Can smart contracts be legally binding contracts?

An R3 and Norton Rose Fulbright White Paper

Contents

Introduction

There is much excitement globally about smart contracts and distributed ledger technologies that support them. Properly funded technology vendors and consortia have emerged which are now able to give tangible expression to that sense of excitement in the form of new and innovative smart contract and distributed ledger products and services.

It has become apparent to us, however, that when industry stakeholders (both buyers of the new technologies and vendors) speak of smart contracts, they can mean very different things. As any contracts lawyer will tell you, words matter. Consistency of language is vital if clear lines of communication are to be achieved in a rapidly evolving industry. What do we mean by a smart contract? Is it smart? Is it a contract? Do lawyers and technologists understand each other when they use these terms?

Recognising the imperative for clarity on these issues, R3 and Norton Rose Fulbright offer this White Paper as a step forward in forging a consensus of understanding between industry stakeholders, lawyers and technologists in relation to smart contracts.

Executive summary

This White Paper assumes the reader will be broadly familiar with smart contracts and distributed ledger technologies. It accordingly provides only a high level summary of both (including permissioned and permissionless systems), before moving on to consider the spectrum of possibilities of what a smart contract could constitute. It then considers whether a smart contract can constitute a legally binding contract under the law of a number key contracting jurisdictions. Finally, it offers up some observations about the practicalities of enforceability and provides some suggestions for dispute resolution within a smart contract context.

Our key findings are:

1. There is a spectrum of possible smart contract models
On the one hand, there are those who promote the "code is contract" approach (that is, that the entirety of a natural language contract can be encoded). On the other, there are those who see smart contracts as consisting of digitising performance of business logic (for example, payment), which may or may not be associated with a natural language contract. In between these two extremes a number of permutations are likely to emerge including, for example, a "split" smart contract model under which natural language contract terms are connected to computer code via parameters (for example, a smart contract template) that feed into computer systems for execution.

2. Legally binding contractual effect depends on a number of variables
It is tempting to conclude that, just because the moniker "smart contract" includes the word contract, it is a legally binding contract as a matter of law. This is not necessarily correct. Whether it is so in a given situation may turn in part on the type of smart contract at issue, the factual matrix within which it operates, and the applicable law determining the issue.

3. There are jurisdictional variations
At the end of this White Paper we set out an analysis of whether smart contracts can give rise to legally binding contractual relations under the laws of a number of key contracting jurisdictions. Our analysis reveals that the answer may vary significantly depending on the jurisdiction.

Common themes
- The electronic nature of contracting is unlikely to be problematic for many (but not all) jurisdictions in relation to establishing contractual formation.

- Certainty as to what constitutes the contractual terms (and whether they are comprehensive enough) is often a critical factor necessary to establish the formation of a legally binding contract in many jurisdictions. Smart contracts that purely digitise a particular process but do not include, or operate in conjunction with, contractual terms (express or implied) may not satisfy such requirements.

- Follow-on contracting (by which a later, separate "follow-on" contract is brought about by performance of an earlier smart contract) may not give rise to a legally enforceable contact in some jurisdictions.

- Other technical requirements of the applicable jurisdiction's law (typically prescribed by legislation) may, in a few jurisdictions, be a potential impediment to rolling out smart contracts that are intended to have legally binding contractual effect.

4. Enforceability should be considered

Where a smart contract has legally binding contractual effect, the technology within which it is deployed may sometimes give rise to problems in relation to legal enforceability (this is particularly so in the case of a so-called "permissionless" distributed ledger). This may be because, for example, there may be no central administering authority to decide a dispute, there may be no obvious defendant, or enforcement of a court judgment or arbitration award in respect of a transaction using particular distributed ledger technologies may be problematic.

5. Dispute resolution mechanisms could address enforceability and jurisdictional variations

Inserting a dispute resolution mechanism into a smart contract may help to address the issues around enforceability and jurisdictional variations identified in this White Paper. Later we suggest some dispute resolution mechanisms that could help to provide a solution (see *What Dispute Resolution Mechanisms Could be Used?*, on page 19).

Many of the problems identified above may also be addressed by choosing a smart contract model that reduces the risk of a court finding that a legally binding contract has not arisen (assuming that is an objective of the parties).

Businesses need to factor issues concerning the legal status of smart contracts into the wider business case for their deployment, and ensure an appropriate legal and regulatory compliance review of the particular smart contract model chosen has been undertaken for the countries in which they are intended to operate.

Sean Murphy
Global head of blockchain and distributed ledgers
Norton Rose Fulbright, London

Charley Cooper
Managing Director
R3, New York

What is a smart contract?

A smart contract is "a set of promises, specified in digital form, including protocols within which the parties perform on these promises"

(Nick Szabo, Smart Contracts: Building Blocks for Digital Markets, 1996)

Nick Szabo is widely credited for inventing the idea of a smart contract. He gives the example of a drinks vending machine as something embodying its characteristics. When the money is paid, an irrevocable set of actions is put in motion. The money is retained and a drink is supplied. The transaction cannot be stopped in mid flow. The money cannot be returned when the drink is supplied. The transaction's terms are in a sense embedded in the hardware and software that runs the machine.

In Szabo's original abstract description, a smart contract is both an instance of computer code and a running software program that interprets the code, accepts input conditions and decides on outcomes.

It has these key characteristics:

- **digital form:** it is in computer form – code, data and running programs

- **embedded:** contractual clauses (or equivalent functional outcomes) are embedded as computer code in software

- **performance mediated by technological means:** the release of payments and other actions are enabled by technology and rules-based operations

- **irrevocable:** once initiated, the outcomes for which a smart contract is encoded to perform cannot typically be stopped (unless an outcome depends on an unmet condition)

How did the blockchain enable the smart contract?

The idea of a smart contract remained abstract and apparently implausible until the invention of Bitcoin.[1] In what became known as the blockchain, a community of cooperating but adverse "nodes" (participating computers) agree on the state of a block of transactions, each block being linked to the preceding block to make a chain back to the start. Each transaction includes small programs to verify or validate their part of the transaction – each is a small smart contract.

The key principle underpinning the smart contract is the ability for parties (sometimes disagreeing) to come to consensus over a set of shared facts. The blockchain accomplishes this by: (a) sharing identical copies of the ledger database amongst the community of participating nodes; and (b) using a consensus algorithm (sometimes called proof of work) to resolve differences in each block. With every computer coming to consensus (eventually) over the facts in the block, the inventor of Bitcoin, Satoshi Nakamoto, was able to make those very facts be programs, data, events and transactions. In short, the facts in a block are the state and code of smart contracts over which consensus happens every ten minutes.
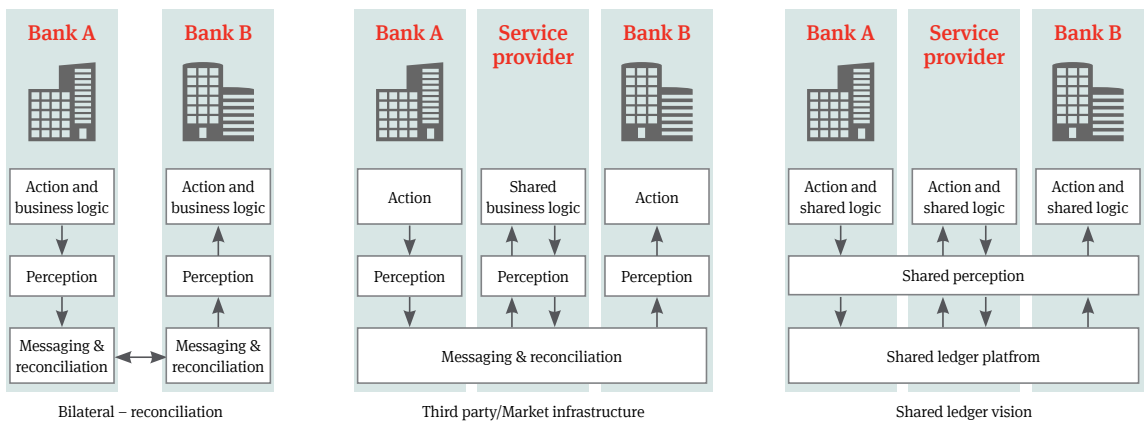
(Brown, Carlyle, Grigg, Hearn, Corda: An Introduction, 2016)

Ethereum extended the blockchain design with fully powerful code, data storage over time and messaging capabilities to make it a general purpose computer specialised for the smart contract.[2]

R3's Corda is a distributed ledger platform designed by and for the needs of regulated financial institutions, and therefore refines in a different direction.[3] Corda is designed and built from the ground up to record, manage and synchronise legal agreements between only those proper parties to the agreement. Therefore, the sharing of facts is only between the parties, and the consensus design is pluggable so that the parties can choose from various designs – for example, from light-weight single server designs through fault-tolerant voting designs all the way up to a full Nakamoto-type blockchain.

1   Satoshi Nakamoto, *Bitcoin: a Peer-to-Peer Electronic Cash System*, http://bitcoin.org/bitcoin.pdf, 2008.

2   Buterin et al, *A Next-Generation Smart Contract and Decentralized Application Platform*, https://github.com/ethereum/wiki/wiki/%5BEnglish%5D-White-Paper.

3   Richard Gendal Brown, James Carlyle, Ian Grigg, and Mike Hearn, *Corda: an Introduction*, http://r3cev.com/s/corda-introductory-whitepaper-final.pdf, 2016.

A refined abstract model

R3's model of smart contracts and distributed ledgers has advanced significantly, as informed by many experiments. Smart contract programmed logic (that is, code) and state (that is, performance as at a given time) sit as a series of transactions on a distributed ledger.

A distributed ledger:

is digital: it is made up of software (coding including algorithms) and data

is a ledger: it is an immutable (unchangeable) log of records in the form of a database of data representing transactions (or of what has occurred) that are laid out in a sequence over time

is distributed: parties to transactions hold reliably identical copies of the state of their transactions. In the blockchain view of this, all transactions are downloaded from the world wide web and are kept on numerous computers (nodes) spread across a site, an organisation, a country, or globally. In the Corda model, only the relevant parties share the transactions, and the other transactions are neither known nor visible

uses consensus: agreement is reached over the facts of each transaction. The protocol for achieving consensus over facts could be: (a) as with blockchains, a Nakamoto-type signature over the current block chosen by the lottery of proof of work, every ten minutes; (b) by decision of a single trusted third party or designated administrator; or (c) a consensus of distributed shared and voting "notary servers" built for just that purpose. In certain distributed ledger applications (for example, in some so-called "permissioned" distributed ledgers, described below – see *What is the Difference between a Permissioned and Permissionless Ledger?*) an administrator or a trusted third party may determine state (instead of this being established by consensus among participants)

uses cryptography: distributed ledgers use hashing, digital signing and other cryptographic techniques to identify participants, to find consensus between their views of facts, and to lock consensus into records for the permanent log.

A smart contract within a distributed ledger can be represented to operate like this:

Transactions
Sending value to the contract

Events
Sending information
to the contract

"Smart contract"

Value

State

Transactions
Sending value to the contract

Events
Sending information
to the contract

Replicated, shared ledger
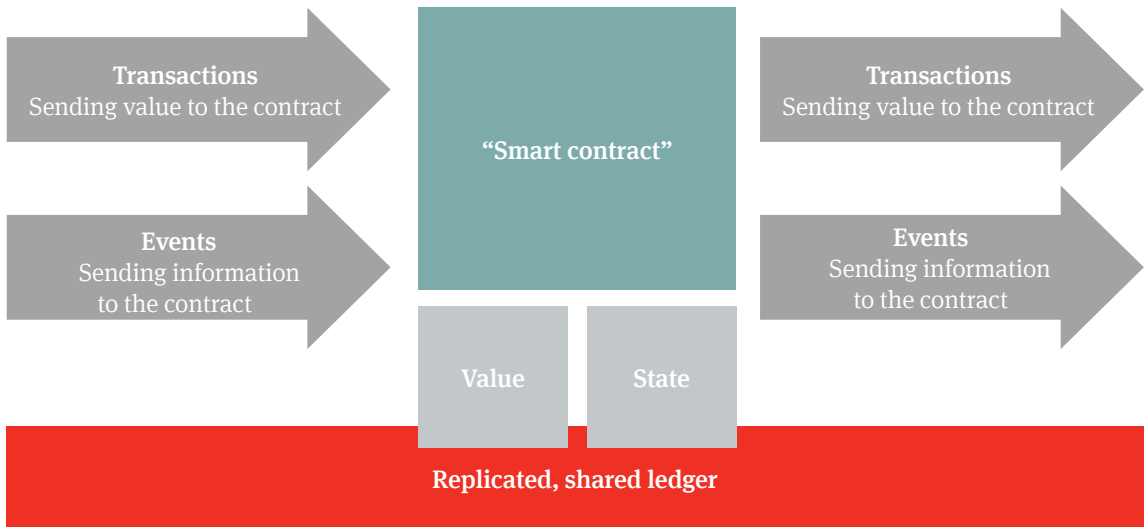
(Richard Gendal Brown, A Simple Model for Smart Contracts, 10 February 2015)

Within the abstract model described above there remain several choices or design decisions in a spectrum:

- is the distributed ledger permissionless or permissioned?

- what is the model of the smart contract and its status from a contractual perspective?

  — is it legally binding?

  — is it legally enforceable?

- what is the consensus protocol over which participants reach agreement over facts?

We now examine the first two issues mentioned above, and leave the last to the technologists.

What is the difference between a permissioned and a permissionless ledger?

A smart contract deployment can operate with a distributed ledger that is permissionless or permissioned:
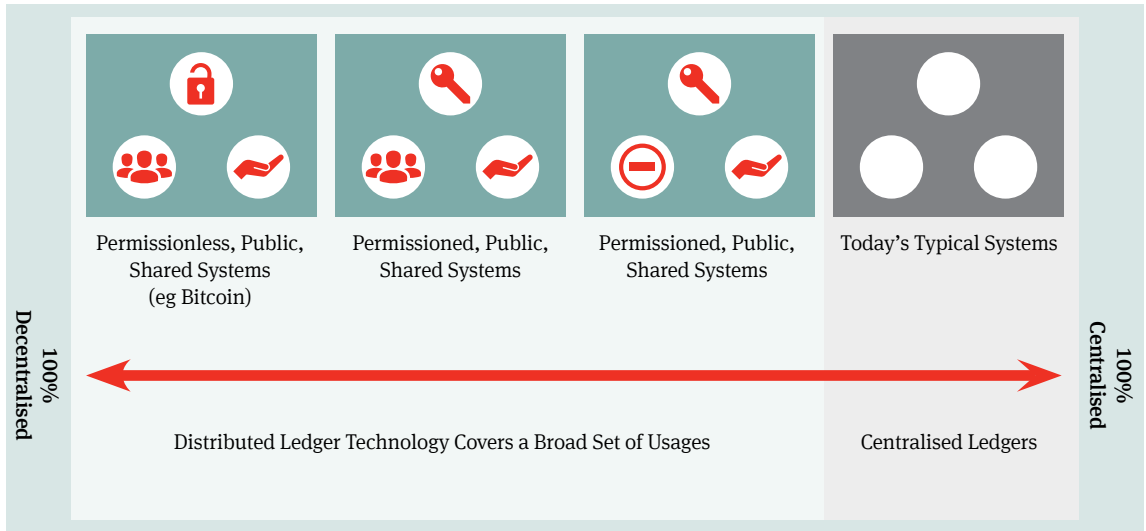
permissionless: a distributed ledger is permissionless when anyone is free to download the software, submit messages for processing and/or be involved in the process of authentication, verification and reaching consensus. Today, permissionless distributed ledgers will typically use the blockchain's public proof-of-work method because permissionless implies open entry and a global mechanism. Such systems are typically controlled by no-one and the participants are usually pseudonymous, making use of an administrator or sub-group theoretically possible but awkwardly non-representative of the open, free-entry community of users

permissioned (private): a distributed ledger is permissioned where its participants are pre-selected or subject to gated entry on satisfaction of certain requirements (this could include, for example, a requirement that a participant must first satisfy "know your client" (KYC) and anti-money laundering (AML) requirements) or on approval by an administrator of the distributed ledger. A permissioned distributed ledger may use a consensus protocol for determining whether a distributed ledger should be updated, or it may use an administrator or sub-group of participants to do so

hybrid systems: there are a number of different variables that could apply to make a permissionless or permissioned system into some form of hybrid. Such variables typically relate to the degree of centralisation that those responsible for setting up a distributed ledger wish to achieve. For example, a permissionless system may be augmented (taking it closer to a permissioned system) to:

- use encryption of transactions, so that, while anyone downloading the requisite software could inspect the raw data, no-one except those with the required cryptographic key could inspect individual messages or transactions

- be supported with a strong identity framework so that all psuedonyms can be inspected for satisfaction of local requirements (e.g. KYC and AML).

Different ledger technologies vary in their 'degrees of centralisation'

UK Government Chief Scientific Adviser, Government Office for Science, Distributed Ledger Technology: Beyond Blockchain, 2016

For many commercial applications, smart contracts deployed on a permissioned distributed ledger are likely to be the preferred option for many businesses.
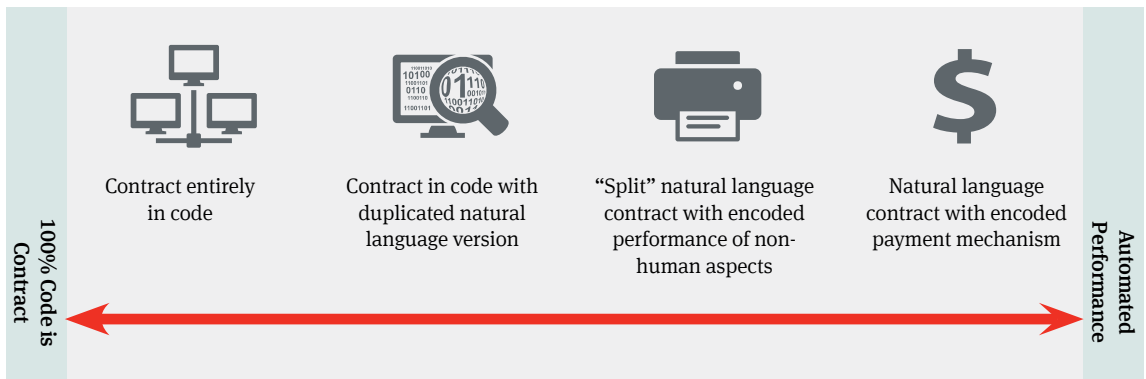
Spectrum of possibilities of what a smart contract could be

There is a wide spectrum of possibilities as to what a smart contract could be. On the one extreme, there is the "code is contract" school of thought. This approach would have it that the code constitutes the entirety of the terms of a contract, and a running program referring to that code is a complete contract undergoing performance. Or to put it another way, contracts can be fully expressed in code, and code can completely replace complex natural language contracts.

On the other end of the spectrum, smart contracts could simply be the digitised performance of business logic (for example, payments).

There is a range of intermediate possibilities in between these extremes, as illustrated in the following diagram:

Smart contracts lie on a spectrum

100% Code is Contract

Contract entirely in code

Contract in code with duplicated natural language version

"Split" natural language contract with encoded performance of non-human aspects

Natural language contract with encoded payment mechanism

Automated Performance

Within the spectrum between "code is contract" and "digitised performance of business logic", intermediate positions include:

- a contract in code that is duplicated with separate natural language documentation (typically electronic). For example, for every clause encoded into computer code, there is matching natural language version, and vice versa

- a "split" contract where non-human performance is encoded into computer code, and wider human obligations, remedial and other provisions are written into natural language, the two components operating together as a cohesive contract.

There is further research in this direction. The Smart Contracts Templates project has examined the possibilities of deriving the natural language from the code, the code from the natural language, and also the possibility of meta-languages that drive both.[4]

Seen as a spectrum, many questions arise. For example, is it realistic to encode a complex commercial contract, based on the current state of technology? A complex commercial contract contains numerous legal phrases, the meaning of which may not be settled at law, and which

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4   Christopher D. Clack, Vikram A. Bakshi, Lee Braine, *Smart Contract Templates: foundations, design landscape and research directions*, https://arxiv.org/abs/1608.00771, 2016.

may only be determined by legal analysis. Examples include "material adverse change", "best endeavours", "reasonable endeavours", and "reasonable steps". These formulations involve judgement and are a question of degree. They do not lend themselves to encoding within a smart contract.

Even if it were possible to encode accurately the entirety of a complex natural language contract, there could well be difficulties in relying on it as the only record of rights and obligations between the parties. What if the code did not perform as the parties expected? How would the parties resolve a dispute as to the meaning of the code? What if a court were to hold that it did not have legally binding contractual effect on a given set of facts (perhaps for the reasons outlined in the remainder of this White Paper)? Moreover, if it were to have contractual effect, it still might not constitute the entirety of the contract. For example, a court might imply additional contractual terms, or legislation might impose them.

These complexities in combination with the considerable technical difficulties of encoding the entirety of a complex natural language contract have led to the emergence of the so-called "split" contracting model, mentioned above. With some variation, a split contracting model broadly reflects aspects of the functionality advocated for what

are known as "Ricardian contracts".[5] These use an identifier (a "hash") to link a natural language contract indelibly to some form of activity within smart contract architecture, such as payment. The smart contract architecture administers the data-driven performance components of the arrangement.

Other models may be possible. For example, the parties could put in place a master supply contract under which each smart contract entered into under it incorporates its terms by reference, and triggers supply.

Within financial services (as in other industries that exchange vast amounts of data), lack of standardisation of data formats between businesses exchanging data can involve expensive inefficiencies in data conversion (with the risk of errors in conversion). Banks in particular incur great expense in maintaining legacy systems and in upgrading them to achieve better standardisation (including in order to achieve compatibility and interoperability between software, systems, and platforms).

Smart contracts based on the Ricardian model – using pre-agreed standard contract templates linked to standard code for performance aspects – offer the opportunity for enhanced standardisation.

5   See Ian Grigg, *The Ricardian Contract*, First IEEE International Workshop on Electronic Contracting, 2004, pages 25 to 31.

Do smart contracts have legally binding contractual effect?

It is tempting to conclude that, just because the moniker "smart contract" includes the word contract, it is a legally binding contract as a matter of law. This is not necessarily correct. Whether it is so in a given situation may turn in part on the type of smart contract at issue (see *Spectrum of Possibilities of What a Smart Contract Could Be*, on page 13), the factual matrix within which it operates, and the applicable law determining the issue.

The "code is the contract" school of thought has, we suggest, led to a common misconception within the smart contract industry that a smart contract somehow displaces the law, or that the automatic performance aspect of a smart contract means that law cannot intervene in the case of a dispute over a smart contract (simply because automatic performance makes the completion of the contract *a fait accompli*).

A similar view came about with the first emergence of the Internet – that it was somehow a legal "Wild West" free from legal intervention. Legislators and the courts across the globe took a different view, and acted to protect those transacting over the Internet in a variety of ways.

The same will probably be true of smart contracts. "[C]ontract law has always displayed an inherent ability to adapt to new situations – without the need for major revisions of its underlying principles."[6] "Technology – while not changing contract law – adds complexity to the traditional analysis. The question is not 'do traditional principles apply?' but 'how do they apply?'"[7] "It is axiomatic that normal contractual principles apply."[8]

In any event, the problems that smart contracts present for the law are not actually new. It is worth recalling that, for over forty years, technologies such as Electronic Data Interchange (EDI)[9], based on private or closed electronic networks, have been used for electronic communications between businesses.

Initially deployed to help perform obligations under pre-existing contracts, EDI was later extended to include automatically entering into binding contractual arrangements based on a set of previously agreed rules for contracting (called an interchange agreement).[10] In other words, both the basis upon which the parties communicated via EDI, and the underlying transactions, were subject to such pre-agreed rules. Given such clarity, it is perhaps no co-incidence that there is a paucity of reported disputes involving EDI.[11] There are obvious lessons to be learned here for how smart contract arrangements could be implemented.

As already described (see A *Refined Abstract Model*, on page 19), smart contracts can be initiated by messages sent over the Internet and processed onto a distributed ledger. In other words, they deploy within a communications system. In analysing whether smart contracts have legally binding contractual effect, it is worth bearing in mind that "[n]ew methods of communicating do not imply a need to create new principles or a parallel regime to accommodate online contracting. The revolution

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6   Eliza Mik, 'Formation Online', 159, in M Furmston and G J Tolhurst, *Contract Formation: law and practice*, OUP, 2010.

7   *Idem*, at page 161.

8   *Chwee Kin Keong and Others v Digilandmail.com Pte Ltd* [2005] 2 LRC 28 at paragraph 102 (High Court, Singapore).

9   EDI is a system of business-to-business electronic communications between businesses over a closed system, governed by a set of previously agreed rules for contracting: Chris Reed, ed., 267, *Computer Law*, OUP, 7th edn, 2011.

10 *Ibid*. Depending on the jurisdiction, EDI interchange agreements may regulate just the details of the communications process or such process as well as the underlying transactions: *Idem*, at page 296.

11 See Z A Zainoi, *Electronic Data Interchange (EDI) and Formation of Contract: A Malaysian Perspective*, International Journal of Law and IT (1999) 7(3): 256.

in how people communicate need not result of a revision of contract law."[12] "It is a common pitfall in legal analyses to imply that the basic principles of analysing contract formation do not apply or that online transactions must be treated differently due to the mere fact that they are formed by novel methods of communication."[13] As we shall see, in English law, for example, communications by email can give rise to a legally binding contract.

Smart contracts can automatically perform. It is important to draw a distinction between two types of situations in relation to this characteristic:

- a smart contract initiated by the parties to it. Here subsequent performance may not be relevant at all to the question of contract formation of the smart contract

- a later, separate "follow-on" contract that has been brought about by performance of the smart contract itself (that is, where the smart contract purports to enter the parties into that other, separate follow-on contract). As we shall see, the laws of some jurisdictions dealing with whether that separate follow-on contract could have legally binding effect are more developed than others.

As the focus of this White Paper is contract formation, we do not deal here in any detail with e-signatures (for example, through public key infrastructure (PKI) in relation to a smart contract) or prescribed formalities (for example, the requirement for some types of contracts be in writing or to take the form of a deed) laid down by law in various jurisdictions for certain types of contracts. "The function of a signature is to authenticate the document, that is, to demonstrate the signer's approval or apparent approval of its contents."[14] In many jurisdictions a signature is

not required at all for a legally binding contract to come into existence (for example, in English law a contract can be formed entirely orally, without the need for it to be in writing or for the contract to be "signed"). Speaking generally, such formal requirements tend to be the exception not the rule.

At the end of this White Paper we set out an analysis of whether smart contracts can give rise to legally binding contractual relations under the laws of a number of key contracting jurisdictions. Our analysis reveals that the answer may vary significantly depending on the jurisdiction. However, our analysis also reveals that there are some common themes:

- perhaps unsurprisingly, the electronic nature of contracting is unlikely to be problematic for many (but not all) jurisdictions in relation to establishing contractual formation. Australia, South Africa and China, for example, have gone so far as to put in place legislation to clarify aspects of contract formation in relation to electronic contracting which is very helpful in analysing the legal status of smart contracts. The common law in a number of countries has applied existing principles in analysing electronic transactions by email and other means

- certainty as to what constitutes the contractual terms (and whether they are comprehensive enough) is often a critical factor necessary to establish the formation of a legally binding contract in many jurisdictions. Smart contracts that purely digitise a particular process but do not include, or operate in conjunction with, contractual terms (express or implied) may not satisfy such requirements

- follow-on contracting (by which a later, separate "follow-on" contract is brought about by performance of an earlier smart contract) may not give rise to a legally enforceable contact in some jurisdictions

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12 Eliza Mik, *supra*, at page 160.

13 *Idem*, at page 167.

14 Ewan McKendrick, *Goode on Commercial Law*, 4th edition, 2010, Penguin Books, pages 81 – 82.

- in some cases, other quite technical requirements of the applicable jurisdiction's law (typically prescribed by legislation) may be a potential impediment to rolling out smart contracts that are intended to have legally binding contractual effect. For example, in China if the parties purport to conclude a contract in the form of data messages, either party may request that it be given the option to sign a letter of confirmation before conclusion of the contract actually takes effect.

These various factors (and others) are examined on a jurisdiction-by-jurisdiction basis at the end of this White Paper.

What are the potential enforcement problems?

Apart from the other requirements discussed in this White Paper, in order to be legally valid, the common law of many jurisdictions provides that a contract must be entered into by a person having legal capacity to do so, e.g., a human or natural person, or a legal person such as a corporation. There is also common law authority (for example, in English law) to the effect that, for a contract to arise, there needs to be sufficient certainty over who the other contracting party actually is. Civil law jurisdictions may lay down other requirements (see the country analysis at the end of this White Paper).

Legal requirements such as these can make disputes relating to smart contracts particularly problematic. For example:

- there may be no central administering authority (for example, an administrator of a permissioned blockchain that hosts a smart contract) to decide a dispute between participants to a smart contract, forcing them to seek recourse in the courts

- there may be no obvious defendant against whom legal action could be brought. For example, who would be responsible for system operational defects, corrupted messages, or defective programme logic that led to non-performance (or unexpected performance) of a smart contract?

- it may be unclear if a legally binding contract exists between participants to a smart contract if they seek legal redress for breach of contract in the courts

- even if there is no clear contract, a smart contract transaction may itself have an effect on property rights – for instance, if it is a register of legal ownership – and so any dispute would need to be resolved as between the rival claimants to those property rights

- transactions using some digital ledger technologies, especially blockchains, can be conducted pseudonymously. If a dispute arose, how would an aggrieved participant to a permissionless blockchain identify the other party to a smart contract in order to bring legal proceedings against it? Would a court regard a smart contract hosted on a blockchain as having legally binding effect if it is simply not possible to identify who the other contracting party to it is?

- there may be difficulties in proving the existence or content of a smart contract in court proceedings where evidence exists only in electronic format on a distributed ledger or elsewhere

- enforcement of a court judgment or arbitration award in respect of a transaction using distributed ledger technologies may be problematic

- even where dispute resolution mechanisms exist for distributed ledger technologies, there may be problems applying them beyond the "trust boundaries", that is, where they interact with third party systems.

What dispute resolution mechanisms could be used?

As mentioned above, recourse to the courts to enforce a smart contract can be cumbersome and ineffective. Inserting a dispute resolution mechanism into the smart contract itself may provide a neat remedy to these problems.

Where a distributed ledger technology has a central administering authority with the power to insert arbitrary or remedial transactions into that ledger (a permissioned ledger might provide for this), the parties might, for example, agree that this authority has the power to determine any disputes. This agreement might be contained in a particular smart contract, or it could be part of the terms and conditions accepted by the participant when it acquires an identity or otherwise participates in the particular ledger. The authority would need protection from disputes arising from its exercise of these powers. Again, that could be a term of a smart contract or the terms and conditions of the permissioned ledger.

Where: (a) a distributed ledger has no central administering authority (whether the distributed ledger is permissioned or permissionless); or (b) the parties do not wish to delegate dispute resolution to it; or (c) it is logically impossible to unwind a transaction without the participation of a quorum of all of the participants, then the problems are more acute: it may be impossible to unwind a transaction even if clearly desired by the direct parties. A dispute resolution mechanism built into the smart contract itself could provide a solution.

Such a mechanism would need the following characteristics:

- a provision in the contract code that causes delegation to an arbitrator, which would be triggered under rules encoded in the smart contract: for example by both parties asserting a defect and nominating the arbitrating entity;

- a provision in the contract natural language version agreeing to submit disputes to arbitration: this assumes that there is a natural language version of the contract and that it matches the delegation mechanism in the contract code

- a forum for arbitration, which could be administered centrally, or via a relevant ledger, or by use of one of the many existing and experienced fora. The forum would identify these essential components:

  - a body of rules for the arbitration

  - pool of possible arbitrators, who could vary from persons able to provide expert determination at a low fee to high-value arbitrators capable of overseeing complex disputes

  - an administration capable of managing the cases as they are filed and decided.

A dispute resolution mechanism embedded in a smart contract reflects the advantages of a smart contract over a traditional contract: enforcement of the dispute resolution process and the consequent decision could be made automatic and integrated into the ledger. Not only would smart contracts deliver finality of agreed actions in performance, but also those actions and events that generate discord for whatever reason – disagreement over intent, bugs in the code, external exigencies – could also achieve finality through a formal process.

Such a mechanism might also provide a partial solution to the complexities of cross-jurisdictional trade. By using a common body of rules, the parties can agree to a rule base that is aligned across borders and legally acceptable within both jurisdictions.

The future

Sooner or later it is likely that the legal status of a smart contract will be tested in the courts. Our analysis (set out below) demonstrates that, across the jurisdictions, what is problematic in one jurisdiction in relation to contract formation may not be so in another. However, many such problems ought in principle to be able to be addressed by choosing a smart contract model that reduces the risk of a court finding that a legally binding contract has not arisen.

On the other hand, those who wish to deploy smart contracts in the belief that they can never give rise to contractual relations between the parties should be wary of accepting that conclusion uncritically. Much will depend on the particular smart contract, the facts surrounding deployment, and the applicable law determining the issue.

The absence of laws or precedent dealing specifically with smart contracts does not mean that we are in a lawless Wild West. Like nature, law abhors a vacuum. We can reasonably expect that in one way or another answers from our courts and legislators will be forthcoming.

In the meantime businesses need to factor issues concerning the legal status of smart contracts into the wider business case for their deployment, and ensure an appropriate legal and regulatory compliance review of the particular smart contract model chosen has been undertaken for the countries in which they are intended to operate.

> "The internet has revolutionised commerce and radically altered the manner in which commercial interaction currently takes place. The law will have to organically adapt itself to respond to new challenges without compromising on certainty and fairness."[15]

15 *Chwee Kin Keong and Others v Digilandmail.com Pte Ltd* [2005] 2 LRC 28 at paragraph 155 (High Court, Singapore).

Country analysis: do smart contracts have legally binding contractual effect?

English Law

Article 9 of the Electronic Commerce Directive[16] (which applies on both a B2B and B2C basis) requires member states of the European Union (which currently include the United Kingdom) to ensure that their legal systems allow contracts to be concluded by electronic means, and that the legal requirements applicable to the contractual process neither create obstacles for the use of electronic contracts nor result in such contracts being deprived of their legal effectiveness on account of their having been made by electronic means.

The Electronic Commerce Directive does not attempt to prescribe the contract formation process for electronic contracts.[17] Many commentators consider that Article 9 is satisfied by existing English common law.[18]

Under English common law, four key elements are required for the formation of a legally binding contract:

- the parties should have reached agreement. This typically requires for there to be an offer and a corresponding acceptance

- consideration

- intention to create legal relations

- certainty / completeness of terms.

Under English common law, there is often no clean separation of each of these requirements in a court's assessment of whether a legally binding contract has been formed. For the purposes of our analysis, however, it is expedient to deal with each of these requirements in turn.

Offer and acceptance: under English common law, offer and acceptance are assessed objectively. That is, the requirements for both an offer and an acceptance are established if there is an outward appearance of the relevant requirement, even if this does not reflect the subjective mental views of the relevant party.

Email messages have been assumed by the English courts to be capable of constituting offers and acceptances.[19] There should be no theoretical objection to using any form of electronic message for this purpose.[20] Smart contracts, for example, are typically initiated by messages sent using PKI over the Internet. It would be surprising if the English courts were to draw conceptual distinctions between such messages and email communications.

Moreover, the English courts have accepted that the parties are free to stipulate what acts will constitute acceptance.[21] Applied to a smart contract context, that could in principle mean that the parties to a smart contract could prescribe in its terms what

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16 Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market. The Directive was implemented into English law by the Electronic Commerce (EC Directive) Regulations 2002 (SI 2002/2013).

17 Chris Reed, *supra*, at page 274.

18 Ewan McKendrick, *supra*, page 82.

19 See for example *J Pereira Fernandes SA* v *Mehta* [2006] EWHC 813; and *Thomas* v *BPE Solicitors* [2010] EWHC 306. In *Golden Ocean Group Ltd* v *Salgaocar Mining Industries PVT Ltd* [2012] EWCA Civ 265 the Court of Appeal found that the exchange of a number of emails could lead to the conclusion of an agreement.

20 Chris Reed, *supra*, page 270.

21 *Holwell Securities Ltd* v *Hughes* [1974] 1 WLR 155.

particular message requirement will constitute acceptance of a previously messaged offer. This would go some way to achieving certainty as to what would constitute an offer and an acceptance within a smart contract context (if that is what the parties wish to achieve).

In Nick Szabo's seminal work on smart contracts,[22] he equated a smart contract with the functioning of a vending machine. The fact that an automated machine has intermediated in the interactions between parties may not, under English common law, affect the application of offer and acceptance analysis as the basis for determining whether the parties have reached agreement.

For example, in the well-known case of *Thornton v Shoe Lane Parking* [1971] 2 QB 163, the court equated a ticket vending machine at a parking lot with an offer. "Provided the contents [of the transaction terms] are certain and complete, the intention to be bound derives from the immediate ability to execute the transaction."[23]

In *Software Solutions Partners Ltd, R (on the application of) v HM Customs & Excise* [2007] EWHC 971 the facts were that insurance brokers who used a software system provided by Software Solutions Partners (SSP) were able to enter into insurance contracts on behalf of their customers with insurers who were using the same system. The broker would input the details for the required insurance product into the system, and the system would calculate quotes available from insurers participating in the system and determine whether the risk was acceptable to the relevant insurer (without referring the issue back to the insurer). Once the customer accepted the price and terms of insurance cover, the policy contract was generated by the system and the insurer was bound by it. The system then produced the necessary paperwork.

Although the main issue in the case was whether SSP's services were VAT tax exempt, the English High Court made some observations about contract formation in this case. It said that, in legal terms, it was the insurer which made the binding offer of insurance (rather than a mere "invitation to treat") and that it was the broker, on behalf of his principal (the customer), which gave acceptance, "such acceptance being presumably effective when received on SSP's information system, or on the information system of such other party as might be stipulated in any operating protocol to which SSP, broker and insurer may be party".[24]

The court noted that:

> "all the information necessary for electronic contract formation has been pre-programmed, according to strict parameters laid down by the insurer, in the SSP computer software ... The relevant data is, therefore, processed automatically by electronic means through the computer software, and the transactions are self-executing within the specified parameters pre-determined in the programme. Once the broker, using his computer and accessing the SSP software, has input the appropriate data, the 'offer' is automatically generated by the programme itself without further human intervention; and once the broker has taken the steps required by the computer programme necessary for an 'acceptance' of the offer, the acceptance is automatically processed by the programme itself, again without further human intervention."[25]

The court observed that "the electronic process of contracting was automated"[26] and that:

> "the correct legal analysis is that the relevant insurers, expressly or impliedly, invited brokers who had access to the appropriate SSP software

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22 Nick Szabo, *Smart Contracts: Building Blocks for Digital Markets*, 1996.

23 Eliza Mik, *supra*, at page 169.

24 [2007] EWHC 971, at paragraph 19.

25 *Idem*, at paragraph 20.

26 *Idem*, at paragraph 64.

to use the computer programme for the purpose of contract formation, and that the insurers undertook that, if the brokers followed the pre-programmed procedures, they would be bound by the automatically generated result, even if they (the insurers) were temporarily unaware of that result."[27] (Emphasis added.)

Drawing an analogy with *Thornton v Shoe Lane Parking* [1971] 2 QB 163 (which it will be recalled held that a ticket vending machine was an offer), the court said:

"Similarly, in the present case, insurers hold out the SSP software as the *automatic medium for contract formation*. Once the broker, like the plaintiff in *Thornton* putting his money into the machine, has input the necessary data into the electronic process, no further human intervention is necessary for the formation of a binding contract between broker and insurer."[28] (Emphasis added.)

Even though contracts were made electronically, rather than mechanically, that did not "alter the application of the basic legal principles."[29]

In rare situations the English courts may be willing to depart from a traditional offer and acceptance analysis in establishing whether the requirement that the parties have reached agreement has been satisfied. For example, they may be willing to find that a contract can come into existence, not as a result of offer and acceptance, but during and as a result of performance.[30]

Such an approach may be relevant to some smart contracts (particularly those whose initiation process does not include clear offer and acceptance messaging).

Consideration: under English common law, a promise has no contractual force unless some value (known as "consideration") has been given for it. However, the English courts do not concern themselves with the question whether "adequate" value has been given, and in many instances they readily find consideration for commercial arrangements made in a purportedly contractual context. Consideration can even be constituted by mutual promises where neither party is obliged to do anything at the date of signing but at some future date.

Other things being equal, in the absence of express smart contract terms providing for consideration, an English court is likely to look to see if there is an exchange of value, or mutual benefit and burden, in considering whether a smart contract is supported by consideration.

Intention to create legal relations: even if an arrangement is supported by consideration, it will not be a legally binding contract under English common law if it the parties did not have an intention to create legal relations.

Under English common law, an intention to create legal relations is measured objectively (that is, the parties have an outward appearance of intending to contract, even if this does not reflect a subjective reservation of some sort).[31]

In the case of ordinary commercial transactions it is not normally necessary to prove that the parties to an express agreement in fact intended to create legal relations. The burden of proving that there

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27 *Idem*, at paragraph 65.

28 *Idem*, at paragraph 67.

29 *Idem*, at paragraph 68.

30 See the authorities cited by the Supreme Court in *RTS Flexible Systems Ltd v Molkerei Alois Muller Gmbh & Company KG (UK Production)* [2010] UKSC 14 at paragraph 50. The Supreme Court considered that performance was a very relevant factor pointing in the direction of there being a binding contract, although it ultimately depends on all the circumstances of the case.

31 *RTS Flexible Systems Ltd* v *Molkerei Alois Muller Gmbh & Company KG (UK Production)* [2010] UKSC 14, at paragraph 45.

was no intention is on the party who asserts that no legal effect is intended, and the burden is not lightly discharged.[32]

In deciding whether the burden has been discharged, "the courts will be influenced by the importance of the agreement to the parties, and by the fact that one of them acted in reliance on it."[33]

It follows that, if the other requirements for a legally binding contract are satisfied in the case of a smart contract, it may be difficult for a party to assert, as against the other party who acted in reliance on it, that there was no intention to create legal relations in relation to the smart contract.

However, where a smart contract performs by purporting to enter the parties into other, separate "follow-on" contracts, the English courts would need to determine whether such follow-on contracts are in fact legally binding contracts. (Although follow-on contracting is potentially relevant to a number of the requirements for the formation of a legally binding contract, the issues in relation to it can best be examined in terms of intention to create legal relations.)

With the advent of electronic commerce over the Internet, many commentators have questioned whether "electronic agents" (or "bots") could autonomously enter parties into legally binding contracts.[34] Such commentators have considered a range of theories that could support (or deny) contractual force at common law to contracts initiated by electronic agents, including that:

- electronic agents should be accorded agency status to bind a party. Here it is worth noting that the English High Court in *Software Solutions Partners Ltd, R (on the application of) v HM Customs & Excise* [2007] EWHC 971 observed that an automated system could not be regarded as an agent, because only a person with a mind could be an agent in law[35]

- electronic agents should be accorded separate legal personality to bind a party. Such a development would probably require legislation

- electronic agents should not be able to bind a party where they are fully autonomous. So the argument, goes, "[i]n a fully automated system, human decisions are involved in creating the system and making it accessible; humans assent to the system, not specific transactions. Traditional contract doctrine looks at the intention of the parties surrounding the offer and acceptance of the specific agreement in dispute. As such, it is not clear whether people can be bound by offers or acceptances made by their computer on their behalf. They may have had no knowledge of, let alone intention to enter, a given transaction."[36] However, it will be recalled that, under English common law, intention to create legal relations is in fact measured objectively, not subjectively

- an electronic agent should, some commentators argue, be regarded as a mere communications tool. The pre-determined program logic of an electronic agent should therefore simply be equated with the actions of the party that put it in motion (even if that includes an ability to make autonomous decisions). As the argument goes, software "does not make its 'own' decisions but executes earlier human decisions within the limits of pre-set parameters."[37]

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32 *Edwards* v *Skyways Ltd* [1964] 1 WLR 349, at page 355.

33 Chapter 2 (the Agreement), <u>Chitty on Contracts</u>, Volume 1, 32nd edition, Sweet & Maxwell, 2015, at paragraph 2-168.

34 See, for example, Tom Allen and Robin Widdison, *Can Computers Make Contracts?* [1996] 9 Harvard Journal of Law & Technology 25; Emily Weitzenboeck, *Electronic Agents and the Formation of Contracts*, International Journal of Law and Information Technology, Volume 9, pages 204 – 234; and Anthony Bellia, *Contracting with Electronic Agents* [2001] 50 Emory Law Journal 1047.

35 [2007] EWHC 971, at paragraph 67.

36 David Castell, *Electronic Contract Formation*, Juris Diction IT, 1997, http://www.jurisdiction.com/ecom3.htm.

37 Eliza Mik, *Certainty at Last? A "New" Framework for Electronic Contracting in Singapore* [2013] 8 Journal of International Commercial Law and Technology 160, at page 174.

This last point is perhaps reflected in the rationale of the English High Court in S*oftware Solutions Partners Ltd, R (on the application of) v HM Customs & Excise* [2007] EWHC 971, described above. Similarly the Singaporean High Court (the courts of Singapore traditionally closely follow English common law) has observed that:

"It is not really in issue that contracts can be effectively concluded over the internet and that programmed computers sending out automated responses can bind the sender. ... The fact that the acceptance was automatically generated by a computer software cannot in any manner exonerate the defendant from responsibility. It was the defendant's computer system. *The defendant programmed the software.*"[38] (Emphasis added.)

However, given the absence of English authority directly on point, it remains an open question as to whether follow-on contracts initiated by a smart contract could have legally binding contractual effect under English common law.

Certainty / completeness of terms: an arrangement may lack contractual force under English common law if it is too vague or uncertain.

English common law can use a number of principles to resolve such problems, but they cannot always be resolved. The arrangement may satisfy the requirement of contractual intention, but still be too vague to have contractual force.[39]

For these reasons smart contracts that operate purely to digitise processes may, in the absence of contractual terms relating to them, simply lack contractual force on the basis that their terms are incomplete, too vague or too uncertain.

On the other hand, where a smart contract's terms are embodied in code alone (in the absence of a natural language rendering), if there is a lack of certainty relating to them, an English court may be willing to admit expert evidence as to the meaning of the code.

English law lessons for smart contracts: it is apparent that the usual rules relating to contract formation will probably apply under English law to determine the legal status of a smart contract. Whether a particular smart contract gives rise to a legally binding contractual arrangement under English law may turn in part on the type of smart contract at issue and the factual matrix within which it operates. The fact that it may be wholly electronic is unlikely to be determinative.

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38 *Chwee Kin Keong and Others* v *Digilandmail.com Pte Ltd* [2005] 2 LRC 28 at paragraphs 134 and 136 (High Court, Singapore).

39 *Dhanani* v *Crasnianski* [2011] EWHC 926.

United States of America

While US contract law arose out of the English common law, it has evolved into its own unique creature. Contracts can still be formed pursuant to common law principles, but transactions for the sale of goods are typically governed by the Uniform Commercial Code, or UCC, as adopted and sometimes modified by individual states. In fact, while certain principles are universal in the United States, contract law does vary by state – sometimes significantly – and here we offer only a generalized description of United States law.

At its core, US law requires the following for a contract to be enforceable: an offer, acceptance, intent, and consideration:

- **offer and acceptance**: an offer is the statement of what someone is going to do or not going to do. For example, an offer would be to sell something or pay someone or provide some service. An acceptance means an agreement to what has been offered. Most of the time, any changes to the terms or the offer will be considered to be a counteroffer, which must be also accepted for a contract to be created[40]

- **intent:** a core principle of contract law is intent: did the parties intend to enter into an agreement (did they intend to be bound) and, if they intended to be bound, to what did the party intend to be bound? Intent is determined from an objective perspective.[41] Contracts are generally interpreted by reference to their terms and, only if the terms are ambiguous, by external evidence of the intent of the parties.[42] When contracts or terms are held to be ambiguous, they are generally construed against the party who

drafted the contract, especially in the context of an unsophisticated party agreeing to a standard form (template) contract[43]

- **consideration:** finally, consideration is generally anything of value, even if very slight, exchanged between the parties.[44] However, a binding contact would normally not be formed by the mere giving of a gift.[45]

Shrinkwrap and clickwrap cases: with respect to smart contracts, the question is whether the required elements of contract law will exist and how they will be proved. Some comparisons relating to how the courts have dealt with new technologies in the past may be of use. For example, smart contracts may evolve like "clickwrap" agreements. A clickwrap agreement is one formed over the Internet typically when a website posts terms and conditions to which the user clicks an "I Accept" button.

Generally, US courts have held clickwrap agreements (and similar shrinkwrap agreements)[46] to be enforceable, recognizing that parties in a modern context do not need to consider and negotiate every term.[47] However, US courts still require notice of the existence of a term before agreement to it.[48] Whether a party to a contract is on sufficient inquiry notice of a term not read by a contracting party may depend on how conspicuous

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40 Restatement (Second) of Contracts § 59.

41 *Empro Mfg. Co. v Ball-Co Mfg., Inc*, 870 F.2d 423, 425 (7th Cir. 1989) ("'intent' in contract law is objective rather than subjective").

42 *See Haeberle v Tex. Int'l Airlines*, 738 F.2d 1434, 1438-39 (5th Cir. 1984).

43 *See Farmers Auto. Ins. Ass'n v St. Paul Mercury Ins. Co.*, 482 F.3d 976, 977-78 (7th Cir. 2007).

44 *See Exch. Nat'l Bank of Chicago v Daniels*, 768 F.2d 140, 143 (7th Cir. 1985) ("This is a lot more than a peppercorn, which would be consideration enough").

45 *See, e.g., Congregation Kadimah Toras-Moshe v DeLeo*, 540 N.E.2d 691, 692 (1989) ("there was no legal benefit to the promisor nor detriment to the promisee, and thus no consideration.").

46 A shrinkwrap agreement is one where a consumer is found to have accepted the terms and conditions contained inside a product that were unknown to the consumer until after purchase.

47 *See, e.g., Hill v Gateway 2000, Inc*, 105 F.3d 1147, 1150 (7th Cir. 1997).

48 *Register.com, Inc v Verio, Inc*, 356 F.3d 393, 403 (2d Cir. 2004).

the term is, whether and the extent of the course of dealing, and industry practice.[49] It really comes down to whether reasonable people would have known that the terms existed and what conduct equated with assent, with many US courts being concerned about "unequal bargaining power" (particularly in the context of retail investors).

US courts are apprehensive of applying terms to a contract, however, if the assent was limited to other aspects of the contracting process. For example, US courts have found that clicking a "Yes" button in connection with transmitting credit card data could not bind the purchaser to terms emailed to him after the enrollment process was completed.[50]

Clues concerning electronic agents: the section of this White Paper concerning English law dealt with the legal status of "follow-on" contracts entered into by so-called "electronic agents". There are a number of helpful US cases which shed light on the issue of whether the US courts will enforce contracts entered into by such electronic agents:

- at one end of the spectrum, a federal court has held that merely issuing an order tracking number was "an automated, ministerial act" that did not constitute acceptance for contractual purposes;[51]

- in contrast, in the context of an insurance company's liability to cover an automobile accident, the court in that case held that the computerized reinstatement of the insurance policy "was the direct result of the errors and oversights of State Farm's human agents and employees. The fact that the actual process of

the policy was carried out by an unimaginative mechanical device can have no effect on the company's responsibilities for those errors and oversights."[52]

In the equities markets, a customer can place limit orders "where the customer specifically instructs the market maker to execute a trade when the stock reaches a particular price."[53] In essence, the customer agrees to the automatic execution of a trade when a future event occurs (specifically a stock falling or rising to an agreed price). US courts have discussed limit orders in detail without questioning that customers are bound by the resulting transactions.[54] It is highly doubtful that a customer could successfully argue that it should not be bound by the execution of a limit order it put into place.

US lessons for smart contracts: in the context of smart contracts, the parties will need to consider a number of key questions, including:

- how will the parties give assent to the terms and conditions inherent in the smart contract?

- what steps need to be taken to ensure that courts are satisfied that the parties have sufficient notice of the contract's terms?

- what steps must a customer take to be held to a contract which is ultimately executed by an electronic agent?

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49 *Schnabel v Trilegiant Corp*, 697 F.3d 110, 121–22 (2d Cir. 2012).

50 *Ibid*.

51 *Corinthian Pharmaceutical Sys., Inc v Lederle Labs.*, 724 F. Supp. 605, 610 (S.D. Ind. 1989).

52 *State Farm Mut. Auto. Ins. Co. v Bockhorst*, 453 F.2d 533 (10th Cir. 1972). (The court also emphasized the human element of the policy reinstatement: "The computerized reinstatement of the policy was not unavoidable as State Farm alleges").

53 *S.E.C. v Pasternak*, 561 F.Supp.2d 459, 482 (D.N.J. 2008).

54 See, e.g., *idem* at 517 (refusing to find violative conduct involving trades which included limit orders); *Newton v Merrill, Lynch, Pierce, Fenner & Smith, Inc*, 135 F.3d 266, 269 (3d Cir. 1998) (addressing claims that limit orders were not executed properly by defendants).

The US cases cited above indicate that it will be critical to show that the purchaser has given assent and shown intent to be bound by affirmatively taking a step. US courts, as with shrinkwrap and clickwrap, will likely develop standards to determine whether a particular contract (or term of a smart contract) has been sufficiently agreed to be enforceable, but it will likely turn on what affirmative steps of assent the parties take, what terms the parties can access, how accessible the terms are, and the connection of the parties' control over an electronic agent acting on their behalf.

As at the time of writing, precedent indicates that US courts are open to the possibility of valid automatic contracting in appropriate circumstances. As described above, US courts are willing to attribute the actions of a software program to the person/organization that intentionally uses it, and liability for the programmed actions rests with that person/organization. However, the willingness to impose liability will not be limitless.

Australia

The key elements required for the formation of a legally binding contract in Australia are largely similar to those under English law outlined earlier in this White Paper.

The Electronic Transactions Act 1999 (Cth) (ETA) was passed as part of the "strategic framework for the development of the information economy in Australia."[55] The aim of this legislation is to enable electronic commerce to operate on the same footing as traditional, paper-based commerce. The ETA is based on the United Nations Commission on International Trade Law Model Law on Electronic Commerce of 1996.[56] To a large extent, the ETA merely clarifies certain existing common law principles as they apply to electronic transactions, rather than dramatically departing from the established rules of Australian contract law.

Formation of electronic contracts: the ETA deals with the formation of electronic contracts. Section 8 establishes the basic rule that a transaction is not invalid merely because it took place by means of electronic communication. A requirement to give information in writing is satisfied if it is given electronically, provided that it will be reasonably accessible in future and the recipient has consented to electronic provision.[57] The ETA also sets out the requirements for a valid signature by electronic means[58] and clarifies when electronic communications are deemed to be sent and received.[59]

Automated contracts: section 15C of the ETA provides that a contract formed by the interaction of an automated message system and a natural person, or the interaction of automated message systems, is not unenforceable purely for the

reason that no natural person was involved in the contracting process. An "automated message system" includes a computer program, without review or intervention by a natural person each time an action is initiated or a response generated by the system.

Accordingly, a contract concluded between a natural person and an "electronic agent" (as discussed above), or even between two "electronic agents", is not unenforceable purely for the lack of human involvement. This means that, even in cases where an agreement is reached through the interaction of two smart contracts, such an agreement will not be unenforceable purely because no natural persons were involved.

However, it should be noted that, in some cases, where a natural person is involved in electronic contracting, there is a right to withdraw certain electronic communications where an error has been made by the natural person. This is achieved by contact with the system, as long as that is done as soon as possible and no material benefit has been received by that time by the party who made the error.[60]

Offer and acceptance: the ETA clarifies the position in relation to offer and acceptance in the context of electronic agreements. Section 15B provides that a proposal to form a contract made through electronic communications which is not addressed to specific parties and is generally accessible to everyone is to be considered as an "invitation to treat" (and not an offer in itself). That applies unless the proposal clearly indicates that the party making the proposal intends to be bound in case of acceptance by a recipient of that proposal.

This means that, in most cases, an online merchant is generally not taken to have indicated an

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55   Revised Explanatory Memorandum, *Electronic Transaction Bill* 1999 (Cth).
56   *Ibid*.
57   Section 9 of the ETA.
58   Section 10 of the ETA.
59   Section 14 of the ETA.

60   Section 15D of the ETA; *Theol v Bike Bug Pty Ltd* [2014] NSWCATCD 123.

intention to be contractually bound until such time as it has accepted the price offered by a customer. In the case of a smart contract, the expectation is that the electronic communication will usually be directed to a specific counterparty. In such cases, the communication would be characterised as an offer, open for acceptance by the counterparty in order to create legally binding rights and obligations.

Other key requirements: as mentioned above, the other key requirements to form a legally binding contract in Australia are the same as those under English law, namely: an intention to create legally binding obligations and consideration. The terms of the agreement must also be certain. The comments made in respect of each of these requirements in relation to English law (above) largely also apply in the Australian context. The test applied by courts to determine whether parties intend to create legal obligations is an objective one.[61] Generally speaking, the intention to create binding obligations is presumed in a commercial context.[62] The uncertainty surrounding intention in circumstances where a contract is concluded with an electronic agent is ameliorated in Australia by section 15C of the ETA. As is the case under English law, the terms of any smart contract will need to be sufficiently certain in order for it to be legally enforceable.[63]

It is important to note that the ETA does not apply in all cases. It explicitly does not apply, for example, to documents produced for migration purposes, cheques, bills of exchange and in certain situations which involve Australian corporations.

The position under the Corporations Act 2001 (Cth) (Corporations Act) is that third parties who contract with an Australian company, without any notice of a defect in the authorisation of the persons who

have signed on behalf of the company, are entitled to rely on certain statutory assumptions as to the validity of that contract, if that contract is executed in compliance with that legislation.[64]

There is some debate among Australian commentators as to whether electronic execution of contracts by companies is sufficient to satisfy the formal execution requirements of the Corporations Act. However, even if reliance is placed solely on common law principles, there is nothing which explicitly prohibits two parties from concluding an agreement by way of electronic communication, provided that the key requirements for a binding contract are met.[65] Accordingly, as is the case under English law, there is no theoretical objection to using any form of electronic message for the purposes of communicating an offer and its acceptance.

Each state and territory in Australia has passed its own legislation regulating electronic transactions. These laws are substantially similar in most respects, but are not identical. Accordingly, the position may vary in relation to some matters, including when the ETA does and does not apply.

There have not been many decisions relating to the enforceability of electronic contracts in Australia. However, we would expect that the relevant Australian court will consider those issues with reference to common law principles, as modified by any applicable legislation. As can be seen below, Australian courts have generally been receptive to enforcing contracts that have been concluded by electronic means.

In *eBay International AG v Creative Festival Entertainment Pty Ltd*,[66] it was held that a binding contract of sale was concluded when the purchaser completed the online process on the website.

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61 *Taylor v Johnson* (1983) 151 CLR 422.

62 Thomson Reuters, *The Laws of Australia* (at 24 August 2016) Contract: General Principles, 'Commercial Transactions' [7.1.240].

63 *Thorby v Goldberg* (1964) 112 CLR 597.

64 Sections 127-129, Corporations Act.

65 *McGuren v Simpson* [2004] NSWSC 35.

66 [2006] FCA 1768.

The court noted:

> "The Ticketmaster online purchase was a contract in writing signed by the parties. By clicking on the relevant buttons and, by the computer bringing up all terms needed to purchase a ticket, on behalf of Ticketmaster as agent for Creative, the whole transaction was in writing, signed and agreed by the parties. The contract was signed electronically by clicking on the relevant buttons agreeing to the terms and conditions, paying for the goods and receiving confirmation of the order by email."[67]

The enforceability of online terms and conditions was considered in *Centrebet Pty Ltd v Baasland*,[68] where it was found that a contract was concluded when the customer opened an account by completing an online form. This required the applicant to tick a box acknowledging that he understood the relevant terms. The contract was held to be enforceable.

Similarly, in *Smythe v Thomas*,[69] the court ordered specific performance in relation to the disputed purchase of an aircraft. It was held that a valid contract of sale had been concluded through eBay and that the seller was not entitled to impose additional conditions after conclusion of the contract. The court had no difficulty in finding that online auctions were akin to (and as legally binding as) their "real-world" counterparts, noting that:

> "Two matters which commerce has always cherished, access and certainty, are achieved by the combination of internet technology and acceptance by prospective buyers and sellers of the conditions for use of the particular site and its facilities."[70]

The court reached conclusions in all three cases without the need to resort to any legislation insofar as the enforceability of the contracts was concerned, and relied solely on common law rules of contract.

Australian law lessons for smart contracts: we consider that that these Australian common law rules are flexible enough to cope with the digital age,[71] in the absence of any separate body of law that governs agreements formed by electronic means. The usual rules of Australian contract formation apply, together with any other substantive Australian law which would have applied had the contract been concluded using paper and signed in ink by the parties. The ETA clarifies certain aspects of these long-established Australian common law principles as they apply to contracting by means of electronic communications.

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67 *Idem*, at paragraph 19.
68 [2013] NTSC 59.
69 [2007] NSWSC 844.

70 *Idem*, at paragraph 36.
71 Philip Argy and Nicholas Martin, *The Effective Formation of Contracts by Electronic Means* [2001] 46 Computers & Law 20.

Canada

Canada is a common law jurisdiction. The same principles and analysis pertaining to smart contracts under English law are also largely applicable to Canada. In particular, the basic elements of entering into contracts are identical in Canada to those under English law: there must be offer and acceptance, consideration, an intention to create legal relations and certainty as to the terms of the contract. These elements are discussed elsewhere in this White Paper; the focus here is on the more unique points of Canadian law as they may apply to smart contracts.

Electronic contracts: as a starting point, since they are entered into electronically, smart contracts will be subject to the provincial implementations of the Uniform Electronic Commerce Act (UECA), a model law enacted in 1999 and designed to implement the principles of the UNICATRAL Model Law on Electronic Commerce.

The provincial implementations of this legislation, which apply to virtually any legal relationship requiring documentation, expressly allow the formation of contracts by way of electronic offers and acceptance, and provide rules for when an electronic document is deemed to have been sent or received. Therefore, in Canada UECA clearly provides that, as a baseline, contracts entered into by electronic means can be enforceable.

The legislation is silent, however, on a number of fronts of significance to smart contracts, including, for example, exactly what kind of electronic communication constitutes an offer and an acceptance. These continue to be left to the common law.

Internet contracting analogies: currently, there is no Canadian case law directly addressing the enforceability of smart contracts. However, some general guidance may be drawn from cases dealing with the enforceability of contracts entered into over the Internet.

Generally, Canadian courts have been willing to enforce Internet contracts, which suggests they may be amenable to enforcing smart contracts. The Canadian jurisprudence tends to focus on four requirements in enforcing Internet contracts:[72]

- both parties must have sufficient notice of the terms of the contract, removing uncertainty as to these terms[73]

- there must be an opportunity to consider and decline the contract[74]

- there must be evidence of mutual acceptance of the contract[75]

- There must be no unconscionable contractual terms.[76]

The first three of these factors are often intertwined and merit some discussion.

In *Rudder v Microsoft Corp*, notice and certainty of terms were of particular concern to the court. The plaintiffs in that case were held to have entered into a valid Internet contract when they clicked an "I agree" button after being presented with a scrollable "Member Agreement".[77] The court found that the plaintiffs consented to the agreement, even though they had not read the agreement or even scrolled through it.[78] Simply being presented with the "Member Agreement" constituted notice, and clicking "I agree" constituted acceptance of the contract.

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72 CED 4th (online), *Internet Law* "Online Contracting" (II.1.(g)) at §85.

73 See for ex, *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at para 107.

74 *Rudder v Microsoft Corp*, [1999] O.J. No. 3778 at para 14.

75 *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at paras 73-74.

76 *Kanitz v Rogers Cable Inc*, [2002] O.J. No. 665 at paras 13, 35 – 37.

77 *Rudder v Microsoft Corp*, [1999] O.J. No. 3778 at paras 12 – 14, 17 – 18.

78 *Rudder v Microsoft Corp*, [1999] O.J. No. 3778 at paras 6, 13 -14.

Theoretically, therefore, it appears Canadian courts would be open to finding that acceptance can be validly given through the means of a smart contract provided that, as is the case under English law, the parties had sufficient notice of what was being offered and accepted.

Indeed, the idea of reasonable notice of the terms of the contract is critical when it comes to enforceability of Internet contracts, because it promotes certainty of the terms.[79] The importance of such certainty was again emphasized in *Douez v Facebook, Inc*, where the court held that a valid contract was formed when the plaintiff actively agreed to the website's terms of use upon registering for an account.[80]

Similarly, *Century 21 Canada Ltd Partnership v Rogers Communications Inc* highlighted notice and acceptance as being the main determinants of a binding Internet contract.[81] The court held that a valid contract was formed when the defendant browsed the plaintiff's website after being notified that use of the website would subject users to its "Terms of Use".[82] The court stated:

> "As previously discussed, where notice of the Terms of Use is established along with the knowledge that using the Website will serve as agreement to the Terms of Use, then I am satisfied that agreement is proven. As noted in the browse wrap cases, the act of proceeding further into the website is sufficient to communicate agreement. I find that Zoocasa's conduct formed a contract. It is not a case of a contract being imposed without their assent."[83]

Automated performance: the court in *Century 21* appears to hint that performing the steps involved in the contract (which, in *Century 21*, included proceeding further into the website) may be sufficient to indicate that a valid contract has been formed, provided that notice of such implications had been delivered. The result in *Century 21* turned on the defendants having knowledge that use of the website will serve as agreement to its terms of use, and their having been notified of those terms.[84] This is significant in the context of smart contracts, because it indicates that, as in the case of English law, automated performance of a contract based on previously known rules may well be upheld.

Some unresolved issues: notwithstanding the view reached in the previous paragraph, if a smart contract is designated to a distributed ledger by one party, potential issues could arise as to whether there have been valid offer and acceptance. The smart contract itself could designate what constitutes offer and acceptance, but there is no guarantee that courts will accept this designation.[85]

Establishing reasonable notice in respect of a piece of computer code could be challenging. Inherently, it would be difficult fully and accurately to explain the code to both parties, especially if they are not well versed in coding. Thus, establishing consensus *ad idem* between the parties in respect of the code may be problematic, as the parties' understanding of the code may differ. These differences in understanding would likely be exacerbated in situations where one or both of the parties are mistaken in their understanding of the code. As is the case under English law, given the absence of authority on this point in Canada, it remains unresolved whether so-called "follow-on" contracts initiated by a smart contract could have binding effect.

79 Barry Sookman, *Computer, Internet and Electronic Commerce Law* (Toronto: Carswell, 1988) (loose–leaf updated 2015), chapter 10 at 10.4.

80 *Douez v Facebook, Inc*, 2014 BCSC 953, reversed on other grounds [2015] B.C.W.L.D. 4708.

81 *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at para 73.

82 *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at paras 132 – 134.

83 *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at para 134.

84 *Century 21 Canada Ltd Partnership v Rogers Communications Inc*, 2011 BCSC 1196 at paras 132 – 134.

85 *Ibid*.

Unconscionability considerations: finally, unconscionability is another area of significant concern to Canadian courts in their analysis of Internet contracts. Canadian courts have found that such terms exist when three elements are present:

- there is an inequality of bargaining power

- the stronger party preyed upon the weaker one

- the result was an improvident agreement.[86]

Questions about unconscionability are particularly relevant in the context of Internet contracts where one party is often a large corporation making an offer to a single consumer (that is, B2C contracts). It is likely that smart contracts between parties in similar situations of unequal bargaining power will be subject to the same scrutiny.

Canadian law lessons for smart contracts: while it is not yet clear whether smart contracts will be legally binding in Canada, it is reasonable to suppose that the courts probably will not take a fundamentally different approach to contract law in relation to a smart contract from that routinely applied by them in relation to any other document. However, there remain several potential legal hurdles to their enforceability under Canadian law.

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86 *Kanitz v Rogers Cable Inc*, [2002] O.J. No. 665 at para 37.

China

The legal status of a smart contract has not, as far as we are aware at the date of writing, yet been the subject of legal proceedings in the People's Republic of China (PRC).

The PRC recognises that contracts signed in electronic form are as valid as contracts signed in written form. Where Chinese laws or administrative regulations require a contract to be concluded in written form, that contract must be made in written form. The PRC Electronic Signature Law provides that a data message has the same legal effect as a written document as long as it can be displayed in a tangible form and is retrievable on demand.

The PRC Electronic Signature Law further enables electronic contracting by giving the same legal effect to electronic signatures as to a traditional ink signature. It follows that a reliable electronic signature is deemed to have equal legal force as a handwritten signature or seal.

In determining whether an electronic transaction such as a smart contract is concluded and valid as a contract under Chinese law, a Chinese court will look at both PRC Contract Law and the PRC Electronic Signature Law.

Formation of contract: PRC Contract Law distinguishes the formation of a contract from its effectiveness:

- formation occurs when there is an accordance of minds among the parties, which is normally concluded by means of an exchange of an offer and an acceptance

- for a contract to be effective, on the other hand, it must satisfy several conditions prescribed by law. For example, where a law or administrative regulation requires approval or registration, a

contract shall take effect only after the successful completion of such requirements. As such, a contract in China may be formed without having a legally binding effect. It is important to bear this in mind when analysing the legal status of a particular smart contract.

PRC Contract Law refers extensively to the UNIDROIT Principles of International Commercial Contracts in relation to the concepts of offer and acceptance, as follows:

- an offer is a party's manifestation of its intention to enter into a contract with the other party. Such an offer needs to have terms that are specific and definite, and to indicate that, upon acceptance by the offeree, the offeror will be bound thereby. There are two elements that an offer must contain: (a) a manifestation of intent; and (b) intention to make a contract with others. An offer becomes effective when it reaches the offeree. It can be withdrawn, revoked or terminated in accordance with law

- acceptance can be achieved by notification, by conduct in line with business practices, or in accordance with the terms of the offer. An acceptance may be withdrawn provided that notice of withdrawal reaches the offeror before or at the same time as the notice of acceptance.

Data messages: how might such requirements potentially relate to smart contracts? There are a number of considerations. If a contract is concluded by means of a data message, the time when the data message first enters any of the recipient's systems shall be regarded as the time of arrival. If the recipient designated a special system for receiving the data message, the time of arrival is when the data message first enters that special system. It is currently not clear whether

a designated special system could include a distributed ledger that hosts a smart contract application.

Letter of confirmation: where the parties conclude a contract in the form of data messages, ether party may request that it be given the option to sign a letter of confirmation before conclusion of the contract. The contract shall then be established at the time when the letter of confirmation is signed. The ability to request a letter of confirmation may, under Chinese law, limit the efficacy of contracting via smart contracts (because a core virtue that those who advocate smart contract technology put forward for the technology is that it is an entirely electronic form of transacting).

Location of conclusion of contract: from a technical/IT perspective, smart contracts are recorded on a distributed ledger. As already described, a ledger comprises identical copies of data held in the systems (computers or "nodes") of the participants to it. Those participants and their systems will in many cases be in different places.

With regard to the place of conclusion of a contract, it is provided specifically in PRC Contract Law that the place of dispatch of a data message is the principal place of the sender, and the place of receiving is the principal place of the recipient.

Terms not provided for: obviously the content of a contract needs to be agreed between the parties. Under PRC Contract Law, in cases where a contract does not provide for terms such as quality, price or remuneration and place of performance, or where such provisions are unclear, the parties may agree on supplementary terms through consultation. In cases where the parties have failed to agree, such terms shall be determined in light of relevant clauses in the contract and trade practice.

This means that, if a particular smart contract does not contain all such terms, under PRC Contract Law there are still mechanisms by which such terms

could be determined if it is found that a contract has in fact been concluded.

Evidence of electronic contracts: PRC Contract Law does not address the evidential issues in proving the formation of an electronic contract. This issue is addressed in the PRC Electronic Signature Law. The PRC Electronic Signature Law prescribes how a data message (such as those used in initiating smart contracts hosted on distributed ledgers) fulfils the legal requirement of originality, retention and admissibility as evidence.

In general, a contract in an electronic form would be recognised as admissible evidence under PRC law. The Civil Procedure Law, the Criminal Procedure Law and the Administrative Procedure Law of the PRC contain express provisions stating that admissible evidence includes electronic evidence. All admissible evidence (including both electronic evidence and non-electronic evidence) must meet the requirements of authenticity, relevance and legitimacy. A data message is authenticated if it can be evidenced by its reliability of methods of creation, storage or transmitting, the reliability of the methods of integrity, and reliability of methods of identifying the sender.

Standard form contracts: usually in electronic contracting a standard form contract template is adopted in advance for the purpose of repeat use by the parties. Such standard form contract template is typically not the subject of negotiation with the other side at the time when a particular the contract is concluded, based on its terms.

PRC Contract Law requires that the party determining the terms of such a standard form contract template must adhere to the principle of fairness in defining the rights and responsibilities of the parties, and must take reasonable steps to draw the other party's particular attention to those clauses which exclude or restrict its liabilities, and must explain the effect of such clauses.

If the standard form contract contains terms which enable the party which determines those terms to exempt itself from its liabilities, or to exclude the rights of other party, such standard terms shall be null and void. Where there is a discrepancy in the interpretation of a standard term, such term shall be interpreted in line with general/common understanding. If there are two or more potential interpretations, an interpretation unfavourable to the party determining the standard term will be adopted.

It follows from this that, if a smart contract has been found to give rise to a concluded contract, where it takes a standard form determined by one of the parties, its terms may not be definitive under Chinese law in certain circumstances. Chinese law may intervene to determine meaning or to strike out clauses.

Chinese law lessons for smart contracts: given the absence of express provisions under the current PRC laws and regulations with respect to the position of smart contacts, it is possible that the usual rules of contract formation and evidence of electronic contracting will apply.

Additionally, the principles and provisions under other substantive law (such as the General Principles of Civil Law and Laws on the Protection of Rights and Interests of Consumers) shall apply if a contract has been concluded, especially the principles of voluntariness, fairness and good faith when parties to a smart contract have unequal bargaining power.

France

Under French civil law, four key elements are required for the formation and validity of a legally binding contract:

- consent ("*le consentement*"). The parties must reach a mutual agreement through an offer and a corresponding acceptance

- legal capacity of the parties to enter into a contractual relationship ("*la capacité*")

- determined or determinable object of the obligation ("*l'objet*")

- an existing and lawful cause of the obligation ("*la cause*"). The cause is similar to the principle of consideration under English common law.

French civil law does not require prescribed formalities, except under specific circumstances and/or with respect to particular contracts (for example, sale of real estate, marriage contracts, transfers of IP rights) to enter into a contractual relationship. A written document and the signature of the parties are usually only required for evidence of the contract's existence and of each party's consent.

Recent changes in French contract law: French contract law was reformed in 2016,[87] and a modified version of the French Civil Code relating to contract law will apply to contracts formed from 1 October 2016. Contracts formed before 1 October 2016 will continue to be governed after this date by the current rules.

- The reform introduces important modifications to French contract law, but its impact on contract formation remains limited. Many new articles of the French Civil Code have been introduced to reflect the French Supreme Court's case law relating to contract formation. Through this reform, the terms of "*objet*" and "*cause*" were removed from the French Civil Code, although such concepts remain under the general term of "*contenu*" (content) of the obligation. What follows outlines the pre and post reform position in relation to French contract law.

Consent reached through an offer and its acceptance: under French civil law, consent is the fundamental criterion of any contract formation. Each party must have the intention to be bound by legal obligations. Without such intention to create legal obligations, consent cannot be reached.

Mutual consent of the parties is always reached through an offer made by one party, and its acceptance by the other. The offer must be firm, sufficiently precise and complete, so that its acceptance would simply form the contract.

According to the French Supreme Court, to be valid, "an offer must indicate the intention of its author to be bound in case of acceptance".[88] If the offer lacks precision, this would not be deemed a binding offer but merely an invitation to enter into negotiations. The acceptance of a non-binding offer would not result in the formation of a contract (but would simply confirm pre-contractual negotiations).

A valid offer may be made for a specific time, indicated by its author, or for a reasonable time allowing the recipient to be able to study the offer and provide a response.

To form a contract, the essential elements of the offer must be accepted. This implies that the recipient of the offer has been able to look into its terms before accepting it. An incomplete acceptance of the essential terms of the offer would not form a binding contract, but constitutes a mere counter-offer which would need to be accepted.

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87 *Ordonnance n°2016-131 du 10 Février 2016 portant réforme du droit des contrats, du régime géneral et de la preuve des obligations.*

88 French Supreme Court: Cass. com., 3 June 2003, n° 00-17.008.

The French contract law reform does not introduce major modifications to the rules of offer and acceptance, but introduces a pre-contractual obligation for a party to provide information which is decisive for the other party's consent.

Electronic contracts: the reform also maintains the specific provisions relating to electronic contracts. The French Civil Code specifically envisages the possibility of entering into a contractual relationship by electronic means.

In B2B contexts, there are no limitations on the use of electronic means to enter into a contract (which, for instance, could be exclusively concluded by email exchanges). Smart contracts could therefore be formed under French contract law, provided the essential terms of such contract would be accessible and understandable by each party, and that a technical mechanism would allow each party to express its consent (by the use of cryptographic means, for instance).

The French Civil Code specifically provides for the validity of an electronic signature, using asymmetric cryptography, to express a party's consent to a contract. Distributed ledger technology typically uses asymmetric cryptography, which can also be used in relation to smart contracts too. Where that is the case, the current rules governing electronic signature could apply to smart contracts.

The French Supreme Court adopted a ruling in 2015[89] regarding contract formation by email exchanges. A chartered accountant was required by email to provide tax advice to a company. After the services were provided by the accountant, the company refused to pay for these services, claiming that the email sent to the accountant was not a contractual offer but merely constituted contact to obtain pre-contractual information. The French Supreme Court ruled that the email sent was

sufficiently precise and clear to be deemed an offer and an order confirmation. A contract was formed by the accountant's acceptance of this offer when the latter sent its tax advice to the company.

In a recent case,[90] the Paris Court of Appeals made a similar ruling regarding the conclusion of a services agreement. An offer had been sent via email by a client requesting that his provider perform some renovation works in his house. The Court ruled that the precise and clear offer sent via email indicated the client's intention to be bound by the offer where it was accepted by the provider.

Some particular applications: the French Government recently modified the legal framework[91] applicable to interest-bearing notes ("*bons de caisse*", literally "deposit bonds"), introducing the ability to issue, subscribe and assign an interest-bearing note using a distributed ledger. Article L223-12 of the French Monetary and Financial Code, applicable from 1 October 2016, defines a distributed ledger as a "shared mechanism of electronic recording which allows the authentication of these transactions, within security conditions" which will be defined in a future decree.

Under new articles 1322 and 1323 of the French Civil Code, introduced by the contract law reform, the assignment of debts must normally be made in writing and the debtor must be notified of the assignment.

New article L223-13 of the French Monetary and Financial Code acknowledges the validity of an interest-bearing note's assignment using distributed ledger technology. A distributed ledger is deemed to replace the mandatory written agreement, the debtor being notified of the assignment directly through the relevant distributed ledger.

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89 French Supreme Court : Cass. 1re civ., 1ˢᵗ July 2015, n° 14-19.781

90 Paris Court of Appeals: CA Paris, 4 February 2016, n°13-21057

91 *Ordonnance n° 2016-520 du 28 avril 2016 relative aux bons de caisse*

Legal capacity and identity of the parties: under French civil law, only a natural or a legal person may enter into a contractual relationship, provided it has the required legal capacity to do so (for example, minors do not have the legal capacity to enter into some contracts).

French contract law allows the use of an agent, or another kind of proxy, provided the agent has a mandate – that is, a power of attorney from the principal – allowing him to enter into a contract on his behalf. These rules have not been modified by the contract law reform.

In a smart contract context, the main issue is not the legal capacity of the parties, but their *identity*. Blockchain transactions can be pseudonymous (as the use of a single public key only authenticates each participant to a blockchain without necessarily providing nor checking their identity). Trusted third party services are not required to participate in a blockchain transaction.

It is no surprise, therefore, that, in relation to interest bearing notes, article L223-12 insists on authentication and security conditions in which a distributed ledger will operate in order to allow transactions to take effect through the use of this technology.

Object of the obligation: the subject-matter of each party's obligation must be determined or determinable at the time a contract is concluded. This obligation does not extend to determination of the price, except in relation to sales contracts (where the price must be clearly determined to conclude a valid agreement). Therefore under French general contract law the subject-matter of each party's obligation does not require the related price to be defined in order for a valid contract to be formed. The contract law reform now uses the term "content" instead of "object", but the content of the obligation remains governed by similar conditions.

Provided a smart contract clearly defines each party's obligation, either through a previous normal contract (which is then "translated" or performed in the system through a block chain), or directly into such system, it might be deemed binding under French civil law.

Cause of the obligation: the "*cause*" of an obligation is the compensation for the performance of an obligation. Usually "*objectively*" assessed by French Courts, the "*cause*" of one party's obligation actually lies in the other party's obligation in a bilateral contract. Therefore the cause would be regarded as *consideration* under English common law. For instance, the cause of a client's obligation to pay the price in a sales contract would be the obligation for the seller to deliver the product purchased.

The term "cause" *per se* has been removed from the French Civil Code following the contract law reform, but the underlying legal concept remains: a bilateral contract may be void if the compensation of one party's obligation is unreal or derisory, which still requires the existence of a cause or consideration.

As the cause is closely related to the object of an obligation, the comments relating to the identification of the subject-matter of an obligation in a smart contract context apply here.

French law lessons for smart contracts: our analysis demonstrates that there are both enabling and limiting factors in French law in relation to smart contracts. It is significant that the French Government saw fit to enact specific provisions to enable contracting via distributed ledger in discrete applications.

Germany

Essential elements of a contract: according to German law, essential elements of a contract are performance and consideration as well as determining the parties to a contract. To conclude a contract, two corresponding declarations of intent (offer and acceptance) are required, i.e. the parties need to have an intention to create a legally binding relationship.

A central question raised by smart contracts and machine-to-machine (M2M) communication is whether, and to what extent, a machine and/or code can make a valid declaration of intent under German law.

Declaration of intent: under the German Civil Code (Bürgerliches Gesetzbuch (BGB)), a declaration of intent is made up of an objective and a subjective element. The subjective element consists of: (1) a will to act; (2) the awareness to make a declaration; and (3) the will to engage in a transaction. The objective element requires that the behaviour of the declaring party implies a will to bring about legal consequences.

Can a machine/software declare intent?: with regard to M2M communication and smart contracts, under German law it is questionable whether a declaration of intent can in general be made by a machine and/or software.

According to case law of the Federal Supreme Court (Bundesgerichtshof (BGH)), as well as the prevailing opinion in German legal literature, machines/software cannot make a valid declaration of intent. In the courts' opinion, the subjective element of a declaration of intent requires *human* behaviour and legal capacity, which is not present

in relation to machines/software and cannot be replaced by "artificial intelligence".[92] Accordingly, machines/software are also unable to act as an agent as they lack the legal capacity necessary.

Attribution of a declaration by a machine/ software: the legal uncertainty outlined above is, however, resolved pursuant to German law by attributing the declarations made by a machine/ software to the person responsible for the machine/ software, and a consideration as to whether that also satisfies the requirements in relation to the person's will to act, awareness to make a declaration, and will to engage in a transaction. As these things are not present at the moment the declaration of intent is made, the relevant case law (as well as prevailing opinion in legal literature) make reference to the moment of the activation of the machine/software.

Accordingly, the person responsible for the machine/software is deemed to act with a general awareness to declare intent, which is then attributed to the actions made by the machine/ software.[93]

Analogous litigated cases:

• declarations made by computer systems: according to the opinion of the BGH, "not the computer system but rather the individual (or entity), which uses the computer system as a means to communicate, makes the declaration of intent or receives such declaration. Accordingly,

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92 BGH, judgement of 16 October 2012 – X ZR 37/12.

93 See BGH, judgment of 7 November 2001 – VIII ZR 13/01; BGH, BGH, judgment of 26. January 2005 – VIII ZR 79/04; BGH, judgement of 16 October 2012 – X ZR 37/12.

the content of the declaration shall not be determined by looking at how the system would process such declaration but rather, how the individual making the declaration would interpret such declaration in good faith as well as common usage"[94]

- "auto-reply" e-mails: actions by machines/ software are to be regarded as a declaration of intent by a human, in cases where the machine/ software merely executes actions that have previously been determined by the individual. Accordingly, such human behaviour causes the actions by the machine/software;[95]

- offering agents at online auctions: according to relevant case law, it is irrelevant whether a declaration by a machine is made due to a specific programming or due to other external effects the machine is reacting to.[96]

94 BGH, judgment of 16 October 2012 – X ZR 37/12.

95 BGH, judgment of 16 October 2012 – X ZR 37/12; BGH, judgment of 26. January 2005 – VIII ZR 79/04; Regional Court of Cologne, judgment of 16 April 2003 – 9 S 289/02.

96 District Court of Hannover, judgment of 7. September 2001 – 501 C 1510/01.

German law lessons for smart contracts: the case law outlined above can be applied to smart contracts to provide a legal framework and guidance in order to argue that smart contracts could be valid contracts pursuant to German law and accordingly might be legally enforceable.

However, the more independently a smart contract acts, and the more complex it becomes, the necessary "attribution" (described above) becomes more and more questionable as the general will to act by the individual becomes less specific and clear.

It follows that if there is doubt as to whether or to what extent an individual wishes to be associated with the actions of a smart contract, or where an individual has only a vague appreciation of what the smart contract does or provides for, there may be no attribution (but merely a fiction of a declaration of intent).

South Africa

South African contract law developed from Roman-Dutch legal principles. There are five requirements that must be met before a valid contract can exist:

- consensus: this is similar to the English common law requirement of reaching agreement

- contractual capacity: the parties must have the necessary capacity to be able to form legal intent for the purpose of concluding a contract

- lawfulness: the contract must be lawful and not contrary to the common law, any statute, public policy or good morals (for example, a contract to conclude an illegal activity, such as purchase and sale of illegal drugs would not be enforceable)

- physical possibility: performance of the contract must be determined or determinable at its conclusion (for example, if A agrees to sell its entire yield of corn crop to B for a price per ton, although A does not know exactly how much crop they will yield, the amount and price is capable of being determined at a future date)

- formalities: the contract must comply with any requirements prescribed by law or between the parties themselves (for example, an ante-nuptial contract must be in writing and signed in the presence of a notary public).

Formation of electronic contracts: the Electronic Communications and Transactions Act 2002 (ECTA) gives communications via data messages[97] the same effect as non-electronic documents. This means that if there is a requirement to have a document in writing, the ECTA gives the same legal effect to that document in electronic format.

Consensus – offer and acceptance: section 22 of the ECTA concerns the formation of electronic agreements and states that "an agreement concluded between parties by means of data messages is concluded at the time when and place where the acceptance of the offer was received by the offeror."

Section 23 of the ECTA deals with the time and place of communications, dispatch and receipt, and states that a data message must be regarded as having been received:

- by the addressee when the complete data message enters an information system designated or used for that purpose by the addressee and is capable of being retrieved and processed by the addressee (for example, when an email arrives in an inbox)

- at the addressee's usual place of business or residence.

Section 26 of the ECTA states that "an acknowledgement of receipt of a data message is not necessary to give legal effect to that message."

In relation to smart contracts, we suggest that the contract might be concluded when Party 1's information system receives a notification that Party 2 has accepted the "offer", and is concluded at Party 1's usual place of business.

However, the parties might instead first agree terms "off the ledger", including which parts of the agreement will be coded into self-executing instructions as a smart contract. Nothing in the ECTA prevents parties from entering into agreements that are partly physical and partly electronic, but the parties must ensure that nothing in the contract precludes them from using both methods.

Where a smart contract is coded to only contain the executable obligations of an agreement (while the

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97 "Data" is defined as "electronic representations of information in any form", and "Data message" is defined as "data generated, sent, received or stored by electronic means". This would include online transactions and data sent via emails.

rest of the agreement may be in physical or other electronic form), South African law allows for it to function as one agreement.

Contractual capacity – automated transactions: section 20 of the ECTA sets out the requirements when an electronic agent[98] performs some of the actions that are required by law for an agreement to form (for example, accepting an offer).

Electronic agent is defined widely enough to include the use of distributed ledger technology and smart contracts. It allows for a situation where all the parties to a contract are using an electronic agent.

A party that chooses to use an electronic agent to form an agreement is presumed to be bound by the terms of that agreement (irrespective of whether a person reviewed the actions of the electronic agent or the terms of the agreement). However, if the terms are not capable of being reviewed by a natural person prior to the agreement forming, a party interacting with an electronic agent is not bound by the terms of this agreement.

This means that the option to review the terms needs to be available to a natural person before conclusion of a contract. If a party elects not to review the terms, that party will be bound by the terms through the electronic agent.

There are a few requirements that need to be met when a natural person interacts directly with an electronic agent and makes a material error (this may be unlikely in a smart contract scenario, as all parties should normally be participating through electronic agents rather than as natural persons). No agreement is formed if a natural person made a material error and:

- the natural person did not have an opportunity to prevent or correct an error

- the natural person notifies the other person of the error as soon as practicable after that person has learned of it

- the natural person takes reasonable steps to return performance or destroy performance, if instructed to do so

- the natural person has not used or received any material benefit or value from any performance received from the other person.

If smart contracts are encoded in a manner that allows for natural persons to interact with the technology, these opportunities to correct a material error made by the natural person will need to be catered for in order for the contract to become legally binding under South African law.

Formalities – "signed and in writing": a South African court decision, *Spring Forest Trading v Ecowash,*[99] potentially allows contracting parties to sign their electronic contracts by way of a data message (which is wide enough to include emails and other communication platforms such as WhatsApp and social media) by typing their name at the end of a message. In the case, the contract was subject to a non-variation clause stating that no variation or consensual cancellation would be valid unless reduced to writing and signed by both parties. An email signed "Greg" was held to be a signed document.

In this case, a person's name at the end of an email satisfied these requirements. It might similarly be easy for a smart contract to meet these ordinary electronic signature requirements too.

South African law lessons for smart contracts: ECTA provides some welcome clarity for the likely legal status of smart contracts under South African law. The involvement of a natural person in the contracting process does of course complicate matters under the Act and would need to be factored into a smart contract deployment involving South Africa.

98   "Electronic agent" is defined as a computer program or an electronic or other automated means used independently to initiate an action or respond to data messages or performances in whole or in part, in automated transactions.

99   *Spring Forest Trading 599 CC v Wilberry (Pty) Ltd t/a Ecowash and Another* [2014] ZASCA 178.

Glossary of key terms

address	an identifier (typically seen in alphanumeric string form) constituting a hash over the participant's public key for the authentication of messages from that participant
block	a collection of transactions as sent by participants in a blockchain system that has been authenticated and verified by that system and consensus reached on it, and which has then been added (as a block) to the previous block in the chain of blocks. Blocks record 'transactions' which are typically financial transactions or the change in status of something
blockchain	a distributed ledger taking the form of an electronic database that is replicated on numerous nodes spread across an organisation, a country, multiple countries, or the entire world. Records in a blockchain are stored sequentially in time in the form of blocks. Each hash for a block depends on the block header for that block. The block header for that block contains a reference to the previous block in the chain. Accordingly there is a continuous chain back in time. In order to change one block in the chain it would be necessary to change every block that came after it
block header	a message or messages relating to many transactions within a slice of time are bundled together in a block and given a title record known as a block header. The block header is dependent on the combination of messages in the block. A block header lists the transaction(s), the time at which the list was made (that is, a time stamp), and a reference back to the most recent block.
consensus	more than 50% of nodes conclude that a proposed block message is authenticated and verified, so that the block can be appended to the chain
consensus protocol	a computer protocol in the form of an algorithm constituting a set of rules for how each participant in a blockchain should process messages (say, a transaction of some sort) and how those participants should accept the processing done by other participants. The purpose of a consensus protocol is to achieve consensus between participants as to what a blockchain should contain at a given time (especially, by the addition of new blocks). Terms used to describe consensus protocols in the context of blockchain technologies include "proof of work" or "proof of stake"
distributed ledger	a collection of records (making up a database), where identical copies of each record are held on numerous computers across an organisation, a country, multiple countries, or the entire world, either jointly or partitioned by the parties to which each record relates. A blockchain is a form of distributed ledger, but not all distributed ledgers are blockchains
fork/forking	occurs when participants in a blockchain system cannot immediately choose between two (or more) blocks upon which to continue the chain of blocks, so that two (or more) separate blocks are built on at the same time, creating a "fork" in the chain

hash / hashing	the process by which a grouping of digital data is converted into a single number, called a hash. The number is unique (effectively a "digital fingerprint" of the source data) and the source data cannot be reverse engineered and recovered from it.
message	a submission of data (typically a proposed fact or transaction) for processing by nodes with the object of having the message authenticated and verified as a transaction record, so that the message can be proposed for consensus as a shared and agreed fact. Messages may act as inputs or outputs of computer programs, and may themselves contain or point to computer code
node	a single computer involved in processing a message in order to reach consensus. Nodes are connected to each other via the Internet
off-chain transaction	a transaction occurring outside a distributed ledger (for example, on a legacy system)
peer-to-peer	where participants to a network send information to one another without using an intermediary or central point
permissioned	a distributed ledger is permissioned where its participants are pre-selected or subject to gated entry on satisfaction of certain requirements or on approval by an administrator of the ledger or some other mechanism. A permissioned ledger may use a consensus protocol for determining what the current state of facts should be, or it may use an administrator or sub-group of participants to do so
permissionless	a ledger is permissionless when anyone is free to submit messages for the purpose of, for example, processing and/or being involved in the process of reaching consensus. While a permissionless ledger will typically use a consensus protocol to determine what the current state of the chain should be, it could equally use some other process (such as using an administrator or sub-group of participants) to do so
private key	an instance of data, privately held, and paired with a public key, used to initiate algorithms for text encryption and signing. A private key is created as part of a public key cryptography algorithm, and generates both the private and public key as a pair
public key	an instance of data, available to anyone, paired with a private key to decrypt or verify text as part of public key cryptography
shared ledger	another name for a distributed ledger
smart contract	smart contracts typically consist of software code, legal text, and parameters to particularise the contract. A running smart contract has the ability to self-perform autonomously, and may have the ability to record state and operate over time. Depending on a range of factors, they may sometimes amount to binding contracts in the legal sense or otherwise affect legal relations between parties. Smart contracts that are linked to distributed ledgers could move value or information across the ledger
time stamp	a number representing a point in time at which something was created or done

Contacts – Norton Rose Fulbright

Sean Murphy
Global head of blockchain and distributed ledgers, London
Tel +44 20 7444 5039
sean.murphy@nortonrosefulbright.com

Nick Abrahams
Partner, Sydney
Tel +61 2 9330 8312
nick.abrahams@nortonrosefulbright.com

Jamie Nowak
Partner, Munich
Tel +49 89 212148 0
jamie.nowak@nortonrosefulbright.com

Marc d'Haultfoeuille
Partner, Paris
Tel +33 1 56 59 53 73
marc.dhaultfoeuille@nortonrosefulbright.com

Robert Percival
Partner, Toronto
Tel +1 416 216 4075
robert.percival@nortonrosefulbright.com

Rohan Isaacs
Director, Johannesburg
Tel +27 11 685 8871
rohan.isaacs@nortonrosefulbright.com

Ronald Smith
Partner, Dallas
Tel +1 214 855 8349
ron.smith@nortonrosefulbright.com

Barbara Li
Partner, Beijing
Tel +86 10 6535 3130
barbara.li@nortonrosefulbright.com

Contacts – R3

Charley Cooper
Managing Director
Tel +1 (917) 885 8529
charley@r3cev.com

Ian Grigg
Consultant Architect
Tel +356 7708 2640
iang@r3cev.com

Isabelle Corbett
Senior Counsel & Director, Regulatory Affairs
Tel +1 (929) 329 1511
isabelle.corbett@r3cev.com

About R3

R3 is leading a consortium with over 70 of the world's largest financial institutions to develop ground-breaking commercial applications for the financial services industry that leverage the appropriate elements of distributed and shared ledger technology.

Operating in New York, London and San Francisco, the R3 team is made up of financial industry veterans, technologists, and new tech entrepreneurs, bringing together expertise from electronic financial markets, cryptography and digital currencies.

The R3 Lab and Research Centre has quickly become a centre of gravity for collaborative research and testing of distributed and shared-ledger inspired technologies, and is where R3 works with its partners to define, design and deliver the next generation of financial infrastructure.

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