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Smart contracts in the derivatives space

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There is no universally accepted definition for 'smart contracts', but this term is commonly used to refer to legal contracts (or elements of legal contracts) being represented and executed by software. The term 'smart' refers to the fact that some elements of a smart contract are automatic and self-executing pursuant to pre-defined conditions.

The market is evolving to differentiate a 'smart legal contract' from a smart contract code. Smart legal contracts comprise pieces of smart contract code creating a legally enforceable arrangement. A smart contract code, on the other hand, does not necessarily form part of a smart legal contract, but constitutes a piece of code (or programming language) designed to provide for the execution of certain tasks by a machine.

As discussed in more detail below, smart contract code can, in theory, either form the entirety of an agreement between parties, creating a smart legal contract, or can be used alongside a traditional paper contract to form a hybrid arrangement. This is particularly relevant in the derivatives space as it can allow parties to consider and incorporate a variety of terms into what are often highly complex financial instruments. Currently, smart contracts require specific and objective instructions, so their use is relatively simplistic. However, it is the market's expectation that with time we will see an increase in the use of code-heavy smart legal contracts in the derivatives space.

There has been an increased interest from key industry bodies, such as the International Swaps and Derivatives Association (ISDA), in the development of technology-enabled solutions (including the use of smart contracts) which will allow a fundamental reshaping of the derivatives infrastructure. ISDA's view is that these solutions should improve operating efficiency, reduce operating costs and risk, and increase both quality and transparency of data.[1]

Distributed ledger technology and smart contracts

Distributed ledger technology (DLT) refers to the technology of maintaining distributed ledgers on networks of computers, and blockchain is a form of DLT. Essentially, the DLT provides a digital record available to all participants across a network, meaning there is just one central source of data instead of competing records or copies. Nothing within the DLT can be changed without acceptance from all parties. The DLT can also be 'permissioned', essentially meaning access to the data stored within it can be restricted to certain parties – in the case of smart derivatives contracts, this would likely include people such as market participants and regulators. DLT also allows data to be masked to ensure certain parties can only have sight of certain data relating to specific transactions.[2]

The key benefit of using DLT in the context of smart derivatives contracts is the aspect of 'centralisation' of the data source. Where previously a smart contract was possible, but would, in practice, have to be effected by running separate sets of code alongside each other on the systems of each party to a contract, DLT allows the code to be embedded in the distributed ledger, essentially providing a 'centralised' source of data that binds the parties. The DLT also provides security for the parties, granting them the knowledge that neither party can tamper with the code or prevent the contract from performing an action without the consent of the other party.[3] Having a centralised source of data in relation to a derivatives contract should help parties deal with the complexities of automating derivatives contracts and encourage the adoption of smart contract code in the derivatives space.

The benefits of smart derivatives contracts

Many of the benefits that smart derivatives contracts will bring to the industry are addressed throughout this chapter as we discuss the issues and challenges to be considered when adopting these contracts.

Broadly, smart contracts have the potential to create significant efficiencies in the derivatives space by giving the parties the ability to automate performance of obligations and processes under a contract. The ability to automate actions such as calculations and payments upon the occurrence of certain events will speed up the processes and save resources for market participants as the human analysis element will be removed. Ultimately, this should reduce operational costs and allow more parties to participate in the derivatives market.

From a sell-side perspective, these efficiencies are expected to be translated into a decrease in operational and middle-office costs. There has been an increased interest from financial institutions in using automation in various internal processes involving derivatives and structured products – this includes when providing pre-trade (e.g. quoting processes), execution and post-trade services.

In practice, it is ISDA's view that the development of smart derivatives contracts will be beneficial for most market participants by encouraging standardisation. ISDA has recognised that it is not uncommon for entities, as they have grown and merged over the years, to have increasingly complicated internal systems for the processing of derivatives transactions. The ISDA-led standardisation of processes, terms and industry standards for smart derivatives contracts will save resources within the derivatives space and, in turn, open up the market to more participants.[4]

Recent developments in the derivatives market

There is still a long way to go, but some of the key developments involving ISDA's work to facilitate the use of smart contracts across the derivatives industry include:

(i) In 2017, ISDA issued the first version of the Common Domain Model (CDM), known as ISDA CDM 1.0, followed by its second version ISDA CDM 2.0, which was published earlier this year. The CDM is a standardised solution aimed at providing market participants with a common digital representation throughout the lifecycle of a derivatives transaction. In its first two phases, the CDM provides for the representation of certain events in a machine-readable format with a focus on interest rate and credit derivatives, including an initial representation of equity swaps products and the ISDA Credit Support Annex for initial margin. It is expected that in its next phases the CDM will be developed further to incorporate models for foreign exchange

transactions. ISDA has also been working to update the 2006 ISDA Definitions to make them more compatible with the CDM.[5]

(ii) In January this year, ISDA issued a paper entitled *Legal Guidelines for Smart Derivatives Contracts: Introduction*, which sets out the key principles contained in the ISDA documentation framework and raises awareness of the important legal terms that should be maintained when applying technology solutions to derivatives trading. The guidelines are expected to be supplemented from time to time by further papers to deal with specific ISDA documents, including the ISDA Master Agreement, its relevant collateral arrangements and other product-specific documentation.[6]

(iii) On 9 April, ISDA and Digital Asset (a blockchain start-up) announced the development of a smart-contract based tool for derivatives trading and that they are currently working on an open-source reference code library which will facilitate the implementation of the CDM. The combined use of the smart-contract tool with the CDM is expected to allow a superior level of automation of derivatives management.[7]

ISDA has acknowledged the challenges in implementing the use of smart contracts (and other technology-enabled solutions) in the derivatives space and has established internal committees and member working groups to focus on technology-related topics, including:

(a) The ISDA Legal Technology Working Group, which is focusing on exploring the opportunities for further standardisation of ISDA documentation, in particular by overseeing key aspects of the ISDA Clause Library Project, which is discussed later in this chapter.

(b) The Fintech Legal Group, which focuses on the legal, regulatory and governance issues relating to smart contracts and DLT, an approach that will be vital in addressing some of the issues identified in this chapter.

(c) Various CDM working groups, including the ISDA CDM Design Working Group, whose goal is to develop the CDM while identifying how it may be adopted in order to facilitate shared data management and automation of standardised derivatives lifecycle events. Other CDM subgroups look at specific elements of the CDM design, such as collateral, and different asset classes for which it may be used, such as credit or equity derivatives, and reporting.

These groups are currently open to ISDA's membership, and involvement from market participants will be key to the development of smart derivatives contracts in a way that is appropriate for all participants of the derivatives market.[8]

Regulation of smart derivatives contracts

Smart derivatives contracts are expected to be regulated substantially in the same way as traditional paper derivatives contracts.

The derivatives market was subject to extensive global regulatory reform in the aftermath of the financial crisis. This was reflected in the United States with the adoption of the Dodd-Frank Wall Street Reform and Consumer Protection Act and in the European Union (EU) with the European Market Infrastructure Regulation (EMIR).

Overall, the regulatory framework was reviewed with a view to provide further transparency to the derivatives market and reduce systemic risk. EMIR, for example, is built on the basis of three key pillars: (i) risk mitigation; (ii) reporting; and (iii) central clearing. EMIR provides for a set of obligations that apply to market participants depending on how they are classified under the regulation (i.e. broadly, as financial counterparties or non-financial

counterparties), dependent (in some cases) on the volume of derivatives transactions they have in place, and on the types of derivatives transactions that they enter into.

These regulatory regimes would apply to smart derivatives contacts in the same way as it applies to paper contracts.

On one hand, the use of smart contracts will most likely enable parties to comply with certain aspects of EMIR in a more efficient manner. For example, the automation of certain processes, such as the sharing of data in respect of derivatives transactions, could help to facilitate the parties' compliance with regulatory portfolio reconciliation and reporting obligations.

On the other hand, regulations applicable to derivatives contracts have the potential effect of making it more difficult for the derivatives market to adopt the use of smart contracts. As mentioned in further detail below, this is especially true in the context of the development of the automated ISDA collateral documentation, and ensuring that it provides for regulatory-compliant mechanics (e.g. in line with the provisions relating to regulatory variation margin and initial margin requirements).

Smart derivatives contracts would also be subject to the regulation that is directly applicable to smart contracts more generally. Such regulation is less developed than that in the derivatives space, and there are currently no comprehensive international standards on regulatory policy issues concerning smart contracts.[9] It is likely that, should smart contract work continue to develop and become more widely used, regulation of smart contracts would follow, and smart derivatives contracts would have to abide by this regulation.

Issues and challenges to be considered when adopting smart derivatives contracts

There are a number of issues and challenges that will need to be considered by ISDA in its discussions with market participants to facilitate the transition of the derivatives market towards the use of smart contract code and smart legal contracts.

Scope of automation: operational and non-operational clauses

The main payment and delivery obligations in respect of a derivatives contract are dependent on conditional logic, so these would be well placed for being represented into a smart legal contract. However, not all clauses are susceptible to being automated and self-executed. Certain legal terms are subjective in nature and would produce ambiguity if represented in smart contract code.

The materials produced by ISDA relating to the use of smart contracts in the derivatives space suggest that, when determining which parts of a derivatives contract are susceptible to automation, it is helpful to distinguish between operational and non-operational clauses.[10] Operational clauses would generally contain conditional logic that states that, on the occurrence of a specific event or within a given timeframe, a pre-determined action will be taken, so they would be more amenable to automation. Examples of operational clauses include a payment obligation that arises on a particular date and a collateral transfer requirement that arises where certain pre-determined thresholds are met.

Non-operational clauses, on the other hand, do not necessarily contain such conditional logic, and would more likely relate to the wider contractual relationship between the parties, proving to be more resistant to automation. For example, a governing law clause or a representation that a party is validly existing under the laws of its jurisdiction of incorporation. That is not to say, however, that non-operational clauses cannot be automated. Using the example of valid incorporation, a sufficiently developed smart contract code would

be able to check such information on the relevant company registry to ensure the information is correct. Nevertheless, questions still arise as to how the code will be developed and how common standards will be implemented across smart legal contracts and across different jurisdictions and legal systems.

A potential solution to these issues with automation would be for parties to adopt a hybrid form of smart derivatives contract, in which some of the provisions would be automated and others would be set out in traditional paper form. It is intended that the ISDA Clause Library Project will play an important role in enabling parties to use hybrid smart derivatives contracts. The objective of this project, initiated by the ISDA Legal Technology Working Group, is to build an industry-wide clause library for the Schedule to the ISDA Master Agreement in order to standardise ISDA documentation further as parties continue to explore legal technology. ISDA believes the project will encourage development and adoption of technology by providing greater clarity on how smart code can be implemented in practice. Similarly, ISDA's CDM aims to increase automation and efficiency within derivatives markets by providing a blueprint for how derivatives are traded and managed during the lifecycle of a transaction in order to standardise the market as a basis for automation.[11]

It is expected that the development of these projects will play an important role in simplifying the process of creating a hybrid smart contract, and counter the issues concerning the scope of automation. The development of standardised forms (or smart code) for key provisions selected for automation (in this initial stage, with a focus on operational clauses) will encourage and simplify the adoption of smart legal contracts in the derivatives market.

As the industry is still in its early stages of adopting smart contract solutions, when selecting provisions for automation, ISDA's work should, for the time being, focus on provisions that can be used across different types of derivatives products. The ISDA CDM aims to avoid making functions product-specific, so commonality of functions performed by the automated provisions is important. Having commonality in key pieces of smart contract code will also help with legal validation, which is discussed further in this chapter. If a smart legal contract is entirely in smart contract code, knowing that the code has been 'translated' into human language by a significant proportion of the derivatives industry (as this code will be common across the industry) gives parties comfort that it has been properly scrutinised and validated. Nevertheless, this in itself will create the further challenges of ensuring the contract as a whole works, and that the codified contractual elements integrate fully with the paper documentation.

Issues with legal validation

For a smart legal contract to produce its intended legal effect, its automated provisions (or smart contract codes) must be legally validated by a lawyer. This might be challenging as it would require lawyers to understand the programming language. It follows that there is the need for programmers to work in collaboration with lawyers to leverage their legal insight into which parts of the ISDA documentation framework would be legally effective if converted into an automatable form. ISDA is expected to play an important role in facilitating this work.

If lawyers are to be able to validate the legal effect of a smart derivatives contract, lawyers themselves will need to learn the relevant programming language – perhaps from a starting point of having little or no prior knowledge or understanding of programming. Alternatively, if lawyers are to work closely with computer programmers to draft the smart legal contracts, the lawyer's legal drafting will need to be in a form and language that a non-lawyer is able to understand and translate into smart contract code. This would need to take the form of

clear, natural language that is logical and unambiguous, while properly reflecting the legal meaning. Ultimately, both the lawyer and the programmer may have to invest significant resources into learning and using new language if it is intended that smart legal contracts will be legally validated.

It will be challenging for non-operational clauses that include some degree of subjective interpretation (e.g. where a party is required to act in good faith or commercially reasonable manner) or those that are more complex in nature (e.g. when an event of default is linked to the occurrence of a specific event outside the contractual relationship and that is not easily asserted) to be legally validated.

Furthermore, the requirement for programmers and lawyers working in collaboration to create such contracts raises questions concerning liability. The certainty provided by a smart contract can be framed as an advantage – there may be no room for ambiguity and the code can easily be replicated and re-used. However, leaving such little room for nuance could lead to unforeseen and unwanted outcomes. The fact that high-speed code does not necessarily allow for subjective interpretation and human judgment could result in a specific clause being triggered by certain events – such as in an event of default, as explored further below – where a different course of action may have been preferable. A key question arising from this issue is: who takes on the risk of such concerns, and where does the liability fall? This is a question that will need to be considered with caution as the use of smart contracts in the derivatives space increases and develops.

Issues with automation

Not all provisions, when automated, would produce the same effect as if complied with in their original form (i.e. in natural language) without automation.

By way of example, upon the occurrence of an event of default under a derivatives contract, the non-defaulting party would have the right to terminate the outstanding transactions. Under normal circumstances, under a non-automated contract, there are a range of factors that the non-defaulting party would take into account before pulling the trigger – these tend to be subjective and include commercial considerations, the relationship context at the time of the event and the nature of the default. It would be difficult to cater for these factors when translating event of default provisions into programming language. In practice, the occurrence of an event of default under a smart derivatives contract would be self-automated, so it would automatically trigger the termination of any outstanding transactions.

It is unlikely that all counterparties would have the same attitude and response to the occurrence of events of default due to their subjective nature. Therefore, a potential solution is for smart contract code to inform the parties upon the occurrence of an event of default in order to allow the parties to give further consideration to the event (and the then prevailing facts and circumstances) and provide further authorisation as to the consequences that will arise from the occurrence of that event, ideally from a selection of pre-programmed actions to allow for greater efficiency.[12] As the code is developed and the contracts are used, it may be possible for parties to include responses to certain events that are different for each party, or for the code to monitor the level of risk by the frequency of the occurrence of events and use that monitoring to inform its response.[13] However, as the code would be agreed by all parties entering into the contract, this again raises further issues – parties are unlikely to be willing to spell out their intended responses to each event of default, thus opening themselves up to exploitation under the contract.

ISDA has proposed to work with its members to select provisions within the ISDA documentation framework that are best suited for automation – their goal is to select

provisions that can be automated without changing their legal effect, as well as ensuring the work required to standardise the automated format of the selected provisions is cost and time effective.[14]

Drafting precision and automation

The difficulties outlined above regarding automation and flexibility arise because the code, compared to a human user, struggles to understand the subjective considerations – for example, the use of the term 'reasonable'. Without clearly defined parameters within which to work, converting natural language into a codified contract creates the risk that the code would divert from the true legal meaning of the contract.

As ISDA has identified, the human user of a paper contract has the flexibility to fully understand legal drafting, as evidenced by the approach to legal drafting in a court room. Whereas a court will try to give some meaning to ambiguous words to understand what the parties have agreed, a machine is unlikely to be able to take a similar (flexible) approach when 'interpreting' the programming language.[15] However, it is thought that, as the use of smart contract code develops, it could be possible to create software that adds a level of non-determinism to code and that could work out the meaning of non-recognised code by exploring other versions and examples of similar programming.[16] This development could be invaluable in the derivatives space.

Nevertheless, it appears evident that smart derivatives contracts capable of complex subjective interpretation of legal issues are some years away. For most lawyers, deliberate ambiguity can be a vital drafting and negotiating tool. Contracts often contain a mixture of carefully specified language and language which is expressed with a degree of ambiguity – for example, if parties are unable to agree terms, or if a draftsperson wants to improve an unfavourable position for their client. Also, even when the code is capable of applying discretion, for complex derivatives transactions parties may be concerned about the idea of allowing computer code to effectively make commercial decisions following certain events.

There appears still to be some way to go before smart contracts are created with the necessary flexibility and subjectivity for derivatives contracts.

Issues concerning the use of smart contracts in ISDA's collateral documentation

There are a number of legal issues that need to be considered when applying legal technology solutions to the ISDA collateral documentation.

The ISDA collateral documentation includes the credit support documents prepared by ISDA (such as a credit support annex or a credit support deed) providing for the exchange of assets between parties as collateral in respect of underlying derivatives transactions (including for the purposes of compliance with the applicable regulation, e.g. the variation margin and initial margin requirements under EMIR). Broadly, in a derivatives context, collateral is used to support a party's obligations – such as to make payments in certain circumstances – by identifying assets to which the other party can have recourse if the party providing the collateral fails to meet their obligations.

ISDA has identified collateral processes as an area in which opportunities might exist for automation. There is often seen to be a lack of efficiency in many existing collateral processes – for example, differences in reference data (such as for valuation purposes) which may give rise to calculation disputes. Many of these processes use conditional logic which, as discussed elsewhere in this chapter, can be particularly conducive to the use of smart contracts. The benefit of automating these processes is evident as regulation has increased complexity in the area, as automation would add operational efficiency that would save

valuable resources. Nevertheless, legal and regulatory concerns arise when considering the automation of collateral documentation.

When considering the use of smart code in the ISDA collateral documentation, it is important to consider the specifics of the assets to be provided as collateral. Smart contract developers' design choices when it comes to the creation of the smart derivatives contracts, and the use of DLT, will have an effect on the nature of, and the rights to, the collateral, in particular regarding access and restrictions on use. Further, developers must consider the legal *situs* (location) of the assets, and this is an issue explored in more detail later in this chapter.

A party's ability to choose the assets to be posted as collateral might also be affected when its transfer is automated. Under a paper contract, parties may have a choice as to the type of collateral it wishes to post on receipt of a collateral call – for example, where the party is entitled to post either cash or securities, it will consider, from a commercial perspective (including based on liquidity and operational concerns), which type of collateral it wishes to transfer across to its counterparty. This ability to choose may face opposition from a fully automated process. It may therefore be necessary to embed further coding into the mechanics of the smart contract to provide the parties with the ability to elect for specific types of collateral to be transferred upon the occurrence of pre-determined market events (or other commercially agreed triggers).

Also, under applicable derivatives regulation, certain types of collateral are subject to requirements relating to liquidity, credit quality, concentration and wrong-way risks. Smart derivatives contracts will need to be capable of translating these requirements into smart code. ISDA sees this as falling within the realms of smart contract capability, but it will take some time until the code has been developed sufficiently to deal with these complexities.

Finally, the handling of disputes within the context of automated ISDA collateral documentation will have to be considered carefully. Disagreements over collateral valuations will need to be resolved quickly between the parties, especially with regulatory-compliant collateral arrangements, and it will be vital to ensure the smart derivatives contract is designed to allow for suspension of transfer obligations pending resolution of the dispute and, where applicable, the transfer of any undisputed amounts.

While the automation of the ISDA collateral documentation is certainly possible, this in particular will be an area in which lawyers and smart contract developers must work closely together to ensure the resulting smart contract code reflects the many complexities set out in the ISDA collateral documentation and applicable regulation.

Complex and bespoke derivatives contracts

Certain derivatives contracts can be heavily negotiated and customised to apply to bespoke arrangements made between the parties. The level of customisation might vary depending on counterparty type and product complexity. Examples of highly customised arrangements include total return swaps, longevity swaps and other structured finance products that will likely be made under a suite of documents forming the overall derivatives architecture, where various levels of obligations apply across different parts of the documentation. In light of the challenges addressed above, it would be difficult to translate these interlinking obligations into programming language in a straightforward manner. Beyond whether it is possible, it is also not necessarily practical or desirable to pursue the automation of highly complex elements of derivatives contracts. It is extremely difficult, if not impossible, when entering into such an arrangement, to predict all the possible scenarios that may arise from a particular contract and a particular legal relationship between the parties. Indeed, the time and cost involved in attempting to do so may not be worthwhile. Therefore, apart from the issues

raised above that need to be considered before embarking on the development and use of smart derivatives contracts, parties may wish to think carefully about whether it is beneficial to even to try to develop code that is sufficiently intricate to reflect highly complex provisions of certain types of derivatives contract.

The recent regulatory developments in the derivatives space (which follow a global trend post the global financial crisis) have also contributed to the complexity of certain derivatives contracts. For example, there has been an increase in the use of third-party custodians when implementing collateral arrangements to deal with certain margin requirements, and there are additional layers of complexity arising from the need for certain over-the-counter derivatives transactions to be centrally cleared. This only goes to complicate the matter further – as the derivatives market becomes more heavily regulated more generally, and as regulation of smart contracts is further developed, smart derivatives contract code could become ever more complex to develop.

Laws affecting contractual performance

Certain laws might have the effect of interrupting the performance of contracts – for instance, where a provision under a specific contract is rendered void, or where a contractual stay is applied to a party in financial distress under the applicable regulatory regime. Terms can also be implied into a contract, or amended by the courts if found to not reflect the true agreement between the parties. How would smart legal contracts interact with these laws?

The way forward may include the requirement for smart contract code to need human input, to ensure the contract is managed and is kept up-to-date to reflect changes in law. It is impractical and inefficient to include all possible circumstances and imagine responses within the code, and it is legally risky to ignore the consequences of having smart contracts that could potentially be operating outside the law. Therefore, the contract must allow for human intervention to pause its automatic performance – this would not pause the obligations under the contract, but only its automatic operation.

As part of its work in the smart contracts space, ISDA has noted that the right of suspension would be useful in many scenarios.[17] For example, as mentioned above, it would interact well with the idea that smart derivatives contracts could require further authorisation on the occurrence of an event of default. In practice, this would mean that, where appropriate, parties would have the flexibility to suspend the automatic operation of the smart contract and rely on natural language provisions.

Situs

It is often necessary to be able to identify the location of an asset or the location of performance of a contract to be able to ascertain the relevant legal jurisdiction – for example, in the case of disputes, what is to be the governing law. For dematerialised financial assets, ownership is often recorded on a register, and the *situs* is the place in which that register is held or the registrar is situated. Issues might arise when it comes to information relating to smart derivatives contracts (including in respect of assets provided as collateral) on a DLT as the information might be distributed across multiple jurisdictions – and as there is no registered location for the data, *situs* might be indeterminable. It might be that this issue will be resolved over time as the market develops and regulation is enhanced, but for now it is important for industry bodies and market participants to consider this in further detail.[18]

Liquidity concerns

Once the market has moved to address most of the key concerns that are set out in this chapter, it is likely that only the largest and most sophisticated market participants will be

able to start using smart legal contracts. The smaller or less sophisticated players, including many buy-side entities, might find it more challenging and costly to adapt their processes to the new 'reshaped' derivatives market.

What should market participants be doing?

The market is still evolving and is in its early stages of developing a model that works across the derivatives industry. ISDA is playing an important role in the implementation of technology-enabled solutions (with a special focus on smart contracts and DLT). This will have a positive effect on the market, by improving operating efficiency and reducing operating costs and risk.

For the time being, market participants are encouraged to:

- get involved with the initiatives put forward by ISDA, including the working group discussions; and
- have an ongoing dialogue, and compare notes, with their peers, counterparties, legal advisers and other industry bodies on the changes that will need to be implemented into their systems and processes to allow for the use of smart contracts.

It is important for representatives from all different parts of the derivatives market, including buy-side, sell-side, market makers, industry bodies, regulators and advisers, to join efforts in order for considerable progress to be made across the industry and enable the use of smart derivatives contracts and, most importantly, to address the challenges identified in this chapter.

* * *

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