



The Second R3 Smart Contract Templates Summit, Wednesday 16 November 2016, Minutes

Summit Actions

Action Description	Action Owner
Distribute summit minutes to all attendees	Gavin Thomas, R3
Publically release presentation slide deck on 18 th November – ACTION CLOSED	Gavin Thomas, R3

Welcome. Agenda and goals for the summit

Todd McDonald, Co-Founder, R3

Todd McDonald (TM) opened the Summit from New York with a brief welcome message which included a statement reminding attendees to adhere to competition-related laws and avoid entering into any discussion, activity or conduct that may violate any applicable competition law, including the sharing of any competitively sensitive information. TM highlighted the need to continue to drive forward across the industry, not just by banks but also by legal bodies, technologists and the financial markets. TM said a stretch goal for the summit attendees should be to make real the ideas presented in the summit. TM introduced the four goals for the Summit: 1. Elicit views and opinions on standards for representing smart legal agreements; 2. Share leading edge thinking on smart contract languages and future implementations; 3. Engage with a broad spectrum of financial industry participants; 4. Drive open innovation through collaboration.

Smart Contact Templates: progress

Dr. Lee Braine, Investment Bank CTO Office, Barclays

Lee Braine (LB) gave a brief run through of Barclays' experience in last 11 months: the Barclays Accelerator period was a complex challenge where smart contracts were represented by smart legal agreements with corresponding computer code. The need for standardised templates was demonstrated at the Accelerator Demo Day in April where LB showcased a prototype of inputting data into smart contract templates and executing the trades on a shared ledger.

LB then explained how the first Smart Contract Template Summit in June led to good traction in highlighting that for smart contacts to be viable within the financial services industry we need to think beyond the initial view that code is law. Instead there would need to be a move to a model of overriding legal agreements.



LB summarised the first research paper that Barclays released in August 2016 in conjunction with UCL which asked, and answers: ‘What does it mean to be smart?’, ‘What is the relationship between parameters and code?’, ‘What are the semantics?’. The paper identifies elements of law that you cannot encode and shows evolutionary steps (starting with the Ricardian Contract) to arrive at one possible long term goal of representing all contract business logic as higher order parameters. LB explained how the paper goes on to discuss a possible stepping stone towards a trend of the use of common utility functions by adopting a single source language, one which can generate both computer code and the associated legal prose. Ultimately this would lead to source language being admissible in a court of law.

LB summarised a second research paper in progress which discusses essential requirements and some key design options for smart contract templates.

LB finished by saying all these materials are publically available and highlighting that smart contract templates should not be a topic hidden and developed by a single organisation but rather it needs a minimum quorum of participants to make progress.

LB then requested questions from the attendees.

Smart contract templates: requirements and abstract specification

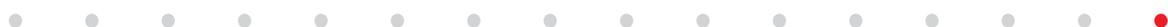
Dr. Chris Clack, Senior Lecturer, University College London

Chris Clack (CC) started his presentation by introducing the idea of defining a format at an abstract level for the storage and transmission of smart legal agreements. This is being achieved by focusing on the prose in legal agreements and not the code. CC reminded attendees of the Ricardian Contract, discussed at the first Smart Contract Templates Summit held in June, where legal prose is connected by execution parameters. CC explained how, in the most general case, a legal agreement can be comprised of legal prose within which parameters are embedded, and these parameters must be identified and passed to the code.

CC asked the question “What are the requirements to support a smart legal agreement?” and summarised some of the essential requirements: 1. Methods for creating and editing smart legal agreements; 2. Standard formats for storing and exchanging them; 3. A method for signing a legal agreement; 4. Methods to link legal prose to smart contract code; 5. Some way to achieve legal dispute resolution.

CC explained how it is important to define every aspect of the format so we know what everyone is talking about. There could be several standard formats, and different standards for different products. If we look at a higher, abstract level then as a community it is possible to define an abstract specification to define smart legal agreements that is interchangeable? And from this, derive concrete standards.

CC presented an incremental approach: start with the simplest agreement and build on complexity. Starting with a simple agreement, we must have a way to embed parameters in



the prose. A header alongside the prose is for administrative convenience such as a document identifier. CC provided an example of a simple abstract syntax where prose is linked to embedded parameters. CC stressed this remains work in progress and said how UCL and Barclays are experimenting with laying out the abstract format. There are no simple academic solutions and, because this is a business problem, there is a need to engage with financial firms and standards bodies. Work is currently exploratory rather than prescriptive and must be careful not to force decisions that are not appropriate. CC said there is still a lot to do to reach concrete solutions and whilst the approach is valid the actual detail is yet to be decided. This should be done in collaboration with the community.

CC presented the idea of an extended smart legal agreement. UCL and Barclays had asked a group of industry practitioners what they would like to see rendered from a smart legal agreement and the initial input included the following: active links to jump between cross-reference sources and targets; clause semantics such as a tag against a clause to indicate, for example, an indemnity clause; clause hashing to take a cryptographic hash and thereby determine whether the clause has been modified; named parts of prose; a parameter will not just refer to what is sent to code, there is also a need to consider it in a wider context, for example, compliance reporting.

CC went on to present the idea of complex smart legal agreements and look at agreements as a grouping of multiple documents. In this case, active links may need to extend between documents. And there will be a need for distributed binding: define a parameter “x” in one document but with no value, give a value for “x” in a second document, and then refer to “x” in a third document. Finally, the derivation of agreements from standard templates introduces a parent / child hierarchy that should be recorded with the agreement.

CC presented points for further discussion which attendees should take into consideration: 1. For an abstract syntax, what are the component parts that make up a smart legal agreement? Can they be partnered with abstract semantics? 2. Is it possible to be generic across all legal agreements, or just one business area? Would we expect to see different semantics for each? 3. Where is there a need for additional academic research?

CC finished his presentation with suggested next steps: 1. Develop a strawman abstract syntax. There have been lots of iterations here because this is in the exploratory stages, and more needs to be done; 2. UCL and Barclays are to release a second research paper in December; 3. Explore concrete implementations; 4. Explore semantic markup, whether it can be generic and how its use can assist workflow.

CC then requested questions from attendees.

It was asked that because you cannot express spoken language in context-free grammar how can this be worked around?

CC answered the intention at this stage is not to try and express the detailed English language but rather use simple markup to express key aspects of smart legal agreements.

It was asked to what extent did people say they wanted contracts readable by ordinary people? Is this a requirement? It has been in the past.

CC answered that views had been sought but the interviews around what they would like to see in a smart legal agreement was limited to a number of colleagues. The issue is not clear, because, taking Microsoft Word as an example, the docx file is effectively unreadable in its raw format and requires the Microsoft Word application to make sense of the content by rendering it. Similarly, a raw text file is stored in binary format on the disk and requires an application to view it or print it in human-legible form.

Michael Will, ESI Laboratory (MW) suggested splitting out definitions to a master definition section with prose in another document. Parameters would similarly reside in another document. Most of the negotiation is in variables, therefore parameters could remain as is. ISDA has been doing this for years using markup inside pro forma and negotiated schedules. By having contextual tags anywhere in the document there is a context-sensitive framework. MW also noted different clauses may compete and have opposite intent in a legal agreement.

ISDA: distributed ledger technology and smart contracts – the future of derivatives processing?

Clive Ansell, Head of Market Infrastructure and Technology, ISDA

Clive Ansell (CA) opened the presentation by saying that, since the first Smart Contract Templates Summit in June, ISDA has published a whitepaper which identified the primary challenge for market participants as one of complexity where global growth of derivatives markets has led to fragmentation of processing. Furthermore, because of increased regulation firms have recognised that some aspects of processing do not hold a competitive advantage.

The ISDA white paper promotes the need for a different and more collaborative approach to solving the challenges that exist today and identifies three core areas of focus: 1. Standardisation; 2. Collaboration; 3. Technology. However, it is important that we do not unnecessarily start from scratch but leverage the good bits of what exists today.

The current fragmented environment creates inefficiency, increased regulatory and operational risk and greater cost for market participants. Opportunities exist for greater standardisation in certain areas, e.g. code, data, messaging formats and documentation that can help to address some of these challenges. CA cited specific regulatory compliance challenges around EMIR data reporting and CFTC rules on straight through processing and clearing timeframes.

CA explained there may be parts of the process, such as multiple reconciliation steps, which could be made redundant by next generation technology. The support of multiple trade execution mechanisms and the proliferation of processing models without a common set of standards, for example straight through processing rules under CFTC and MiFID II, represent further challenges.

CA went into more detail on the three focus areas from the ISDA whitepaper. 1. Standardisation: currently multiple data formats are creating a burden on market participants which along with the regulatory community would benefit from clean, consistent and transparent data; regarding documentation, ISDA have a tried and tested suite of documents that could be leveraged in a future state environment. CA further noted that FpML creates a degree of electronic representation of this documentation and suggested that FpML could provide the link between code and legal prose. Considering products, CA said by the nature of the derivatives markets there will always be a need to tailor products but there may be an opportunity for some further standardisation.

CA said ISDA members recognise a need for some standards as being key to developing safe and efficient markets. It is also important to connect the different areas of functional and asset class domain knowledge and for lawyers to work with technology and operations teams to arrive at appropriate solutions. Keeping discussion centralised can help to avoid accidental differences in process and ISDA can facilitate this through access to thought leaders within its membership. CA explained the implementation of solutions is unlikely to happen at a single point in time. We would anticipate gradual migration to any new ecosystem which will need to run alongside legacy technology and processes during any transition. Trade Associations can provide assistance here.

CA advised that ISDA have recently hosted a discussion among legal, technology, operations and business teams from market participants alongside FinTech and law firms and regulators to explore opportunities for smart contracts and use of distributed ledgers for derivatives markets. The discussion raised a few interesting questions and considerations for further analysis, including: FpML may provide a good basis for financial derivatives smart contracts but how far upstream or downstream should it be extended? What are the features of blockchain technology that are most suitable for a derivatives solution?, developing any solution should not be done in a technology vacuum as legal considerations are a critical element of a successful outcome. Good design is critical so we need to consider what goes where on the ledger.

The discussion also flagged the importance of anticipating what happens when things go wrong. There is always likely to be the need for discretion in some scenarios, e.g. default management and close out and what happens when unexpected market events occur. There are limitations on the use of auto-executing contracts, what happens when the process needs to stop or rolled back. Above all, there is a need for a co-ordinated plan.

Smart contracts for cleared derivatives

Simon Puleston Jones, Head of Europe, FIA

Simon Puleston Jones (SPJ) opened the presentation with a conclusion on smart contracts: smart contracts are an important technical innovation; smart contracts are a viable tool for contract creation when using FIA's terms of business or ISDA's documentation; one benefit of smart contracts is to integrate contractual terms into enterprise systems to capture and monitor contracts; in consideration of smart contracts being self-executing, we are not there



yet, and will not be for a long time. SPJ said FIA look forward to working with all those around the globe to achieve this.

SPJ explained the context for the challenges facing smart contracts and asked, what are cleared derivatives? OTC derivatives are about a process of two parties entering a trade. A clearing house is a guarantor to the trade. Clearing is important because the G20 responded in 2009 to the Lehman Brothers crisis by identifying a need for guarantors. It was already there for Futures. It would preserve people's rights even if a counterparty goes under.

SPJ said focus for smart contracts is between the client and the clearing broker. Two parties provide collateral to a clearing house. Both parties provide margin. A clearing broker may need to provide further collateral. Upcoming European regulation focuses on the default of parties and clearing houses. SPJ presented example clearing scenarios.

SPJ asked, what templates exist and what industry standard documentation exists? If we consider exchanges and clearing houses, they can set the rules of their contracts. It is possible to have long chains of back to back contracts and there is no industry standard documentation for this. There are industry standard documents between broker and trader from ISDA and FIA which vary by product. Regulatory change means there is a need for direct client terms and these are coming. SPJ explained FIA and ISDA have a modular approach to documentation so where clients want to use FIA documentation they can be upgraded to meet regulatory requirements, for example, MiFID II.

SPJ presented the promise of smart contracts and the challenges to their implementation. Cleared derivatives mean there are two relationships: one is the clearing broker to the client governed by clearing brokers, the other relationship is back to back between clearing broker and the clearing house. Therefore it's not a single, bilateral relationship. SPJ pointed out the difference between ISDA being bilateral and FIA being multi-lateral with multiple parties. FIA Terms of Business are the rules of the clearing house and will stipulate the rules which must be in the contract between the clearing broker and the direct client. The clearing house is at liberty to change the rules even after execution, making it a challenge to include them in a smart contract.

A further challenge, SPJ said, is overlaying regulatory change. Regulations around the globe form the bedrock of contracts. Regulations are different in each country therefore smart contracts need to work for multiple countries.

SPJ explained the modular architecture of the FIA Terms of Business means building contracts can be done using building tools to complete a template. This would decrease the time taken to onboard a new client. Also signing electronically leads to a further reduction in onboarding time. For smart contracts to be successful we need confidence they will be legally binding in all relevant jurisdictions.

SPJ highlighted the benefits of taking legal terms into document storage platforms. SPJ said this is a powerful part of smart contracts. The manual requirements to review 1000s of contracts with clients can be removed, and data analysis can be completed across the contracts.



SPJ presented the challenges for cleared derivatives and the self-executing of contracts. Discretion is the enemy of smart contracts and clearing relies heavily on discretion, for example: the clearing broker has discretion on margin and on when and how to close out a position upon a client default; the client has discretion upon the default of its clearing broker as to whether to close out its position or to novate it to a back up clearing broker ; if a clearing house, national competent authorities have discretion as to when and how to intervene.

SPJ identified the following challenges with respect to the implementation of self-executing contracts to cleared derivatives: how to address the flexibility that clearing brokers have when setting client margin calls; how to deal with the default of a client or clearing broker; how to automate margin calls; how to code margin transformation; how to deal with cross product margining; how to address post-execution regulatory change. Further, what IT platform should be used? ETD markets are accessed via brokers and products have a long lifecycle. How will smart contracts evolve over this time?

SPJ asked, is it too early to define a standard for smart contracts? It is an important technical innovation and viable tool for contract building. It would be great if they can integrate into legacy systems. SPJ noted that questions remain unanswered regarding the legal characterisation of, and rights relating to, cash and non-cash assets that are transferred via distributed ledger technology.

SPJ finished by considering the way forward for ISDA and FIA. FIA are discussing their proposed fintech strategy with their Board at a planning session in New York next week. Smart contracts are a part of that proposed strategy. FIA will work with ISDA and other trade associations. Via the Joint Trade Association Group (a London-based roundtable of 20 financial services trade associations), which SPJ currently chairs, financial services trade associations have the ability to co-ordinate their work on smart contracts and distributed ledger technology.

Experimental oracle for Corda

Mark Raynes, Blockchain Developer, Thomson Reuters

Mark Raynes (MR) started the presentation by asking “Why do we need oracles?” Smart contracts will need to source data from external services. All parties need to arrive at the same result for any transaction. Parties to an agreement cannot arbitrarily choose different data sources. Therefore they need agents who can attest to the facts. MR said there different types of oracles: a trusted source of data; sign data within transactions; act as a definitive model or valuation service which would be impractical to run on the ledger itself; act as schedulers.

MR explained oracles and legal agreements can automatically agree key facts to the agreement and automate lifecycle events. It is also possible to specify data sources upfront, for example, future interest rates will be provided by an oracle, and provide details of a backup. Details of these can be agreed upfront and worked into the legal agreement. Once transactions are on the ledger they are certain.



MR presented an example floating rate loan agreement. The contact code contains two clauses and an agreed transaction each time the new interest rate fixing is applied. Legal prose within the agreement is referred to by a hash value. Throughout the lifecycle of the agreement an oracle signs the transactions on each fixing date.

MR presented a potential architecture and concluded the even on a single data service we see there may be many oracles sitting on top of a service integration layer because different oracle need different subscription models. Also oracles need to provide different types of behaviour, for example, market pricing, rate fixings, interpolation between tenors. Smart contracts themselves will interact with oracles. MR said there could be standard oracles, for example interest rate fixing oracles, and proprietary oracles.

MR said key considerations for attendees are: have conversations around standards, for example standard terminology; testing concepts on Corda TestNet; commercial models may not apply to this new world, for example, license agreements, therefore engage with market participants and standards bodies to establish and understand requirements.

MR then requested questions from attendees.

It was asked, with respect to industry collaboration, is there anything happening across data vendors at the moment? Amanda West, Thomson Reuters, answered there is no collaboration right now.

It was asked, can the industry do anything to help collaboration? AW said she would take the action to give this consideration and get back to the group. It was suggested to form different working groups to consider standardisation in legal agreements and processes further downstream. This could be facilitated with ISDA and FIA. There is progress but legacy issues with reference data will make standardisation difficult. AW said there are some standards across data sets but they are not adopted industry-wide. PermID would be a good starting point.

It was asked, is machine learning and AI being considered and their interactions with oracles getting some traction? Is it possible to take an oracle and program it to learn and add discretion? There is investment in this space. Machine learning and AI could be built into internal processes and built into smart contracts to execute in a common way.

Brenton Miller (BM) asked when and how will multiple oracles be handled, considering standardising parameters and semantics - will this be done by the vendor? A recent hackfest saw an aggregation oracle which could be a good canvas. How do we migrate from one oracle to another? BM suggested building this into the legal agreements would be the goal.

Simpler OTC smart contracts

Sofus Mortensen, Chief Quantitative Analyst, Nordea Markets

Sofus Mortensen (SM) explained that the prototyping done for OTC smart contracts was done with the aim of reducing the complexity of smart contracts for development and





inspection alike and try to come up with a result that is meaningful to the business so one day perhaps the business will be able to write smart contracts themselves.

SM explained how the UTXO of Corda separates state from contract code. Transactions consume or spend states replacing them with new states. The smart contract code is responsible for verifying transactions. SM goes on explaining how this effectively moves semantics of a contract from smart contract code to higher-order parameters somewhat similar to legal prose into the states, hence the expression '*Contract State is the Contract*'. Intention is for the state to be understandable for machines and humans alike. A 'super' smart contract would validate the transition of contract states with higher-order parameters.

SM went on to provide example contracts where human-readable higher-order parameters provide a logical construct for smart contracts. SM pointed out that the model is deliberately not self-executing; an event only happens if triggered by a party on the ledger.

SM then requested questions from attendees.

Lee Braine asked how does this approach compare to writing smart contracts right now? SM said that OTC contracts written in Ethereum required many pages of code, whereas this approach would reduce the same to just a few lines of code. This approach makes it possible for a non-developer to read and understand the intent of a contract.

Simon Puleston Jones asked is it the expectation that operations departments and legal departments will view the smart contract, with the legal department seeing a lawyers' English version? Or will lawyers need to learn to read the language? Will lawyers need retraining? SM answered that smart contracts in this format would never be a replacement for legal documents in general, but perhaps legal documents could delegate certain details to code like this and keep the legalese for what cannot be expressed in code or for what should intentionally be left open for interpretation. SM said to consider it to be a complete recipe for making back office 'machinery' work, whereas the legal document would be for the handling of extraordinary events.

Adrian Sheddian asked what is the point in having the legal prose that lawyers interpret? Or does it need a holistic rethink? Would it be necessary for courts and arbitration? Lee Braine suggested considering a Venn diagram with two circles representing the legal non-operational aspects and the legal operational aspects. The challenge is then whether we get to a format where the two circles intersect which would be admissible in court? Chris Clack said that, at UCL, students are encouraged to write their programs to look like documentation with small bits of code, in a 'literate script' style. If there is a formal way to set up code like Sofus' examples, is it reasonable over time for lawyers to accept it? Michael Will said what happens next is that code generally would not be sufficient for execution on a distributed ledger because many lower level aspects come into play. A solution to this is for each word to have a relevant meaning in the context of contract and legal prose. ESI Laboratory has developed writing in prose before coding. Clive Ansell said rethinking and retraining on both sides is required. Nothing should be done in a vacuum so each other's experience can be used.





Languages and abstraction layers to support the adoption of smart contracts

Robin Green, Executive Director, Digital Markets Innovation, CIBC Capital Markets

Robin Green (RG) started the presentation by looking at past solutions to create a means to clearly define the business intent of a smart contract, specifically HTML for web page design and SQL for relational databases. These are well defined languages agnostic to platform. The writer does not care what platform they are writing for but rather is able to focus on the business problem they are trying to solve. This avoids vendor lock-in and writers are prepared to be educated because the skills can be re-used.

RG asked can we do the same with smart contracts? RG considered an example delivery versus payment contract. If we can agree on a legal definition for what the tags in the contract code mean then it is unambiguous what the contract parties are committing to and any developer implementing the tag on a ledger would have a clear business definition of what his code should do. In so doing, the business is separated from the technical implementation and legal terms would only have to be negotiated once when the tag was initially defined. With two parties on different ledgers agreeing to the same tags and associated legal definition, then it becomes a technical problem to get the ledgers to talk to each other.

RG explained the layered model: Layer 0 is the Ledger; Layer 1 is Ledger Services - defines the constructs in blockchain-inspired platforms such as transaction support, ESCROW and messaging. Services are well defined with an interface into which higher layers can interact; Layer 2 is Data - needs to be agnostic of underlying implementation. The layers above understand the data; Layer 3 is Actions - manipulate the data on the ledger. It is useful here to define actions to have legal meaning; actions will comprise of common operations such as loading things onto the ledger, querying the ledger and other general concepts. We should also define protocols for how actions interact to allow actions that have been coded on different ledger implementations to work together; Layer 4 is Orchestration and Choreography– this would provide a means to glue the actions together – a parallel would be JavaScript in the HTML world; Layer 5 is Tags - grouping of actions and choreography to have legal meaning. These represent real, usable building blocks which make sense to operational departments.

RG said that until these concepts are tried they remain unproven. CIBC are working with R3 on Project Banff, a Canadian Bankers Acceptance Asset Lifecycle, looking at issuance and transaction operations. RG asked, can we define the Banker's Acceptance business process using this approach?

RG then requested questions from attendees.





Lee Braine asked how does this tag-based approach work with Sofus' prior example? RG answered that it would work well with Sofus's example – his well defined business description would fit into one of the higher layers.

It was asked, is this alluding to a common API for different ledgers? RG said yes. It needs to be done as collaboration with banks, legal bodies and lawyers to reach a uniform definition which can be implemented locally. RG said the R3 forum is a good place to do that.

Michael Will suggested getting all the lawyers together and agree to leave existing documentation at home and cooperate, taking into account all ledgers. Define the tags in advance then define the language.

It was said lawyers need 'containers' they can drop in, not all of these 'containers' can be dropped into reduced, formal terminology. This will remain unchanged in the legal world. RG said the tags are aligned to the deterministic aspects of the contracts. Capturing semantics for the softer non-deterministic sections of legal agreements is more difficult and not something that we have yet attempted to address.

Nick Skinner said if this is left to the legal profession then it is likely to take time to get to a solution. Banks can encourage the lawyers to be a catalyst to work together. This needs a lead.

Dispute resolution for smart contracts

Isabelle Corbett, Senior Counsel, R3

Matt Britton, Consultant, R3

Ian Grigg, Consultant, R3

Isabelle Corbett (IC) asked, which agreements are required to transact on a distributed ledger? Agreements which govern obligations and behaviour are necessary, including user agreements, transaction agreements, and confirmations. Additionally, at present the parties to be considered when determining what other agreements are required include software providers, platform providers, oracles, FMIs, issuers, agents, and platform participants. IC said contract law will not evolve as quickly as technology and contract law applies regardless of whether contracts have automated components. Asset class and time determine which agreements are ultimately required, and how agreements are structured depends on how ledgers and platforms develop.

IC identified user agreements as critical to the widespread use of DLT and explained how a platform user agreement might be used to accommodate the technology. IC highlighted that working with regulators will be a key driver in shaping user agreements because many regulatory considerations are (or will be) addressed by a platform user agreement. IC asked, what will be in a user agreement? Business plus technical aspects potentially, and it will include the use of platform services. User agreements will have to include that participants agree to be bound by the results of smart contracts, as well as provisions such as the definition of default, entry requirements for the network such as creditworthiness, how



users can be removed from the ledger, and security requirements. A dispute resolution mechanism is key and the user agreement should include what the mechanism will be and how out of bound values that trigger dispute will be determined.

IC said the next steps for user agreements is to look at agreements which exist today and identify what needs to change to be used in conjunction with DLT. The ability to combine agreements should be explored. The dialogue with regulators should continue.

Matt Britton (MB) said when it comes to smart contracts, as with all contracts, it should be assumed disputes will happen. The goal is to create certainty and confidence in smart contracts by having an agreed approach to dispute resolution. MB asked, how do we deal with disputes from smart contracts? How do we hand off to a dispute resolution process? MB said doing this programmatically would be efficient therefore build it into the smart contract code. Whilst in dispute resolution it should be possible to pause or stop the smart contract execution, if required. The implementation of this would vary depending upon the asset and transaction type. Using a programmatic solution means having an automated feed into the dispute resolution process, including the full audit trail of the smart contract. The dispute resolution process itself can be defined in the legal prose of the smart contract and captured in smart contract templates. It is expected the ruling will determine whether the smart contract is correct and can be restarted, or whether it is incorrect and needs to be terminated – the smart contract needs to be able to handle these rulings.

Ian Grigg (IG) said dispute resolution has different levels. Starting with **negotiation**, this is a way to get small disputes fixed. Thinking is required on how to promote negotiation as an active element in the smart contract dispute resolution process. Next, **mediation** which presents a degree of formality, finding the facts and encouraging parties to bring these forward. There is no ruling found for mediation. Next **arbitration** which does provide a ruling which can be binding and enforceable. Finally, **courts** where there is backing of the state and the law. IG said courts may lack the expert knowledge for smart contracts. This will be an issue if they cannot come up to speed with smart contracts. A further issue is cross-border jurisdiction. IC said courts are also expensive particularly lawyers therefore the emphasis is on getting back to arbitration, and experts providing arbitration.

IG said using arbitration was thought to be a straight forward choice but now there is a need to open the dialogue and choose which of the four dispute resolution levels is the best way to go. IG asked should the solution be a hybrid of all four levels?

IG asked, what would arbitration look like? There are currently organisations of experts which have a forum available to assist, for example EDI, where there is a body of experience to tap into. IG asked, what would be needed if the decision is made to proceed with arbitration? An arbitration clause in the smart contract, case managers, archival support and a policy which sits above the existing legal framework including fixes, for example accepting digital signatures are binding, are required. IG noted the acceptance of digital signatures as binding would help to resolve current cross border issues with digital signing.

IG explained the challenges of arbitration: finding the experts. There is expertise in the industry but they need to find the time to engage; the scope of disputes needs to consider



whether vertical forums which specialise, or horizontal forums which cover all smart contracts, or a hybrid of specialist forums structured according to the nature of the dispute are appropriate; scaling the solution to handle the volume of cases.

IG said the next steps are to create a strawman user agreement and a strawman forum. Run a proof of concept with the strawman user agreement and strawman forum running a mock dispute resolution and objectively analyse the choices for dispute resolution.

IG then requested questions from attendees.

Aaron Wright said there is a lack of precedent cases in arbitration. Normally well-established arbitration rules are selected. Use lightweight rules initially.

Roman Dahl (RD) asked, what is the distinction between a platform user agreement and a smart contract? In the transaction some of the terms are relevant to the smart contract. RD suggested starting with a smart contract, if there is a clause which overrides the agreement, for example by an ISDA document, then the ISDA terms bind. Using this approach it is possible to continue going down until the platform user agreement is reached. Simon Puleston Jones said when considering the relationship between a user agreement and a smart contract, think about an interest rate swap: the clearing house rules are the user agreement. When an interest rate swap is entered into, the terms of the trade are submitted to a distributed ledger that is run by, say CME, and agree that any trades submitted are governed by a single jurisdiction. This revolves around governance, specifically clearing house rules that set out what happens in a dispute. Similarly the governance of the distributed ledger lays out the rules. SPJ said there is no need to recourse to the courts but rather keep it within the distributed ledger network.

Lee Braine asked, are new governance structures required for this? Consider both derivatives and non-derivatives. Henry Hunter said that with well-established trading venues the transactions are small agreements which are trumped by overarching rules. Michael Will said prime banks are setup to deal with financial disputes.

Dax Hansen (DH) said pausing a transaction during dispute resolution is the worst possible outcome. No matter that happens the transaction continues to perform until dispute is resolved. DH asked, who pauses the transaction? The counterparty may want to continue. It could be written into contracts how this is to be handled.

Conceptualizing smart contract

Aaron Wright, Clinical Professor, Cardozo Law School

Aaron Wright (AW) explained how smart contracts provide a means of encoding legal agreements, group rules, and machine-to-machine interactions. AW said electronic agreements have been thought about for decades but what makes a smart contract unique is it reduces monitoring costs and makes termination more expensive because smart contracts can be designed in such a way that makes it difficult to halt the execution of code.





AW said when considering schemas, all parties need to do is agree on terms and a smart contract will ensure that encoded promises occur without further action of the parties.

AW explained that oracles can be used to create dynamic agreements that adjust in real time. Alternatively, an oracle can accept human input-orientated to trigger dispute resolution mechanisms, which over time could help facilitate decentralized arbitration systems.

AW highlighted the benefits of smart contracts include the fact that code that is potentially less ambiguous than words used for objectively verifiable facts, for example, the interest rates on a specific date. Using code in smart contracts makes the contract more modular which, in the long term, could be assembled by lawyers or AI systems.

AW discussed how questions related to smart contract enforceability have largely been explored in the US. Data-oriented contracts, like electronic data interchange (EDI) agreements have around for decades and have been structured in such a way that they rely on natural language master agreements and electronic confirmations. These master agreement contain language to ensure the agreements enforceable if challenged, and courts have examined disputes related to data-oriented agreements in the U.S. and enforceability issues have not been raised.

Beyond EDI agreements, AW explained that in the US the E-sign Act provides language that should shield otherwise enforceable smart contracts from challenge. . The E-Sign act defines electronic signatures and electronic records broadly, and in a way that should permit it to cover smart contracts. In New York, the Electronic Signatures and Records Act (ESRA) follows the spirit of the E-Sign Act, but contains more precise language that

Outside of enforceability, AW said there are likely to be other limitations with smart contracts, which need to be examined: immutable contracts run the risk of being void, because--at least in the U.S.--those who make contracts need the ability to amend their agreements; regarding bankruptcy, if there is a default how are will the automatic stay be accounted especially if it is hard to terminate or unwind an agreement; can these non-verifiable facts (like reps and warranties or provisions requiring that parties take "best efforts") be turned into code?

In the interests of time, AW did not request questions from attendees.

Can smart contracts be legally binding contracts?

Sean Murphy, Partner, Norton Rose Fulbright

Sean Murphy (SMu) highlighted three issues with smart contracts that he would deal with: 1. Is a smart contract legally binding? 2. If a smart contract is legally binding, can it be enforced? 3. Are dispute resolution mechanisms a potential solution to questions of enforceability?

SMu explained that Norton Rose Fulbright has completed research across a number of key contracting jurisdictions globally and has arrived at some important findings about smart contracts from a legal perspective. Key among these is that whether a smart contract gives rise to a legally binding contract may turn in part on the model of smart contract deployed,





as well as the facts surrounding the particular deployment and which jurisdiction's law is determining the issue.

SMu observed that the term "smart contract" is unhelpful from a legal perspective as it suggests that there is in fact a legally binding contract. That may not necessarily be the case.

SMu noted that there had been suggestions in the industry from time to time that smart contracts might bring about a new contracting paradigm in circumstances where current legal principles would not apply. SMu's view was that established contractual principles would apply to smart contracts.

He observed that the courts in many jurisdictions had already decided that various forms of electronic contracts, including those formed by email and on websites, can give rise to legally binding contracts. Moreover, SMu observed, "EDI" (Electronic Data Interchange) has been around for decades for implementing contractual procurement relations between businesses. Such examples suggested that the question from a legal perspective is not whether existing contractual principles apply, but rather *how* do they apply?

SMu commented that smart contracts lie on a spectrum between, on the one hand, what he called the "code is contract" school of thought and, on the other, simply automating aspects of performance of a contract, such as the payment function. In between lie a range of possibilities, such as the R3 / Barclays "split" model, known as "Smart Contract Templates". The reason why the model adopted can impact upon whether a smart contract be a legally binding contract, SMu explained, became clear when looking at the results of Norton Rose Fulbright's research.

SMu explained that the research shows that the electronic status of smart contracts would not of itself be a problem for most jurisdictions in terms of the formation of a legally binding contract.

On the other hand, the research also showed that certainty of contractual terms (a key requirement under the laws of many jurisdictions for a legally binding contract to come into existence) might be a stumbling block for some smart contract models. If a smart contract did not, for example, incorporate by reference the contractual terms, or did not include a full set of terms, then in some jurisdictions this might mean that such a smart contract would not give rise to a legally binding contract.

Similarly, SMu noted that the research also highlighted that, in some jurisdictions, there was a requirement that the parties must be able to have understood the terms in order for there to be a legally binding contract. This could be a problem where a smart contract's terms are purely in code form.

Technical requirements of the applicable jurisdiction's law may, in some cases, be a potential impediment to establishing the legally binding contractual effect of a smart contract. SMu gave the example of South African legislation, under which a natural person must be given an opportunity to review the terms, and to correct errors, before a legally binding electronic contract is formed.





SMu then went on to consider what he described as “follow-on contracting”. He explained that follow-on contracting is the result of a smart contract itself automatically entering the parties into other contracts without input from the parties to the original smart contract (perhaps in the context of related transactions or transactions that depend on the completion of a first smart contract).

Although follow-on contracting might be a bit hypothetical at the moment, SMu said that Norton Rose Fulbright’s research showed that, for some jurisdictions, follow-on contracting might not give rise to a legally binding contract because you may need human intent to form a legally binding contract. This was particularly true in Germany. On the other hand, in Australia, legislation anticipated that follow-on contracting might be possible.

SMu said that the full results of the research were available in Norton Rose Fulbright’s whitepaper, [*Can Smart Contracts be Legally Binding Contracts? An R3 and Norton Rose Fulbright White Paper*](#), published in association with R3.

SMu said that assuming through, say, your choice of a particular smart contract model, you resolve problems over whether a smart contract is legally binding, there was still another legal issue that a business would need to satisfy itself of: is a smart contract enforceable?

SMu explained that enforceability was about the practicalities of enforcing a contract, and the legal difficulties there might be in doing this. Many enforceability problems were particularly an issue in relation to smart contracts deployed on permissionless blockchains: 1. for example, there may be no administrator to address disputes; or 2. for certain kinds of problems (for example, program logic that did not perform as expected), there may be no obvious defendant.

It could also be a problem if the smart contract was entered into pseudonymously. In some jurisdictions it might be difficult to prove the existence or content of an entirely electronic contract in court as a matter of evidence. And similarly, how would a court judgment be enforced in relation to the forward operation of a smart contract on a blockchain (for example, if the dispute occurred during the life of the smart contract)?

SMu noted that (as Isabelle Corbett’s (R3) session had already touched upon) problems of enforceability may be able to be addressed by using an appropriate dispute resolution mechanism. In the interests of time, SMu did not expand upon what had already been covered by Isabelle Corbett.

Chris Clack commented that a signed smart legal agreement has to include the code (or at least an identifier for the code) so those signing know how it will be executed. Anyone deploying smart contracts will want to build it into a natural language contract.

In the interests of time SMu did not request questions from attendees.





Next steps

Dr. Lee Braine, Investment Bank CTO Office, Barclays

Lee Braine (LB) ended the summit by summarising follow-on actions and next steps identified during the course of the event:

- Chris Clack, UCL: Obtain broader industry input for the definitions of abstract syntaxes for storage and transmission of smart legal agreements
- Clive Ansell, ISDA: Explore producing a co-ordinated plan regarding templates for derivatives smart contracts
- Clive Ansell, ISDA: Explore the evolution of FpML to potentially extend its use upstream to include legal prose within legal agreements. Explore the use of FpML to progress both technical structure and legal structure themes
- Simon Puleston Jones, FIA: Explore approaches for progressing solutions to the challenges of smart contracts for cleared products. Consider collaboration across trade associations, for example via the Joint Trade Association Group
- Mark Raynes, Thomson Reuters: Participate in driving towards data provider standardisation, specifically for input into legal documentation and inclusion in downstream execution of smart contracts
- Mark Raynes, Thomson Reuters: Engage with ratings agencies to participate and be represented in the process of data provider standardisation
- Sofus Mortensen, Nordea: Explore opportunities to replace some legal prose with code, including considering 'literate script' representation
- Robin Green, CIBC: Prototype the use of tags in the Banker's Acceptance prototype, and determine whether this approach simplifies the definition, creation, and operation of a business process that runs on a distributed ledger.
- Isabelle Corbett, R3: Define a strawman forum and working group for dispute resolution and test it using different scenarios and use cases
- All: Read the findings in the Norton Rose Fulbright whitepaper

