like a contract, it's probably a contract in the eyes of the law.

The persistence of remedies

> [I]t is not very meaningful to say that a promise is binding unless some further explanation is given of what sort of remedy is offered for its breach[39].

The following remedial analysis of smart contracts will consider two areas, rectification and rescission. In discussing rectification and rescission the aim here is not to rehearse in-depth the nature or conventions of either doctrine. Instead the focus will be on those elements that advance an understanding of what is legally required from smart contracts, including suitable regard for the principles of equity, to ensure the thorough review of promises and to allow for the full range of interventions in case of procedural unfairness or mistake[40]. Again, this can be seen, fundamentally, as a commentary on the inflexibility of smart contracts that do not adhere to contract law and theory, but instead only privilege the moment of agreement. As Bill Marino and Ari Juels have suggested: 'security mechanisms form the archstone in the promise of smart contracts to transcend analog contracts. The problem, however, is that securing contracts

[39] P. S. Atiyah. 1985. *The Rise and Fall of Freedom of Contract*. Oxford: Oxford University Press, p.653

[40] Worthington, 2006, pp.199-226. For more on the relationship between equitable principles and blockchain applications see: Robert Herian. 2017. Blockchain and the (re)imagining of trusts jurisprudence. *Strategic Change: Briefings in Entrepreneurial Finance*, 26(5) pp. 453–460.

against disruption for the purposes of breach often means securing them against disruption of any sort. And that is not always a desirable result'[41]. There are two main questions that underpin the following discussion, both of which reflect on the conditions dictating whether or not a smart contract ought to be treated differently from a conventional contract in the eyes of the law: firstly, how should the courts view the failure of a smart contract to achieve the intended aims of the parties; and secondly, what does it mean to breach a smart contract?

Rectification is an equitable rather than common law remedy that enables the court to amend a contract by focusing specifically on a mistake common to both parties and which means that the agreement runs contrary to the intention of the parties[42]. The nature and operation of rectification can be described as follows:

> Rectification is a discretionary equitable remedy whereby an instrument which does not accord with the intentions of the parties to it may be corrected. It must be emphasised that the court does not rectify a mistake in the contract itself, but only a mistake in the instrument recording the contract (or other transaction). It must be very clearly shown that the parties had come to a genuine agreement and that the instrument had failed to record it. When rectification is ordered, a copy of the order may be indorsed on the instrument. There is no need to execute a new document. Rectification is retrospective, and affects steps taken by the parties in the meantime. But the instrument remains binding in its uncorrected form until rectification is actually ordered[43].

[41] Bill Marino and Ari Juels. 2016. *Setting Standards for Altering and Undoing Smart Contracts*. https://www.arijuels.com/publications/ (accessed 1 April 2019)
[42] *Murray v Parker* (1854) 19 Beav. 305; *Fowler v Fowler* (1859) 4 De G. & J. 250; *Webster v Cecil* (1861) 30 Beav. 62; *Craddock Bros v Hunt* [1923] 2 Ch. 136; *Day v Day* [2013] EWCA Civ 280
[43] Jill E. Martin. 2012. *Modern Equity*. 19th Edition. London: Sweet & Maxwell, pp.914-915

There is much in this short description to consider. Firstly, mistakes as to the agreement are not the focus of rectification, only the mistakes in the record of the agreement. Key to the nature and operations of smart contracts is not simply that they record an agreement, but that they have the capacity to perform that agreement in whatever form is intended. The remedy in relation to smart contracts must initially tackle mistakes in the code or programming as it would tackle mistakes in the drafting of a conventional contract. This does not seem untoward or unreasonable where the smart contract reflects a straightforward, single transaction between parties, such as the purchase of a chattel. In such cases any mistake in the code of the smart contract which leads to an outcome not consented to or intended by the parties – the purchase of a red car but delivery of a black car for example – could be rectified with little or no dispute concerning the validity of the remedy.

The same cannot necessarily be said where a mistake (or bug) in the code of a genesis instrument produces a variety of unintended outcomes in the subsequent agreements performed semi- or fully autonomously, such as those fulfilled machine-to-machine for instance as part of a DAO. Nor where a mode of machine learning reinterprets the nature of the agreement once execution has already begun, and, therefore, any mistake as it is commonly understood in the doctrine of conventional rectification cannot necessarily be traced to a genesis instrument at all. Common sense dictates that the contract related to the genesis instrument remains the target for remedy in both cases, but in the latter context the notion of consent, as well as intention, is obfuscated, especially once AI becomes an explicit and defining factor in contractual processes. Would it be correct to say that the "intention" manifested by AI or less advanced algorithmic machine learning reflects the intentions of the parties to the contractual process? If the answer is yes, then it would presuppose that the intention of human actors (the promissee and promisor for example) must reside in a reasonable knowledge or expectation of the outcome produced by, what is in effect, alien intelligence. If machine learning does not

advance beyond merely improving instrumental bureaucratic efficiencies, however, then it might be reasonable to suggest that human insight into the nature of the intention underpinning that bureaucratic process did, indeed, continue to reflect human consent and intention.

The fundamental benefits of AI and lessor forms of machine learning turn on far more than bureaucratic efficiency, however. Instead they express an ability to recognise patterns and make subsequent decisions that exceed the capabilities of human actors in terms of speed, accuracy and scale. The initial data set that an AI relies on may well be human in origin, for example AI contract formation may well begin via an analysis of millions of discharged or existing contracts as well as case law dealing with a wide variety of contractual disputes. However, as demonstrated by AlphaGo, the Deep Mind AI designed to play the ancient board-game Go, once human data-sets have been exhausted an AI can continue to develop and evolve by relying on its own knowledge and experience[44]. Hence the nature of the intention manifest in advanced AI systems such as AlphaGo can no longer be called human because its source material is no longer human. This example may seem far-fetched given the present state of smart contracts, but it is indicative of the ways in which intelligent technologies can frustrate the foundational characteristics of human legal doctrine and, perhaps more importantly, the processes and procedures which apply that doctrine.

As a remedy predicated on the mistake of the record, rectification may begin with fundamental errors in contract drafting easily reproduced in the smart contract context due to errors in coding. Unlike traditional contracts, however, mistakes in smart contracts can be exacerbated by the architecture in which smart contracts operate, namely, the blockchain. A blockchain provides a highly reliable witness to events, documents, or instruments such as contracts due

[44] James Vincent. 2017. DeepMind's Go-playing AI doesn't need human help to beat us anymore. *The Verge*, 18 October. https://www.theverge.com/2017/10/18/16495548/deepmind-ai-go-alphago-zero-self-taught (accessed 1 February 2019)

to the distributed way the record simultaneously updates across nodes, and because they rely on hash functions, timestamping, and cryptography for security and pseudonymity[45]. While it is debatable that a blockchain is completely immutable or, indeed, that timestamping provides an entirely precise record of events, as a database a blockchain is nevertheless highly tamper-proof relative to other forms of electronic data storage, and to hack, change, or rectify a record is virtually impossible at present[46]. These sorts of features have been mooted as the basis of a new and radical form of transparency for the contemporary digital age[47]. Equally, however, it causes concern regarding privacy law, including the right to erasure of personal data (the "right to be forgotten") enshrined in the European Union's General Data Protection Regulation (GDPR). Quite simply a threat lies in the perpetuity of the data record and the fact that this could undermine the legal legitimacy of the record, rather than strengthen it[48].

In the case of a contract subject to an order for rectification a similar concern arises. Returning to the outline of rectification given above we can see a notable temporal characteristic at its heart: 'Rectification is *retrospective*, and affects steps taken by the parties *in the meantime*. But the instrument remains binding in its uncorrected form *until rectification is actually ordered*' [emphasis added]. Applying the remedy to smart contracts on these terms poses the obvious problem that rectification will be incapable of erasing any former version or versions

[45] Herian, 2018, pp.18-25

[46] For instance, a contract written in the Ethereum programming code, Solidity, will not timestamp a transaction, and therefore timestamping only occurs once the block containing the contract is mined on the blockchain. Consequently, it has been suggested that miners, whose aim is to verify information or documentation appended to blockchain, can 'influence the time of execution of a transaction within a margin of several seconds', which can make timestamping imprecise (https://consensys.github.io/smart-contract-best-practices/general_philosophy/ (accessed 4 February 2019)

[47] See, for example: The Economist. 2015. The trust machine, 31 October–6 November; Don Tapscott and Alex Tapscott. 2016. *Blockchain Revolution: How the Technology behind Bitcoin is Changing Money, Business and the World*. London: Portfolio Penguin; Rachel Botsman. 2017. *Who Can You Trust? How Technology Brought Us Together – and Why It Could Drive Us Apart*. London: Portfolio Penguin; Michael J. Casey and Paul Vigna. 2018. *The Truth Machine: The Blockchain and the Future of Everything*. London: HarperCollins

[48] For example, where a blockchain record and the physical reality the record represents diverge over time until the two no longer reasonably correspond. Moreover, perpetuity has long been of concern in law, notably in the law of trusts, where time limitations on property held on trust are enforced in order 'to restrict the extent to which future vesting could be postponed' (Martin, 2012, p.379)

of a disputed instrument. Moreover, whereas 'there is no need to execute a new document' in a conventional order for rectification, there can be no choice but to code and execute a new version to countermand (over-write) a mistaken smart contract. Issues of time and temporality are hardly new concerns for the courts, especially when it comes to ascertaining the order in which disputed events occurred, money was transacted, or legal instruments executed. But the multiplicity and potential proliferation of evidential documentation and the semi- or full autonomy of smart contracting could prove difficult for courts to monitor. Indeed, it would almost certainly require additional remedial or monitoring technologies rather than human intervention alone to ensure rectification occurs and forms the basis of the final contract as performed. Once again, difficult questions regarding the legal recognition of smart contracts apropos human interest and adjudication flow from this context, as does the future of remedial applications that are capable of meaningful execution of arbitration functions.

Why is it important to be able to return parties to the position they were in before the execution of a contract? The remedial process of rescission, whether at common law or in equity, turns on a variety factors that impact the legitimacy of an agreement, including duress, undue influence, fraudulent or non-fraudulent misrepresentations. Considering such factors, the aim of rescission is *restitutio in integrum*, to unwind an agreement, including any transactions conducted under the agreement, thereby returning the parties to pre-contractual positions. In cases of misrepresentation, the role of rescission can be summarized as follows:

> Before the passing of the *Misrepresentation Act* 1967, the position with regard to rescission was, broadly speaking, as follows: where a person was induced to enter into a contract as a result of a misrepresentation by the other party to the contract, and the misrepresentation never became incorporated as a contractual term, the representee was entitled to rescind the contract, whether the misrepresentation was fraudulent, negligent or wholly innocent. At common

> law, the right to rescind was confined to cases in which the misrepresentation was fraudulent or in which there was a total failure of consideration, but in equity there was a right to rescind even for innocent misrepresentation. Since the Act of 1967 this right of rescission is qualified (except in cases of fraud) by the court's power to refuse rescission and award damages in lieu, and there remain certain bars to rescission in all cases. But it still remains a general proposition that the remedy for misrepresentation is rescission of the contract[49].

A court will deny restitution if compensation (damages) is regarded as a better or more suitable outcome. This means that the reasons for justifying rescission must be tightly drawn if they are to succeed and not be "barred". Such reasoning must anticipate factors including whether there has been an affirmation of the disputed contract by the party seeking the remedy, or whether there has been excessive delay in seeking the remedy[50]. Both factors are particularly germane considering those aspects of smart contracts that relate to and promise efficiency gains by virtue of the speed with which smart transactions occur, and similar benefits from the autonomous or semi-autonomous nature of the smart contracting processes that enable transactions to be finalized with little or no human intervention. The latter of these issues is of concern because it is difficult to make a case for rescission if performance of the contract cannot be stopped due to the persistence of the automated processes ensuring absolute performance of the smart contract as written. Even if that contract misrepresents the intention or consent of the parties. Moreover, a smart contract that completely executes may reasonably be said to

[49] Beale, 2018, at 7-112

[50] Affirming the contract has been considered by receiving of goods, thereby barring rescission and having no firm means of rejecting them: *Long v Lloyd* [1958] 2 All ER 402, Court of Appeal. It must be noted that this line of reasoning has come under a lot of scrutiny in recent years. See, for example: *Bernstein v Pamson Motors (Golders Green) Ltd* [1987] 2 All ER 220 and *Clegg v Anderson* [2003] EWCA Civ 320, [2003] 2 Lloyd's Rep 32. For the issue of delay see, *Leaf v International Galleries* [1950] 2 KB 86, Court of Appeal.

have finalized the transactional processes it was designed for, but this is not necessarily the same as discharging the contract, which in law or equity is a different measure.

Referring specifically to smart contracts written in the Ethereum programming language solidity, Bill Marino and Ari Juels discuss the possibility that while contracts cannot be altered on the blockchain, they can be deleted via "self-destruct", meaning the contract's function cannot be called by other contractors[51]. 'The global self-destruct function', claim Marino and Juels, 'if called from inside a contract, sends the contract's Ether [the token or 'gas' associated specifically with Ethereum smart contracts] balance to the address this function takes as its sole argument, then deletes the contract's code from the blockchain going forward' [my addition][52]. To all intents and purposes, the legal effect of a self-destruct function is to stop the contract from executing by rendering it unreadable by potential counterparties; in other words, it kills the possibility for offer and acceptance to occur[53]. The rationale for not executing the contract, which may be due to a misrepresentation for instance, can be attributed by the destructing party *ab initio*, but in the present legal landscape (in the UK for example) there is no provision for arbitration by a judge, meaning it is an extra-legal process that could be based on problematic, vitiating factors. 'Fraud and unconscionability are high risks', as Marino and Juels maintain, because 'code-savvy parties are in a position to defraud or force unconscionable terms on code-naïve parties'[54]. Deletion of the contract from the blockchain is part of the process of self-destruction, which is important because this ensures there is no contract to confound countermeasures at law, for example the execution of a follow-up contract. However, "deletion" in this circumstance does not mean a total erasure of the contract as such, because

[51] Marino and Juels, 2016
[52] Marino and Juels, 2016
[53] For more on the basic function of self-destruct in smart contracts see: Donn Felker. 2018. *Self Destructing Smart Contracts in Ethereum*. https://articles.caster.io/blockchain/self-destructing-smart-contracts-in-ethereum/ (accessed 1 April 2019); *Introduction to Smart Contracts*. https://solidity.readthedocs.io/en/develop/introduction-to-smart-contracts.html#self-destruct (accessed 1 April 2019)
[54] Marino and Juels, 2016

the contract code is immutably recorded on the blockchain. Instead, deletion refers to a change in the "state" – a collection of data at a point in time - in the EVM[55]. This does not necessarily mean a dead or deleted contract could easily be resurrected to confound a legal process (the state will have changed due to the deletion, but the code will remain intact and archived on the blockchain), but it is nevertheless important to register the fact that deletion does not mean the total erasure of a contract.

Further, what is peculiar and somewhat problematic about the arrangement proposed by Marino and Juels is that, the form of rescission the self-destruct function describes and enables does not encapsulate repudiation of the agreement by a single party or reflect the right to rescind in cases of fraud or misrepresentation, but does reflect, at least to some extent, the doctrine of rescission by agreement. Compare, for example, Marino and Juel's outline of the self-destruct function with the outline of the effect of rescission by agreement in *Chitty*: 'A contract which is rescinded by agreement is completely discharged and *cannot be revived*. The parties will frequently make express provision for the restoration of money paid or for payment for services performed or goods supplied under the contract prior to rescission' [emphasis added][56]. In other words, the self-destruct function assumes rescission in a variety of ways that contractual parties would struggle to convince a court of in an ordinary course of dealing.

Marino and Juels do admit that self-destruct is a convenient but not necessarily nuanced enough function to cover all possible grounds for rescission. Nonetheless, what the notion of self-destruct reveals is the application of blunt tools and evolution of kill-switch standards in the processes of smart contracting that would not be considered reasonable or viable in traditional contract law. As Marino and Juels state in their conclusion, 'These standards should be drawn from the principles of contract law but work for the new technology', a statement which

[55] See, for example: Dameron. 2019
[56] Beale, 2018, at 22-026

strongly implies a two-tier evolution of restitutionary remedies that may not sufficiently align[57]. But whilst the implication may be that it is contract law that ought to adjust to the remedial changes wrought by new technologies that demonstrate a more efficient way for contracts to be performed, a simple counter argument maintains that smart contracts must stand or fall on whether or not the technology is able to prove it's legal legitimacy, and that legitimacy demands nuance not blunt tools.

Conclusion

Many features of contract law can be viewed as "problems" to be "solved" - those symptomatic of inefficiencies that electronic and smart interventions are designed to "disrupt" – but contract law and theory is not gratuitously complex. Rather, it has evolved to reflect the complexities of socio-economic interactions and transactions in a wide variety of interpersonal and commercial environments. Contracting is an indelibly human gesture and thus subject to the caprices of human conduct and endeavour. If contracts are to cease being so, by their autonomous, smart reconceptualization, then it is arguably human interest and interference that must retreat in order to make contracts truly smart. And yet, as Sol Yurick said of the broader march of the information age throughout the 20th Century, this endeavour implies 'a perhaps fictional notion; that the universe and everything in it, is logico-mathematical', moreover, 'that all things and forces in the universe [can] be treated as a cryptogram, a code, a text that [can] be *read*, sooner or later'[58]. The time and space that law and legal processes ensure (or ought to ensure) is for the thorough consideration of the value and nature of agreements. To paraphrase Yurick, the value of law resides in the insistence on a messy, base-level of humanity that confounds the notion of a universe that can only be described in logico-mathematical

[57] Marino and Juels, 2016
[58] Sol Yurick. 1985. *Metatron*. New York: Semiotext(e), pp.26-27

terms. Although this is, I suggest, something that ought to be commended not vilified within the onward march of the information age and in technological progress in the 21st Century.

Peer-to-peer service, property and financial agreements and arrangements, modes of exchange, transaction and conveyance are all presently subject of re-evaluation in light of smart contracts. What I have argued here, however, is that contrary to the notion of smart contracts "disrupting" existing contract law and theory, their legal legitimacy turns upon satisfying a high level of interoperability with the processes and procedures of verification defined by traditional contract law and theory. For smart contracts to be legally relevant or valid the technology will need to satisfy more than transactional basics. As Beale *et al* explain: 'contract law' is used to mean the whole collection of rules which apply to contracts, and these may include many rules that are not 'contractual' in the sense of being based on a promise to do something'[59]. This forms part of the determination of legal recognition that smart contracts must meet if they are to be legitimate, and whilst the dynamic nature of contract means it is 'always developing and sometimes changing rapidly as new problems confront the courts and legislature', a full transition to smart contracts, if and when it occurs, is unlikely to sweep away all the vestiges of traditional contract law[60].

Definitions rooted in the fundamentals of contractual form and purpose present, therefore, a clear divergence between law and the visions of technologists; not least when technologists insist or imply the ongoing project of "disruption" involving blockchain and its associated technologies (e.g. smart contracts) has, once and for all, managed to reinvent the proverbial wheel. While smart contracts are problematic as contracts *per se*, the problems they pose are not all that new for the law. Yet the threat of divergence is important for entrepreneurs and technologists who are keen to "leverage" perceived failures in law's ability to keep pace with

[59] Beale *et al*, 2008, p.3
[60] Beale *et al*, 2008, p.8

innovation. Rather, smart contracts represent an evolution in electronic instruments that have demonstrated to the legal imagination that, while it is necessary to engage with and understand the novelties different mediums present (i.e. the Internet or analogous distributed networks), centuries of social experience and intellectual rigour that have made contract law and theory what it is today is not easily "disrupted" nor is it yet to be upended. As Robert A. Hillman and Jeffrey J. Rachlinski concluded in their assessment of electronic agreements during the first major period of e-commerce, at the turn of the Millennium:

> Although the electronic environment is a truly novel advance in the history of consumerism, existing contract law is up to the challenge. The influences that affect the judicial approach to the enforcement of standard terms in the paper world also tend to affect the electronic world or have close parallels in the electronic world. The basic economics of the two kinds of commerce are identical. In both the paper and electronic worlds, businesses choose between adopting a set of boilerplate terms that are mutually beneficial or exploitative. In both worlds, they know more than consumers about the contractual risks, thereby creating an opportunity to exploit consumers. Also in both worlds, consumers can defend themselves by investigating these terms or by making their purchasing decisions based on a business's reputation. E-commerce brings new weapons and defenses to both businesses and consumers, but the basic structure remains intact[61].

The problem of bridging real and virtual worlds (the oracle problem), as well as bringing laws of contract and property into *digital harmony*, remain major obstacles for smart contract design

[61] Robert A. Hillman and Jeffrey J. Rachlinski. 2002. Standard-Form Contracting in the Electronic Age. *New York University Law Review*. Vol. 77 (May), p.495

and implementation within domestic jurisdictions and internationally[62]. Consequently, the question of whether smart contracts ought to be construed as contracts *simpliciter* remains highly contentious[63]. Smart contracts might instead best be understood as a new *type* of instrument within an overall suite of contract law, rather than an alternative to or replacement for traditional contracts. It is clear from a legal standpoint that smart contracts do not provide a wholly viable alternative to existing forms of contract, nor, indeed, pose a threat[64].

Smart contracts are juridically immature and incapable of satisfying most fundamental conditions of traditional contract law and theory. Although complacency on the part of lawyers is unwise and potentially misguided, it is nevertheless correct, I argue, that, as Marino and Juels conclude it is 'essential that the architects of this new technology, like the architects of contracts, create viable ways to alter and undo them'[65]. Failure to do this is one source of a problematic fetishization of the contractual form by smart contract designers: the electronic agreement alone is considered perfect, when this does not, in fact, describe a contract. This article has demonstrated that principles of restitution and equity, alongside those of common

[62] See, for example: Jerry I-H Hsiao. 2017. Smart Contract on the Blockchain-Paradigm Shift for Contract Law, *14 US-China Law Review 685*.
Test cases for smart contract viability have tended to rely on tokenization of non-physical property that is amenable to digital exchange and transaction, such as financial products or intellectual property, and this trend has not changed in recent years despite some high-profile attempts to demonstrate that both chattels and real estate can be conveyed using smart contracts. See, for example: John Ream, Yang Chu, and David Schatsky. 2016. Upgrading blockchains: Smart contract use cases in industry. *Deloitte Insights*. 8 June. https://www2.deloitte.com/insights/us/en/focus/signals-for-strategists/using-blockchain-for-smart-contracts.html (accessed 12 November 2018); Aleksandra Dikusar. 2017. Smart Contracts: Industry Examples and Use Cases for Business. *XB Software*. 17 October. https://xbsoftware.com/blog/smart-contracts-use-cases/ (accessed 12 November 2018); Sudhir Khatwani. 2018. These are the 5 Best Use Cases of Ethereum Smart Contracts. *Coin Sutra*. 22 May. https://coinsutra.com/ethereum-smart-contract-usecases/ (accessed 12 November 2018);
[63] See for example: Werbach and Cornell, 2017; Max Raskin. 2017. The Law and Legality of Smart Contracts. *Georgetown Law and Technology Review*. Vol. 1, Issue 2 (April), pp.305-341; Scott A. McKinney, Rachel Landy, and Rachel Wilka. 2018. Smart Contracts, Blockchain, and the Next Frontier of Transactional Law. 13 *Washington Journal of Law, Technology & Arts* 313. In a Twitter exchange between Ethereum founder Vitalik Buterin and publishers of the Crypto Law Review, CleanApp.io, Buterin admitted: 'To be clear, at this point I quite regret adopting the term "smart contracts". I should have called them something more boring and technical, perhaps something like "persistent scripts"' (@VitalikButerin. *Twitter*. 6.21PM. 13 October 2018).
[64] For example, *Chitty on Contracts* does not mention smart contracts in the latest (October 2018) edition, only electronic documents and deeds with regard to provisions in land registration legislation for e-conveyancing measures (*Chitty on Contracts*, 2018, at 1-123)
[65] Marino and Juels, 2016

law, legislation, and regulation more generally, can enable at least some degree of alignment between the smart and the traditional.