ISDA Legal Guidelines for Smart Derivatives Contracts: Foreign Exchange Derivatives

Contents

Disclaimer

The purpose of these guidelines is to provide an introduction to foreign exchange derivatives ("**FX**") for readers who are designing and implementing technological solutions for them. The intention of this paper is not to specify or recommend any particular technological application or project. Rather, these guidelines intend to provide an overview of the legal and documentary framework used for FX transactions and to highlight certain issues that developers may wish to consider. This paper is intended to help developers tailor appropriate technology solutions for the FX market.

These guidelines discuss a number of legal issues. These discussions are intended to provide general guidance, not legal advice, and to promote a better understanding of the basic principles that underpin documentation produced by the International Swaps and Derivatives Association, Inc. ("**ISDA**"). In practice, the law relating to derivatives transactions and the legal documentation that governs them is complex, may change over time due to evolving case law and new regulations, and may vary substantially from jurisdiction to jurisdiction.

In presenting this material, an assumption is made that certain terms in ISDA documentation relevant to FX are capable of being (and may currently be) represented in computer code or performed by or on a technology platform. For example, payment-related provisions that require one party to pay another an amount that is calculated on the occurrence of a certain event may be suited to codification or automated processing. This paper also assumes that some provisions within such ISDA documentation may not be as well suited or efficient to code and will remain as written in the contract.

These guidelines do not represent an explanation of all relevant issues or considerations in a particular transaction, technology application or contractual relationship. These guidelines do not constitute legal advice. Parties should therefore consult with their legal advisors and any other advisor they deem appropriate prior to using any standard ISDA documentation. ISDA assumes no responsibility for any use to which any of its documentation or any definition or provision contained therein may be put.

Unless otherwise defined or the context otherwise requires, capitalized terms used in these guidelines have the meanings given to them in the relevant ISDA document.

Introduction

Since its foundation in 1985, ISDA has consistently sought to promote efficiencies and cost-savings through improvements to processes for the settlement and management of lifecycle events related to a variety of derivatives products. Today, as new technologies are developed and implemented across the financial markets, the derivatives industry is increasingly seeking to achieve even greater efficiencies and cost-savings through the deployment of such technologies.

In response, ISDA has published a series of *Legal Guidelines for Smart Derivatives Contracts*. The purpose of these guidelines is to support technology developers and other key stakeholders in the development of smart derivatives contracts by explaining the core principles of ISDA documentation and raising awareness of the important legal and regulatory issues that developers and other relevant stakeholders should consider when developing and deploying such solutions within the derivatives market.

This paper builds upon the ideas examined in ISDA's previously published papers to focus on the application of such technology solutions to the FX market. These guidelines will:

- provide high level background on the FX market;
- identify opportunities for the potential application of smart contract technology to FX; and
- highlight important issues for technology developers to consider when designing technology-enabled solutions for trading and processing FX and associated processes.

The significant size of the FX market and the fact that various aspects and features of FX lend themselves easily to automation (as described further in this paper) means that there is a significant opportunity for technology developers to create scalable solutions that can have a significant impact on the broader derivatives market.

A number of technology-based initiatives working towards greater standardization and automation of the FX market have already been developed and implemented. These include the electronic trading and execution of FX and the application of data analytics, including pre-trade transaction cost analysis.[1]

In addition to these existing initiatives, there are opportunities to build further by harnessing new technologies, such as smart contracts and distributed ledger technology ("**DLT**"), in order to provide scalable, cost-efficient and more accurate technology solutions within the FX market.

While the intention of this paper is not to specify or recommend any particular approach or to address any particular technological application or project, these guidelines seek to ensure that the design and implementation of new technology solutions are consistent with existing legal and regulatory standards. These guidelines also highlight areas where further industry collaboration will be required to identify existing areas of legal and regulatory uncertainty and to develop solutions.

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1 *See*, *e.g.*, https://www.r3.com/press-media/blockchain-leaders-join-forces-to-tackle-inefficiencies-in-the-global-fx-market/

The Over-the-Counter FX Market

This section provides high-level background on the over-the-counter ("**OTC**") FX market.

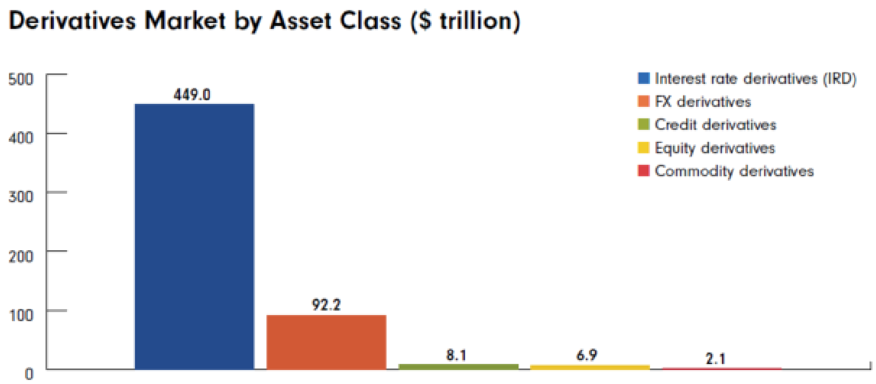
The FX market encompasses a wide variety of products, including FX swaps and FX forwards (both deliverable and non-deliverable forwards). Fundamental FX elements are also found in products like cross-currency swaps and cross-currency options (deliverable and non-deliverable). Payment flows of FX contracts are determined primarily by reference to one or more rates of exchange between currency pairs specified in the derivative contract. The value of the contract in this context is often zero on inception, and fluctuates during the life of the transaction, primarily as a result of movements in the rate of exchange. Payment flows may represent either the exchange of one or more currencies against one or more other currencies (referred to as 'deliverable' or 'physically-settled'), or settlement in a single currency of the difference in value between the two or more currencies of the transaction, as determined on the valuation date based on the rate(s) of exchange for the transaction (referred to as 'non-deliverable' or 'cash settled').

FX may be used by organizations to hedge their exposures to FX rate fluctuations, for instance, where a party receives income primarily in one currency, but their expenses are paid in a different currency. FX may also be used for other reasons, such as for speculative purposes. FX spot transactions are used to purchase and settle foreign securities. If, for example, a U.S. based firm that only has a U.S. dollar account wants to purchase a foreign (*i.e.*, non-U.S.) security, that U.S. firm must purchase the foreign currency in order to pay for the foreign security.[2]

The FX market follows the interest rate derivatives ("**IRD**") market as the second largest derivatives product market, by various measures. As of the end of December 2019, the total gross market value of FX contracts outstanding was approximately $2.2 trillion, which equates to about 19.1% of the gross market value of the OTC derivatives market.[3] The total notional amount of FX outstanding as at the same time was approximately $92 trillion, corresponding to about 16.5% of the total notional amount of OTC derivatives then outstanding (see Figure 1).[4] The daily turnover of FX in April 2019 was $4.6bn, which equates to about 70.7% of the daily turnover of OTC IRDs.[5]

2 Here, the FX transactions' tenor and known currency has to mirror the foreign security, its denomination, and settlement cycle.
3 https://stats.bis.org/statx/srs/table/d5.1
4 https://stats.bis.org/statx/srs/table/d5.1
5 https://www.bis.org/statistics/rpfx19_ir.htm

Figure 1



Source: Bank for International Settlements semi-annual survey as of December 2019[6]

Types of FX

There are different types of FX, including[7]:

- **FX spot**: A type of transaction that involves the payment of an amount in one currency against payment of an amount in another currency at an exchange rate specified on the trade date, for settlement that is typically T+2.
- **Deliverable FX forward:** A type of transaction that involves the payment of an amount in one currency against payment of an amount in another currency at an exchange rate specified on the trade date, for settlement on a specified future date that is beyond the time period typically applying to spot transactions in the relevant jurisdiction(s) (for example, beyond T+2 business days in some jurisdictions).
- **Non-deliverable FX forward ("NDF"):** A type of transaction that involves the payment of an amount in a single settlement currency where the amount of the payment is determined by reference to an exchange rate specified on the trade date, for settlement on a specified future date (beyond the typical settlement cycle for spot transactions). Parties engage in NDF transactions for a variety of commercial reasons, including in scenarios where at least one of the currencies (other than the settlement currency) is subject to exchange controls or transfer restrictions that apply to certain parties.
- **FX swap:** A type of transaction generally involving the exchange of amounts in two different currencies on a specified date, or time, followed by reverse exchanges of amounts in the two

6 http://assets.isda.org/media/ce977683/d3c2a494-pdf/

7 It is appreciated that there are different interpretations in the market in relation to each of these types of derivatives that may be applied in various different contexts. These definitions are intended to be representative examples only, and are neither exhaustive in nature, nor strict technical definitions in the legal sense.

currencies at a later date. In each case, the exchange rate and settlement date are specified on the trade date.[8]

- **Cross-currency swaps:** An IRD type of transaction that, in addition to an exchange of notional amounts in different currencies at the outset and a reverse exchange at the maturity of the transaction, provides for periodic exchanges of amounts in each currency based on one or more fixed and/or floating interest rates.
- **Currency option:** Under a currency option, the holder or buyer has the right (but not the obligation) to either make or take delivery of one currency in exchange for taking or making, respectively, delivery of another currency at a future date. The exchange rate is determined on the trade date. As for other derivatives, there are a variety of possible option structures, including deliverable FX and NDFs (*i.e.*, respectively, involving an exchange of the relevant currencies or settlement in a single currency), as well as structured or more complex options.
- **Barrier FX option:** A type of option under which the right to exercise the option may arise or be extinguished, or the terms of which may change in some other pre-defined manner, upon the occurrence of an event or condition (known as a barrier event) defined by reference to observed values of one or more exchange rates during the term of the option.
- **FX correlation swaps**: A type of swap where each party agrees to pay to the other an amount equal to a specified notional amount multiplied by the difference between a specified level and the observed correlation between exchange rates for specified currency pairs over a specified observation period.
- **Variance-linked FX transaction**: A type of transaction under which a “variance buyer” and a “variance seller” agree to exchange payments based on the difference between (i) an amount proportional to the observed level of variance (as defined under the terms of the variance swap) of the exchange rate for a specified currency pair realized over a stated observation period and (ii) a fixed amount of variance that is agreed upon at execution.
- **Volatility-linked FX transaction**: A type of transaction similar to a variance swap, except that payments under a volatility swap are determined by reference to the observed volatility, rather than variance, in the relevant exchange rate over the specified observation period.
- **FX forward volatility transaction**: A type of transaction in which the parties agree on the trade date to enter into a “straddle” (a combination of a put option and a call option on a specified currency pair, both of which are purchased by the same party (the option buyer)) on a specified future date (the “reference date”) with terms that will be based on a volatility level that is agreed by the parties on the trade date.

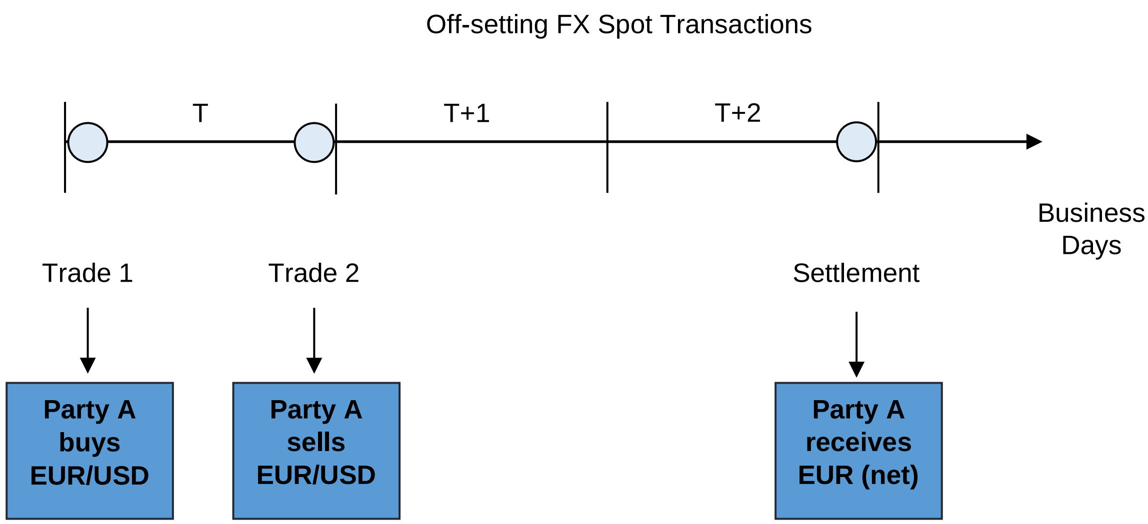
It is important to bear in mind that these descriptions of transaction types address the principal payment flows arising under each transaction type. As a practical matter, except for FX spot transactions, FX transactions are often not carried out to maturity, or to one or more relevant

[8] An “in/out swap” in the CLS system is sometimes considered to be similar to an FX swap, but with a duration less than one day.

payment dates, but are instead closed out or novated to another party, in exchange for a mark-to-market payment.

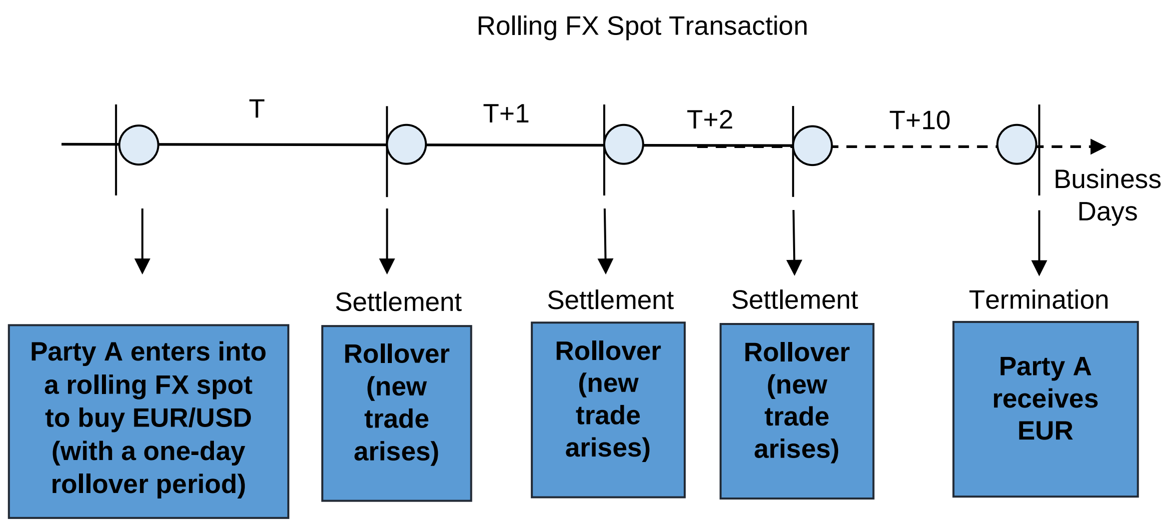
The intention of parties entering FX transactions is not necessarily to take delivery of the relevant currencies; instead, many transactions are entered into to gain economic exposure (whether for hedging or other purposes) to fluctuations in the relevant FX rate during a certain period, after which the aim is to crystallize or close out that exposure. This can be achieved in a variety of ways, for example, by agreeing to terminate a transaction at a specified close-out price, or by entering into an offsetting trade. We have shown below in Figure 2 one example of two offsetting FX spot transactions entered into on the same trade date, where the currency fluctuation has been favourable to Party A, thereby crystalizing a cash payment settled on T+2 (assuming multiple transaction payment netting applies). It is also possible that the transactions settle gross, although the economic effect will remain.

Figure 2



In other circumstances, rollover provisions may be included in an FX transaction (*e.g.,* an FX spot transaction, swap or FX forward), the effect of which is to replicate the economic effect of periodically closing out the relevant transaction and then entering into a new transaction. The effect is a periodic settlement of the transaction, with continuing economic exposure on the terms agreed unless and until the transaction is otherwise terminated. This is illustrated by Figure 3 below.

Figure 3



Deliverable versus non-deliverable FX

FX can be categorized as either deliverable or non-deliverable. Under a deliverable FX, the transaction terms provide for an exchange of payments in each of the two currencies on the settlement date(s).

Under an NDF, by contrast, the transaction terms provide for the payment of a cash settlement amount in a single settlement currency on the settlement date in lieu of delivery of the notional amounts of the bought and the sold currency. The cash settlement amount is determined by multiplying the notional amount for the transaction by a ratio determined by reference to the exchange rate for the contract and the realised exchange rate (referred to as the "**Settlement Rate**") at the relevant time of valuation. In this way, a single payment in the settlement currency falls due on the settlement day, payable by one party. Some NDFs provide that each of the bought and the sold currencies are converted into a third currency that serves as the settlement currency.

Cleared versus uncleared FX

The central clearing of derivatives has generally increased substantially in recent years, largely as a consequence of policy responses following the global financial crisis. The FX market has, however, been less affected by the rise of central clearing, as FX are not currently subject to mandatory clearing in the European Union or United States and, as a consequence, clearing services have tended to be developed by central clearing counterparties ("**CCPs**") only for voluntary clearing of NDFs. Accordingly, as of the end of December 2019, the notional amount of foreign exchange contacts with a CCP was approximately 3.7% of the total notional amount of foreign exchange derivatives then outstanding.[9] By contrast, the share of notional amounts of

[9] https://stats.bis.org/statx/srs/table/d5.1

cleared IRDs was approximately 76.6% of the total notional amount of IRDs then outstanding, as at the end of 2019.[10]

The legal terms which govern the contracts for non-cleared and cleared derivatives can differ, as can the processes, valuation, payment and delivery flows. This may give rise to certain additional issues when considering the use of smart contract technology for other derivatives contracts. However, this is likely to be less significant in the context of the current FX market, where fewer derivatives are centrally cleared (as compared with other types of derivatives, notably IRDs or credit default swaps).

Exchange-traded versus OTC FX

FX can also be traded on specific exchanges (and are therefore referred to as “exchanged-traded derivatives”) rather than bilaterally between counterparties. Note that a detailed discussion of exchange-traded derivatives is beyond the scope of these guidelines, though it is possible that some of the technology solutions applicable to OTC FX could be applied to exchange-traded derivatives as well.

Market evolution

Markets and market practices are continuously evolving in response to a range of factors, including client demand. New products are being developed and old products may have certain terms revised. Developers will therefore need to account for market evolution and to ensure that technology solutions are capable of adapting to changing market practices.

The OTC FX market in particular is known for its flexibility and frequent innovation. While benefiting from high levels of standardization, market participants can enter into highly bespoke FX transactions, with features that allow those participants, for example, to hedge seamlessly the risk of an equally bespoke cash product, such as a complex loan. While these bespoke transactions are less common than more standardized products, initiatives to develop smart derivatives contracts and digitize aspects of the FX market may benefit from taking these more tailored and flexible transactions into account.

10 https://stats.bis.org/statx/srs/table/d5.1

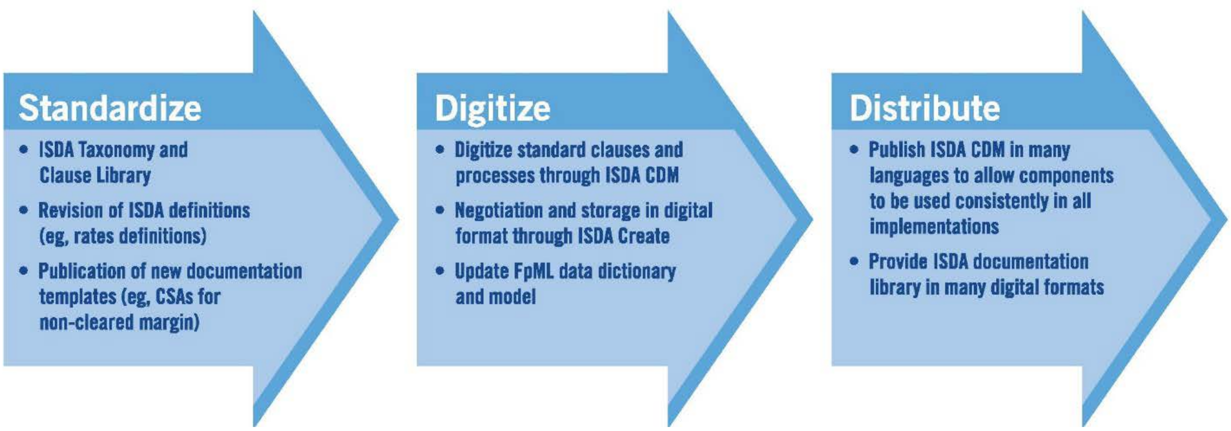
Building the foundation for Smart Derivatives Contracts

On 28th July, 2020, ISDA and several other trade associations sent a letter to the Financial Stability Board, IOSCO and the Bank for International Settlements asserting our joint commitment to defining and promoting the development of a digital future for financial markets.[11] The benefits of digitization for market participants are clear. Increased and more widespread implementation of automated, straight-through processing of financial transactions will increase efficiency and reduce costs for market participants. Digitization will promote the consistent creation, processing and aggregation of global financial data, bolstering regulatory oversight and compliance. Through the removal of redundancy and unnecessary complexity, increased digitization and automation will strengthen the operational resilience of market participants and financial markets infrastructure, reducing systemic risk and creating a safer and more robust global financial system.

None of this is possible without industry-led development of essential data standards and the distribution of these standards in digital formats to allow direct deployment within enhanced, automated and intelligent processes, systems and technology.

The letter sets out a series of principles and objectives aimed at promoting the development, distribution and adoption of digital standards within the financial markets, creating the foundation for transformational change in our industry. These principles and objectives address three key areas: **Standardization**, **Digitization**, and **Distribution**.

Figure 4: ISDA's Digitization Initiatives



Standardization

Expanding ISDA's digital offering across our suite of actively negotiated documentation requires enhanced standardization of those documents. Firms will always need to negotiate and customize documentation to address specific commercial, compliance, legal and operational risks. However, excessive customization can increase complexity and on-boarding times, while providing little or no commercial or legal benefit. A lack of standardization therefore gives rise to operational

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11 https://www.isda.org/a/MGmTE/Digital-Future-for-Financial-Markets-Letter.pdf

inefficiency, increases risk through unnecessary complexity and creates impediments to digitization.

In response, ISDA has developed the ISDA Clause Library. The ISDA Clause Library effectively deconstructs the standard legal document and assigns meaning to the various different obligations and events expressed within it. Using thousands of agreements and clause samples, we identified, defined and categorized the most commonly negotiated clauses within the ISDA Master Agreement and various credit support documents. Having established this framework, we created standard-form drafting options that are capable of achieving the vast majority of the most commonly negotiated outcomes within standard-form ISDA documentation. This standard-form wording is now available for use by market participants in their negotiations.[12]

The Clause Library will also be integrated within ISDA Create, ISDA's digital negotiation and execution platform, when the ISDA Master Agreement is added to the platform. ISDA Create is an online solution that allows firms to produce, deliver, negotiate and execute derivatives documents completely online. The system captures, processes and stores legal data from these documents in a structured standardized format, which provides users with a complete digital record, but more importantly, allows easy automated integration with other systems to facilitate seamless information flows and remove the need for post-execution transfer of data (and the chance of error during such a data transfer).

FX documentation

The 1998 FX and Currency Option Definitions published by ISDA, Emerging Markets Traders Association ("**EMTA**") and the Foreign Exchange Committee (the "**1998 FX Definitions**"), as updated from time to time, provide standard definitions for use by market participants in documenting privately negotiated FX and currency option transactions. The 1998 FX Definitions are intended for use in confirmations and allow parties easily to specify standard economic features of trades and to allocate various risks associated with the occurrence of certain trade events that are reasonably likely to affect FX and currency options. As for other ISDA definitional booklets, the 1998 FX Definitions are, therefore, available prior to the point in time at which parties transact. This may present certain opportunities in the context of technology platforms seeking to automate or address within the platform the concepts referred to in the 1998 FX Definitions. As described further in the section below entitled "Issues for technology developers to consider", this may present certain challenges, including with regard to the interpretation of the 1998 FX Definitions, and ensuring consistency where appropriate, both internally to the platform and across the market.

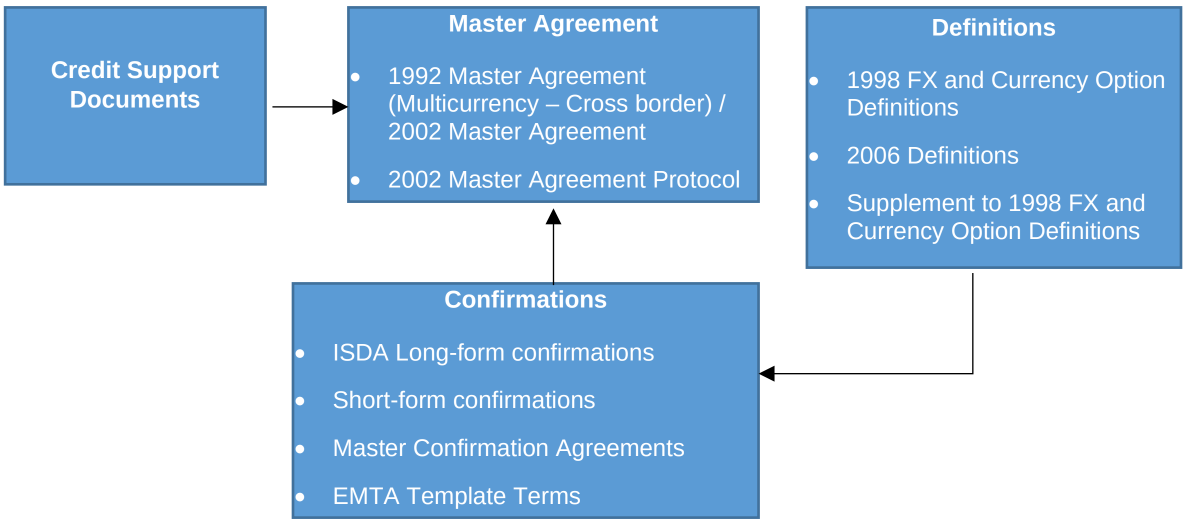
Standard forms of confirmations have also been published by EMTA and ISDA for NDFs as well as supplemental provisions to the definitions for specific currencies and FX products, including, for instance, the Non-Deliverable Cross Currency FX Transactions Supplement published in May 2011, the 2005 Barrier Opinion Supplement, and the September 2019 Averaging Supplement. These confirmations are generally used when documenting currency transactions involving certain emerging market currencies and allow parties to allocate risks associated with the

[12] The ISDA Clause Library currently covers the ISDA Master Agreement. The Clause Library will be expanded to cover various ISDA credit support documents in 2021. More information: https://www.isda.org/2020/06/23/isda-launches-clause-library/

occurrence of certain trade events that are reasonably likely to occur in a specific country and with respect to a related currency pair. We show in Figure 5 how the definitions and supplements are often applied to a transaction. The ISDA documentation architecture, and considerations in relation to smart contracts, are also described further in *ISDA Legal Guidelines for Smart Derivative Contracts: Introduction*[13].

Figure 5

FX and Currency Options Documentation Architecture



The ISDA legal architecture and considerations set out in the *ISDA Legal Guidelines for Smart Derivative Contracts: The ISDA Master Agreement*[14] will also be relevant to the FX market. While the ISDA Master Agreement (and related ISDA published documentation used to document FX, as described above) is standardized, market participants do negotiate and amend these documents bilaterally. There are, however, certain amendments that are made, and provisions added to, ISDA Master Agreements on a relatively regular basis, including, for example, amending the ISDA Schedule to incorporate FX transactions and currency options within the scope of the ISDA Master Agreement or adding language relating to the exercise of currency options, netting of certain offsetting currency option transactions or the payment of currency premium. However, the exact drafting used by market participants often differs based on differences in drafting style, rather than commercial intent. As discussed further above, ISDA is engaged in the ISDA Clause Library Project to encourage the further standardization of derivative transaction terms, including FX transactions, where appropriate.

The range of documentation available has promoted standardization in the FX market. In this context, smart contracts offer a viable opportunity to automate many of the processes involved in the negotiation and documentation of FX. FX confirmations, for instance, which contain the commercial and economic terms relating to the transaction, may be automated through smart

[13] See ISDA, "Legal Guidelines for Smart Derivatives Contracts: Introduction" available at: https://www.isda.org/a/MhgME/Legal-Guidelines-for-Smart-Derivatives-Contracts-Introduction.pdf

[14] See ISDA, "Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement" available at: https://www.isda.org/a/23iME/Legal-Guidelines-for-Smart-Derivatives-Contracts-ISDA-Master-Agreement.pdf

contracts. The payment obligations contained within these confirmations could be implemented as separate pieces of smart contract code. Other obligations related to the economic terms of the confirmation may also be smart contract coded.

Digitization

ISDA is currently working to provide all of its documentation in digital format. ISDA's flagship digital offering is the ISDA Interest Rate Derivatives Definitions, a revised and updated definitions booklet for use with IRDs. Alongside necessary updates and adjustments to take account of market evolution and global benchmark reform efforts, a key driver for this project is making the standardized interest rate definitions more user- and technology-friendly.[15] The ISDA Interest Rate Derivatives Definitions will be produced in a digital format, allowing for the production and maintenance of a consolidated and up-to-date view of the definitions, rather than requiring users to compile paper or pdf copies of the main definitional booklet and up to 70 amending supplements in order to understand the terms which apply to their trades (as is the case with the current 2006 ISDA Definitions). ISDA will deliver the ISDA Interest Rate Derivatives Definitions through an online platform, increasing accessibility and incorporating various built-in functionalities and capabilities, such as hyperlinking and version-control to provide a more user-friendly experience.[16]

Standardization and digitization of documentation is only half the battle. There is also a lack of common data and process standards, and little alignment between these standards and the underlying documentation. Firms and infrastructure providers typically use their own unique set of representations for transaction events and processes. As a result, market infrastructure is inefficient and expensive.

ISDA supports the development of common, interoperable industry standard models for financial transactions and processes. The ISDA Common Domain Model ("**CDM**") establishes a common, digital representation of derivatives trade events and actions and creates a common set of process and data standards that will increase automation and efficiency in the derivatives market. This model can be easily expanded to cover additional products and contracts as a means of encouraging further standardization across the financial markets. Indeed, the International Securities Lending Association ("**ISLA**") is currently working to model and code specific securities financing transaction components for inclusion in the CDM, creating greater alignment between derivatives and securities lending markets.[17]

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15 Amongst other things, the following approaches have been adopted:
- (i) simplifying and standardizing sentence and paragraph structures (*e.g.*, by making sentences shorter and splitting detailed paragraphs into multiple limbs);
- (ii) streamlining definitions (*e.g.*, by deleting duplicate definitions);
- (iii) using formulaic expressions where possible (*e.g.*, in the context of day-count fractions and compounding provisions); and
- (iv) using binary or conditional language that can more easily be understood and converted into code by technology developers.

16 See ISDA, "Legal Guidelines for Smart Derivatives Contracts: Interest Rate Derivatives" available at: https://www.isda.org/a/I7XTE/ISDA-Legal-Guidelines-for-Smart-Derivatives-Contracts-IRDs.pdf

17 See https://www.isda.org/2020/07/27/isda-and-isla-agree-to-closer-collaboration-on-digital-initiatives/

Distribution

Critical to the success of these efforts will be the extent to which market participants can easily access and benefit from these new standards. Fragmented and duplicative distribution of digital offerings will inevitably result in incompatible platforms and solutions. This will increase inefficiency and the cost to the market. We will therefore ensure that our standards and the digitized representation of these standards are made available in a way that promotes competition, encourages innovation, and facilitates the development of mutualized technology solutions within our markets.

Refinement and expansion of these models will facilitate greater connectivity between contractual terms and the processes designed to implement important business and operational functions deriving from contracts, including netting and collateral enforceability, liquidity, and counterparty credit-risk. All of this will help move the industry towards more efficient, cost-effective and scalable payment, settlement, collateral management and regulatory processes, providing a robust foundation for straight through processing of financial transactions.

These enhanced standards will enable the development and implementation of innovative new automated and intelligent technology solutions. For example, common, shared representations of data are required in order for distributed ledger technology to operate effectively. Equally, platforms such as ISDA Create, which capture structured data at the point of origination, that is, in legal documentation entered into electronically from the outset, further facilitate convergence on common standards, and the distribution of standardised data, thereby greatly increasing efficiency across the industry.

These developments facilitate the development and deployment of common processes across different market players; taken a stage further, in the case of distributed platforms, they also facilitate smart contracts to be developed and deployed across the market. The aggregation of large, structured data sets will also accelerate the use of AI-based technology solutions, with potential applications across numerous business, risk management and regulatory compliance functions.

Using these enhanced standards as a foundation, technology developers can then deploy automated business logic in a way that draws upon the ISDA CDM to facilitate specific functionality. One straightforward, but compelling, example of the application of smart contract technology which utilizes the ISDA CDM would be the automation of the calculation and triggering of the payment of a settlement amount under an FX transaction between two counterparties who would otherwise rely on their own internal data models and, often, manual processes and messaging, in order to reconcile and settle the trade.

Constructing Smart Derivatives Contracts for FX

In October 2018, ISDA and King & Wood Mallesons jointly published a white paper entitled "*Smart Derivatives Contracts: From Concept to Construction".*[18]

This paper proposed a practical framework for the construction of smart derivatives contracts.

As part of this framework, the paper suggests that a key step toward the construction of a smart derivatives contract is the selection of those parts of a derivatives contract for which automation would be:

- **Effective**, which involves determining which parts of a contract it is possible to automate; and
- **Efficient**, which involves determining which of those parts where there is sufficient benefit in automating.

Effective Automation

In 2017, ISDA and Linklaters jointly published a white paper entitled "*Smart Contracts and Distributed Ledger – A Legal Perspective.*"[19]

This paper notes that derivatives are fertile territory for the application of smart contracts and DLT because their main payments and deliveries are typically operational in nature, and thus heavily dependent on conditional logic. As a result, they are highly suitable to being machine-automated or analysed in some way. The paper illustrates how these operational provisions can be expressed in a more technology-friendly form, broken down into components for representation as functions within the ISDA CDM) and then combined with other functions into templates for use with particular derivatives products.[20]

The *Smart Derivatives Contracts: From Concept to Construction* paper notes that there are examples throughout the 2006 ISDA Definitions of such operative clauses, including Section 5.1 which sets out how to determine the fixed amount payable by the fixed rate payer. The paper then illustrates how this provision can be expressed in a more technology-friendly form, broken down into components for representation as functions (within the ISDA CDM) and then combined with other functions into templates for use with particular derivatives products, such as FX.

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18 See ISDA's White paper on "Smart Derivatives Contracts: From Concept to Construction" available at: https://www.isda.org/a/cHvEE/Smart-Derivatives-Contracts-From-Concept-to-Construction-Oct-2018.pdf

19 See ISDA, Smart Contracts and Distributed Ledger: A Legal Perspective" available at: https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf. ISDA, along with Clifford Chance, R3 and the Singapore Academy of Law published a whitepaper that provides analysis on the legal issues relating to the use of smart derivatives contracts governed by the laws of Singapore and England and Wales involving distributed ledger technology ("Private International Law Aspects of Smart Derivatives Contracts Utilizing DLT", available at: https://www.isda.org/2020/01/13/private-international-law-aspects-of-smart-derivatives-contracts-utilizing-distributed-ledger-technology/). Whitepapers considering these issues for contracts governed by the laws of other jurisdictions are forthcoming.

20 See also ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction available at: https://www.isda.org/a/MhgME/Legal-Guidelines-for-Smart-Derivatives-Contracts-Introduction.pdf

Efficient Automation

There are a number of areas within the FX market where greater automation can deliver considerable efficiency benefits.

There are a number of observed pain points in the current processes associated with FX. These include:

- repetitive processes that are inefficient and costly;
- challenges with resolving disputes in a timely fashion; and
- slow and ineffective valuations and transfers of payments and assets.

As mentioned above, the operational processes involved in valuing, calculating and settling payment and delivery obligations are likely to lend themselves well to automation and to deliver real efficiencies and cost-savings as compared with existing payment infrastructures. These terms are generally contained in the trade confirmation for the relevant transaction, which sets out the economic terms thereof and typically incorporates the 1998 FX Definitions. [21]

Additionally, the impact of regulatory change on the FX market – particularly with respect to transaction reporting – has caused firms to implement new or amended processes across the front-to-back transaction lifecycle in order to ensure ongoing regulatory compliance. There are opportunities for greater efficiencies and cost-savings in these areas, some of which can be achieved through greater automation.

These guidelines will discuss each of these areas below, identifying opportunities for greater automation and highlighting key considerations for technology developers who are creating responsive technology solutions.

Valuations and Calculations

Calculation of amounts payable on settlement date

A key process in the context of FX is the calculation of the amount which is payable under the FX transaction. As the calculation is primarily based on currency exchange rates, there is a compelling use-case for automation, given that the process is easily translatable into code.

FX swap

As noted in *Types of FX* on pages 6 and 7 above, an FX swap is a derivative transaction that involves the parties' exchange of payments in each of the two currencies at the execution of the swap and on the maturity date, specified in the future at a fixed rate agreed upon on the inception of the transaction. On the settlement date, each counterparty pays the amount specified as payable by it in the confirmation to the transaction, based on the foreign exchange rate previously agreed between the parties in the confirmation.

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[21] Where provisions do not lend themselves easily to automation, developers may consider adopting a hybrid approach, which involves integrating smart contract technology with paper-based documentation, until such time that more sophisticated smart contracts are developed that can cater for more complex provisions.

FX forward and spot

For FX forwards, as we note above, the exchange of two different currencies occurs on a settlement date specified in the future at a fixed rate agreed upon on the execution of the transaction. In the case of an FX spot transaction, one currency is exchanged for another on the settlement date, typically T+2.

Non-deliverable forwards

As noted above, under an NDF, by contrast, the transaction terms provide for the payment of a single cash settlement amount on the settlement date in lieu of payment of the notional amounts of the bought and the sold currency. The economics in a single settlement currency of a cash settlement transaction are intended to reflect those of deliverable transactions, but without the exchange of currencies. Cash-settled transactions are often seen in circumstances where non-deliverable currencies (typically, emerging market currencies) are involved – for example, due to existing currency exchange controls.

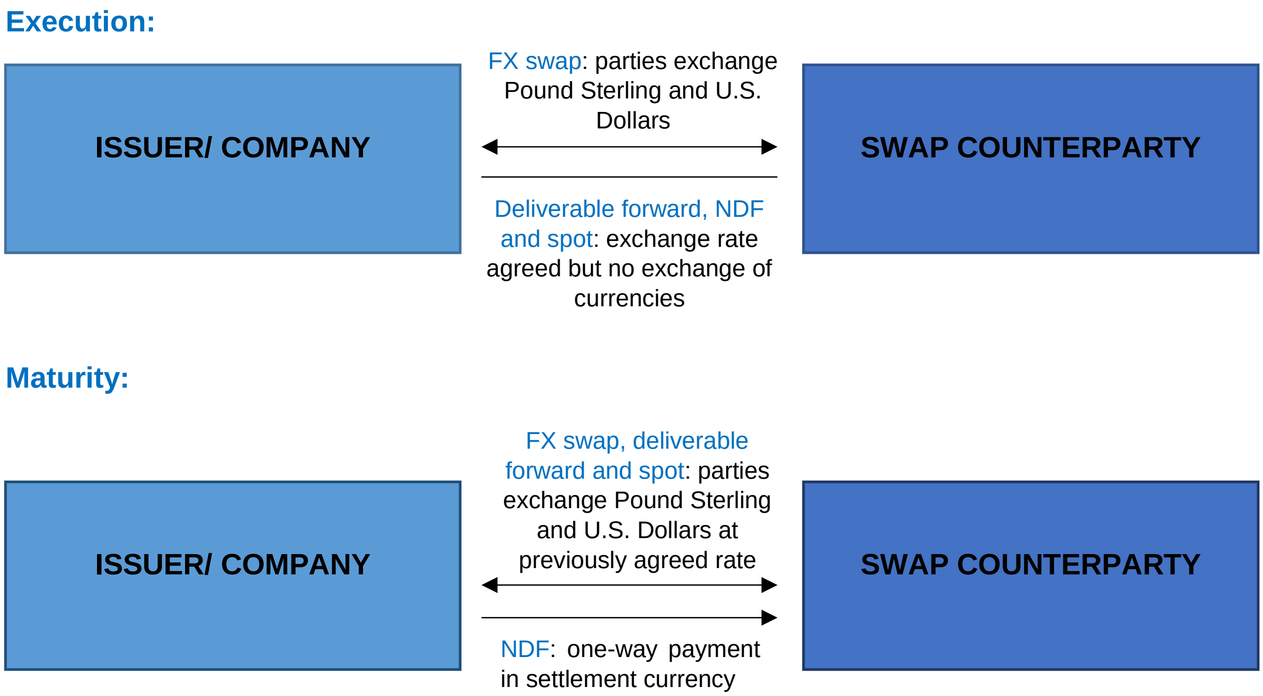
The cash settlement amount is determined by converting the notional amount of one of the currencies into the other currency at a spot FX rate that is either negotiated as the rate at the time, observed from a pre-agreed pricing source, or determined using another pre-agreed method on a date prior to the settlement date, and comparing this with the amount that would have been payable based on the rate agreed between the parties at the time of trading. A single payment obligation then arises, in the amount of the difference between the two currency amounts. That amount is payable by the party owing the excess in the settlement currency on the settlement date.

Pursuant to the 1998 FX Definitions, the single cash settlement amount is calculated as follows:

> *Settlement Currency Amount = Notional Amount x (1 – [Forward Rate / Settlement Rate])*
>
> where:
>
> "Settlement Currency Amount" is the net cash settlement amount;
>
> "Notional Amount" is the aggregate principal amount in respect of which cash settlement amount is being calculated;
>
> "Forward Rate" is the currency exchange rate agreed between the parties at the time of trading, expressed as an amount of one of the currencies that can be purchased for one unit of the other currency that parties have designated as the "Settlement Currency" in the confirmation for the FX transaction; and
>
> "Settlement Rate" means, unless specified by the parties in the confirmation, the spot rate for foreign exchange transactions in the relevant currency pair for value as determined at the time of settlement on the settlement date (generally by the Calculation Agent (as defined in paragraph (iii)(a) (*Calculation Agent discretion*) below)).

We have considered in Figure 6 below the operation of an FX swap, a deliverable FX forward, an NDF and an FX spot.

Figure 6



Issues for technology developers to consider

We have considered below some key issues that technology developers should be mindful of while designing smart contracts for FX markets. These are not exhaustive of all such considerations; in particular, as for other derivatives markets, there are a wide variety of product types traded on the FX markets. There are also a number of existing technologies in the FX markets that should be considered when considering the development of smart contract solutions. Ultimately, any DLT or other technology platform in this context will need to take into account specificities such as these given the commercial context within which it seeks to operate.

(i) Product-related considerations

The focus of automation should not always be on standardization. It is important to have regard to the broad variety of FX products, and the significant variance in their features. This is a key factor for developers to bear in mind while designing FX technology platforms. There are standard FX derivatives, like plain vanilla swaps, as discussed at *Types of FX* on pages 6 and 7 above, that are more amenable to automation as compared to bespoke, exotic or heavily negotiated derivatives. Developers will have to consider how technology platforms can reflect the variety of FX products that are on offer and ensure that the platforms are structured carefully to complement each product's specific features and related market characteristics.

We consider below some important or common features and examples of FX products to exemplify this point.

a. *Rollover provisions*

As noted elsewhere in this paper, rollover provisions are a common feature of the FX markets, and are intended to replicate the economic effect of periodically closing out one transaction at the closing rate on the relevant day, and entering into a new transaction on the same terms. The effect is that there is periodic settlement of the transaction, but the economic exposure continues until otherwise terminated. Although there are different ways of achieving this contractually, each with different effects, this type of "rollover" is frequently automatic, with a periodicity specified contractually, unless one of the parties exercises a termination right.

Given that these types of provisions are common amongst market participants in the FX market, and are amenable to automation, technology developers should be mindful of this feature in the context of FX transactions. In particular, it is important for any FX smart contracts solution seeking to accommodate such a feature to be sufficiently flexible to cater for the exercise of discretion, in particular as to whether the rollover should continue, or whether a termination right should be exercised.

b. *Basis risk in hedging*

FX is used by a wide variety of market participants for hedging purposes, in particular to hedge exposure to foreign exchange rate fluctuations where participants realize income and pay expenses in different currencies. By way of example, a company may pay its employees in U.S. Dollars, but have projected earnings in Japanese Yen based on its product market being Japan. In such a case, the company may wish to hedge its projected earnings in Japanese Yen against a forward U.S. rate. This allows the company to manage the risk of unfavourable FX rate movements when effecting a conversion.

A key concern in the FX market has been to avoid or minimize basis risk which arises where there are inconsistencies between the FX transaction and related exposure being hedged (whether a company's cash flow or a financial instrument, for example), or which otherwise result in unmatched payment flows. The application of smart contract technology to the FX market will need to bear in mind this key commercial purpose in the FX markets and automated processes will need to be developed in a way which does not give rise to such basis risk and which seeks to minimize it to the extent practicable.

Basis risk may arise in a number of ways, including where (i) in the context of NDFs, differences arise between the conversion rate determined under the NDF and the actual conversion rate, (ii) there is a potential disruption event the published rate may not be representative of the actual spot rate, (iii) there are differences between any part of the calculation methodology, (iv) differences arise in the fallbacks which apply where a calculation cannot be made, or (v) the timings for payments of foreign exchange amounts differ. Not all instances of basis risk may be relevant in the context of technology platforms; however, any form of basis risk that is relevant is an important source of unforeseen FX risks.

A number of the market conventions described in these guidelines for the calculation of FX amounts (*e.g.*, Business Day Conventions), and the discussion around fallbacks, apply widely in the financial markets. Consistent implementation of these conventions in automated systems, or effectively permitting human intervention, is therefore important to ensure market participants minimize basis risk. As noted elsewhere in this paper, smart derivative contracts can be designed to, for instance, allow parties to agree changes or fallbacks outside the smart contract through in-built override mechanisms which permit manual intervention.

A separate, but related, aspect worth noting in the hedging context is the potential application of smart contract technology for hedge accounting purposes. Favourable accounting policies apply to certain types of hedges but identifying qualifying trades through manual processes can be challenging. Businesses could benefit considerably from the efficiencies offered by smart contract technology in this respect.

c. *Exotic FX options: barrier options*

There are many forms of exotic FX options, the features of which may need to be taken into account in the development of any technology platform. Given that exotic FX transactions are frequently bespoke, we consider one example, namely barrier options. Barrier options are a type of option on currencies where, upon the occurrence of a specific event or condition (known as a barrier event), a right to exercise the transaction may arise (or be extinguished) or the underlying terms of the transaction may be modified in some pre-defined way. A barrier event is typically determined by reference to some observed event, such as a change in the exchange rate. For example, the parties may agree that a barrier event will occur when an exchange rate reaches or passes through a pre-agreed level or price.

A designated party (typically the Calculation Agent) may be designated to determine when a barrier event has taken place. Smart contracts could be used to automate the determination as to when a barrier event has occurred. It is worth noting that barrier events may occur unexpectedly, and it may not always be clear to both parties that a barrier event has actually occurred.[22] A smart contract solution could address this asymmetry by monitoring when a potential barrier event has occurred and notifying the counterparties at the same time.

(ii) Market-wide considerations

a. FX prime brokerage

The FX prime brokerage market presents a good use-case for a scalable application of smart contract technology.

Use of prime brokerage services is very common in the FX industry, particularly by hedge funds and commodity trading advisors. Prime brokers effectively act as intermediaries in the trading and settlement process, offering services such as portfolio and collateral management, custody, access to liquidity and consolidated settlement, clearing and reporting processes.

The structure involves clients entering into a 'prime broker agreement' with the intended prime broker, which has various 'give up agreements' with executing dealers in the market. The arrangement allows the client to enter into transactions with the executing dealers which are then 'given up' [23] to the prime broker for clearing and settlement.

As the give-up process involves various steps and a number of different counterparties, significant operational efficiencies may be realized from the use of smart contract technology, which can provide seamless end-to-end interoperability across transactions using integrated, automated systems that foster more effective and efficient settlement, valuation and 'give-ups' across transaction legs. This process currently involves considerable costs and operational burdens at present, as it is mainly manual in nature. Use of smart contract technology may therefore also help reduce the fees and compensation spreads charged by prime brokers who provide such services.

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22 For example, depending on the terms of the transaction and supporting documentation, the determination may be based upon information available to the Calculation Agent that is not available to the counterparty at the same time.

23 This precise legal mechanics of the "give up" arrangement may vary depending on the nature and structure of the arrangements, although the essence of the arrangement is that the prime broker enters into transactions on the instructions of the client.

b. *Use of Oracles*

A key data source for FX is the currency exchange rate that is generally specified by the parties to the FX transaction in the confirmation. As discussed above, where a relevant currency exchange rate is unavailable, the 1998 FX Definitions provides fallbacks.

The use of foreign exchange rates may offer a specific use-case for third-party oracles[24] or external data sources in the automation process. Smart derivatives contract models in the context of FX are likely to involve the use of such data providers. Careful consideration must be given to the choice of such data providers, as a fully automated process will rely on them for accurate data. Careful consideration should also be given as to the liability framework in relation to the provision of data and the role of any oracle, given the increased level of automation expected in this context, and in particular where that automation involves any straight-through-process or has a direct impact on the performance of payment or delivery obligations, where significant risks may arise in the event of data inaccuracies or other failures of a data provider or oracle.

Therefore, while automation involving oracles could provide significant benefits, a key issue will be how the relationship between the oracle and the relevant systems should be managed. An alternative mechanism will likely need to be provided for where there is an interruption in the feed from the oracle due to, for example, a technology or coding error (including in relation to reliance on a specified oracle), whether this is a fallback to manual processes or an alternative screen mechanism. Further, foreign exchange rates may be adversely affected where there are material changes to the methodology applied by an administrator of a price source, unannounced government intervention or other actions of unauthorized third parties. Careful consideration will have to be given to how such risks can be mitigated and/or resolved subsequently. The extent of a DLT platform administrators' powers to modify or replace existing methodology (including whether this will require participants' consent) in the event of such disruptions is another relevant issue that will have to be considered in this context.

It may also be appropriate to consider whether and how these disruptions and other issues involving oracles and other data providers to the system will interact with the existing fallbacks in the 1998 FX Definitions and whether new tailored fallbacks may be required to address novel issues that arise in the context of these new technologies.

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24 To execute automatically, smart contracts need to be able to interface with data in the wider world. For example, a piece of conditional logic that depends on whether a particular stock price has reached a certain level would require the smart contract to be able to ascertain that stock price. To do this, it can look up the stock price from a separate data source, typically known in the distributed ledger community as an 'oracle'.

c. *Interoperability*

A smart contract solution may face significant challenges with respect to cross-jurisdiction interoperability and settlement. While the standardization of FX transaction documentation promotes interoperability, smart contracts which use a particular technology must also be interoperable across other technologies. Further, the smart contract must also be accessible to the wide variety of FX market participants (as well as infrastructure providers and regulators) and interoperable with the data feeds that will inform the FX contract.

Standards, accordingly, should be developed to ensure interoperability across different implementations. ISDA can play a role in unlocking the value of smart contract technology by encouraging and facilitating the development of such standards. Developers should also consider how to ensure compliance with standards where they have already been established, for example, by governments and regulators in various jurisdictions.

Consideration will also have to be given to the development of appropriate formats that allow platforms to integrate with firms' internal systems, including booking and other related systems (such as collateral and other risk management systems) which vary from institution to institution. Post-trade process also require appropriate messaging and data formats capable of standardization across different jurisdictions, platforms and market participants (including various counterparties, external data providers, regulators, benchmark administrators, CCPs, other financial market infrastructures and payment providers). In this context, developers may wish to study closely how extant technology (such as SWIFT) functions in the market, as well as which functionalities can be adopted and which ones could be improved, in designing and developing new technology. In this respect, developers should be mindful that adoption of these technologies is not universal, so solutions that build upon them may not be feasibly applied to all market participants.

d. Market Monitoring

The FX industry has implemented the FX Global Code[25], in response to practices that have emerged in FX markets. The FX Global Code is a set of principles of good practice that firms subscribe to, and many of the largest market participants have signed a statement of commitment to the Code, including in relation to their FX market activity.

As an example, Principle 10 states that market participants must handle orders fairly, such as how to fill or partially fill client orders in different situations, and how to make that transparent to clients.

Developers and market participants may be required to consider whether some of the Principles of the Code could be implemented in their systems, what the benefits and

[25] https://www.globalfxc.org/docs/fx_global.pdf

trade-offs would be to implement it in this way, and whether a distributed system could be beneficial.

e. *Harmonized interpretations*

Industry harmonization leads to greater standardization and predictability in the market and is a crucial prerequisite to digitization and automation. However, it should also be acknowledged that market participants have developed firm-specific or proprietary methods and preferences for various stages of the calculation process (*e.g.*, discount factors that apply to determine the settlement amounts upon termination) and may see certain advantages to retaining discretion in this regard. While there is clearly merit in retaining some element of individual discretion in performing the calculations since it allows for a more fact-dependent response to a particular event, this also makes it difficult to implement standardized market-wide approaches in a way that is beneficial for digitization. Discretion should therefore be maintained for business processes where users disagree about the right outcomes or methods, to preserve the value of bespoke negotiated outcomes. The application of smart contract technology to FX transactions may, therefore, be complicated by the differences in approach to the calculation process. Nevertheless, where different language is used to describe the same business process or calculation, this should be standardized where possible to further promote automation.

f. *Consistency across markets*

While paragraph (ii)(e) (*Harmonized interpretations*) above addressed the considerations involved in standardizing data points, methods and processes within the FX market, a further point to bear in mind is the need, in some instances, to also ensure harmonization across markets. There are a number of areas in which, for instance, IRD and FX markets may wish to maintain consistency (including to assist in minimizing hedging risk). Examples include, amongst others, harmonized meanings of Business Days and Business Day Conventions, day count-fractions, benchmark provisions and fallbacks and the treatment of IRDs in the context of disruption events. Technology developers ought to bear in mind, therefore, that different types of derivative products cannot be considered in isolation, as there is a significant amount of interaction between the different markets (including beyond derivatives markets), and in particular, between the FX and IRD markets. Conceptual or operational changes in one market may therefore have a material impact on other markets and market participants are often heavily focused on such changes, particularly where their internal systems are built for cross-product usage. Socialization of anticipated changes on a larger scale would therefore be preferable, and in some cases necessary, in the context of new technologies. Industry associations like ISDA can play a key role in this context to coordinate, encourage and facilitate engagement across market participants.

(iii) *Transaction-specific considerations*

a. *Calculation Agent discretion*

Consideration will need to be given to the position where there is an issue with the automated calculation process, including where an unforeseen issue arises – for example an unplanned bank holiday on which the key market is closed and no Business Day Convention is specified or deemed to apply, an exchange rate is not published when expected, or some question of interpretation of the 1998 FX Definitions arises because of particular circumstances which have not been encountered previously. It is often the case for an FX transaction that the party designated as the "**Calculation Agent**" will step in to help determine the foreign exchange amount payable in circumstances where there are issues (*e.g.*, if the spot rate is unavailable, the Calculation Agent may determine the applicable rate acting in good faith and a commercially reasonable manner). In a recent example, during the Argentina USD/ARS Exchange Rate Divergence (a term defined in previously used EMTA template terms that many parties use to document USD/ARS NDFs), parties found that there was a need for Calculation Agent determination where the Exchange Rate Divergence occurred beyond the maximum number of days for postponement specified for the transaction. As a result of the imposition of various capital controls limiting foreign investors' access to U.S. Dollars, there was an increasing divergence between the prevailing Argentine Peso bid and offer rates for certain transactions in the Buenos Aires marketplace and the settlement rate option of ARS NDF contracts. Such circumstances requiring intervention outside of usual processes can and do arise from time to time in highly complex markets.

Separately, one might also find scenarios in which Calculation Agent determinations are required in the ordinary course of business, as part of its normal contractual obligations. An example is where the FX contract permits the Calculation Agent to determine the applicable exchange rate – for instance, by reference to rates observable in the spot market, rather than rates derived from a rate source. Automation and digitization will have to accommodate such discretions allowed for Calculation Agents.

There is a risk of disputes arising in relation to Calculation Agent determinations. Any application of smart contract technology must also be able to adapt to such dispute resolution mechanisms (and their outcomes). One way of doing this may be to include override provisions that will allow divergences from automated processes.

b. *Collateralized transactions*

Though not unique to FX alone, developers have to be mindful that parties to FX may be required by regulation, or may prefer for risk management purposes, to collateralize their outstanding obligations to each other. Developers will therefore be required to have an understanding of the collateral arrangements and infrastructure relating to the FX. They will also need to appreciate how calculations of the total amount of collateral that is required to be transferred from time to time (which will be determined by the provisions in the relevant collateral agreement) interacts with, and differs from, the calculation methodologies in respect of the regularly scheduled payments of the transaction itself (which are set out in the relevant transaction confirmations), in conjunction with the relevant ISDA Master Agreement.

Collateral can be used as a method to reduce counterparty risk in transactions. However, collateral transfers can be subject to rules, such as a minimum transfer amount, and logic, such as a change in collateral requirements in the event of a change in credit ratings of the counterparty. Developers may be required to take this into account. Transaction valuations are also subject to disputes, which can affect collateral transfers, and this can be another reason to consider the use of an oracle (see above). The complexity of valuations and collateral transfers generally result in collateral being transferred once per day. This can create intraday credit risk between counterparties. A potential benefit of a digitized process is that collateral transfers could occur more frequently, reducing the systemic risk, and reducing the requirement for counterparties to post initial margin and independent amounts to one another.

Collateral may need to be transferred or returned as the value of the collateralized obligations and/or the value of the collateral transferred fluctuates. Developers will need to provide a mechanism that allows parties to control which obligations they are seeking to collateralize. It is common for parties to exclude certain transactions from contributing to the total collateralized exposure under specific collateral arrangements, either because there is no regulatory requirement to exchange collateral for those transactions, or the parties otherwise agree that those trades should be excluded (provided, if there is a regulatory requirement, that they are collateralized under another collateral arrangement).

In this context, developers should note that certain regulatory requirements for the exchange of collateral do not apply in the context of certain types of FX, and there are specific exclusions that may be relevant, depending on the type of transaction and the jurisdiction in question. In addition, regulations requiring the exchange of collateral between the parties have resulted in an increase in the use of third-party custodians and the number and complexity of collateral documents used in a typical trading relationship.[26] This would need to be considered in any smart derivatives contract system design.

The mechanism for determining the amount of collateral that needs to be transferred varies depending on the nature of the margin documentation being used (*e.g.*, the ISDA Credit Support Agreement governed by New York Law or the ISDA Credit Support Deed governed by English Law).

[26] See ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction available at: https://www.isda.org/a/MhgME/Legal-Guidelines-for-Smart-Derivatives-Contracts-Introduction.pdf

The considerations that are relevant for collateral arrangements are set out in further detail in the *ISDA Legal Guidelines for Smart Derivative Contracts: Collateral.*[27]

c. *Business Days and Business Day Conventions*

Whether a particular day is a "**Business Day**" (as defined in the 1998 FX Definitions) is relevant in a number of instances, in relation to the calculation of payments under an FX transaction. For example, the "**Valuation Date**", which is by default the day on which the spot foreign exchange rate will be determined for the purpose of calculating the payment(s) owed by one or both of the counterparties to the FX contract, will generally be specified as a Business Day. The meaning of Business Day in the context of the Valuation Date is slightly different from that which applies to the Settlement Date definition. In the case of the Valuation Date, whether there is a Business Day within the relevant sense broadly depends on whether commercial banks are open on that day, including to deal in foreign exchange in accordance with the relevant market practice in the place specified in the confirmation (subject to certain fall-backs). By contrast, for the purposes of the 'Settlement Date' definition, there is a Business Day broadly if on that day commercial banks effect delivery of the relevant currency in accordance with the relevant market practice of the place specified in the confirmation (subject again to fall-backs). It is conceivable, therefore, that there might be a Business Day for one purpose, but not another – for example, if commercial banks are generally open for dealings (including FX dealings generally) but are not effecting delivery of one or more specific currencies relevant to the transaction in question on that day. Any technological or smart contract implementation seeking to automate payment processes that rely on the occurrence of a Valuation Date or a Settlement Date would, therefore, need to be capable of determining when certain dates (*e.g.*, Valuation Date or Settlement Date) occur and also take account of changes or modifications to existing or contemplated dates, whether via a manual or automated process.

Identification of relevant Business Days in the confirmation is of specific concern in the context of FX transactions as careful consideration would have to be given to a variety of factors to determine the appropriate Business Day(s), including the currency pairs to the FX contract and the location of the parties. For example, a trade involving U.S. Dollars and Pounds Sterling may specify that New York and London Business Days are the relevant type of Business Day(s) for the purposes of that transaction. In the 1998 FX Definitions, parties have the ability to specify, in respect of a specific transaction or transactions, the jurisdictions which are relevant for this purpose or, if no jurisdictions are so specified, the relevant jurisdictions for the purposes of Business Days will apply largely (though not always) depending on the currencies of the payment obligation.

In the context of physically-settled transactions, settlement risks could potentially arise where the settlement is split across different Business Days for different currencies (this is typically referred to as 'daylight' exposure). This is one of the key areas where

[27] See ISDA, Legal Guidelines for Smart Derivatives Contracts: Collateral" available at: https://www.isda.org/a/VTkTE/Legal-Guidelines-for-Smart-Derivatives-Contracts-Collateral.pdf

the deployment of automated process and smart contract technology could provide crucial benefits. This issue is explored further in the section on “Settlement”.

“**Business Day Conventions**” (as defined in the 1998 FX Definitions) are used to adjust days that fall on a non-Business Day. For example, if the “**Preceding Business Day Convention**” applies to a particular day which falls on a non-Business Day, the day for payment (or other specified purpose) moves to the immediately preceding Business Day. There are three other standardized Business Day Conventions specified in the 1998 FX Definitions. The 1998 FX Definitions may apply a particular Business Day Convention automatically unless a different Business Day Convention is expressly agreed to apply instead by the parties. In other instances, no Business Day Convention will apply unless one is specifically nominated by the parties as part of executing the trade. Another complexity that the market must grapple with from time to time in the context of Business Days and Business Day Conventions is the effect of an unscheduled bank holiday or closures (*e.g.*, national days of mourning honouring recently deceased current or former world leaders) for derivative transactions. Smart contract technology will have to take such circumstances into account, and manual intervention might be necessary in some instances.

d. Netting

Payment netting typically applies to payment obligations that are denominated in the same currency and which fall due on the same date. Given that many FX transactions will be denominated in different currencies, with no express mechanism for conversion, payment netting does not typically arise in these contexts.[28] Smart contracts, however, present fertile ground to explore whether the limitations that exist in current models can be resolved using new technologies.

In particular, although certain arrangements for multilateral netting already exist in the context of FX markets, there may be further opportunities presented through the development of technology platforms to extend the benefits of automation of conversion and netting processes to areas of the market that are currently operating on a bilateral basis. For some market segments, netting is carried out on a bilateral basis and frequently subject to manual intervention and processes because of the perceived benefits of flexibility, including the ability to determine the application of netting on a case-by-case basis – for example, whether to include or exclude certain transactions from specific netting sets. Although complex, significant operational benefits could accrue from the deployment of variable functionality of this nature, amongst others, within a technology platform that automates calculations, conversions and netting between participants. This may also require or give rise to further iterations between system development and the supporting legal analysis.

[28] Payment netting may of course be relevant for counterparties who enter into other types of transaction under the same Master Agreement. Further discussion of payment netting can be found in the ISDA Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement, available here: https://www.isda.org/a/23iME/Legal-Guidelines-for-Smart-Derivatives-Contracts-ISDA-Master-Agreement.pdf

Separately, to the extent the close-out netting process is sought to be automated, technologists may be required to consider the application of other netting techniques to FX transactions, as for other transaction types. This is further considered in the ISDA paper, *Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement.*[29]

The rapid development of new technologies, with more efficient and effective processes, may foster more competition and diversity in the market, in particular where netting and settlement have historically been performed by intermediaries. This may lead to new product development or the refinement of existing settlement or netting platforms to meet changing customer expectations. Equally, opportunities for close collaboration with new actors are arising, as the competitive landscape between established players and new service providers and platforms continues to evolve.

e. *Disruption events*

FX transactions need to cater for certain types of disruptions due to the different currencies and jurisdictions involved. These are identified and categorized in the 1998 FX Definitions into (a) convertibility and transferability risks; (b) price source risks; (c) liquidity risks; (d) risks associated with locally held assets; and (e) other risks, and described briefly in Figure 7 below.

Figure 7

Convertibility and transferability risks	Risks arising out of events that make it impossible to convert one currency into another on the settlement date or to transfer currencies across borders (or sometimes, within the same jurisdiction).
Price source risks	Risks related to a lack of available rates from external sources (which may occur as a result of temporary disruptions or permanent cessations).
Liquidity risks	Risks related to illiquidity in the currency markets.
Risks associated with locally held assets	Risks associated with assets that are issued or held in a particular jurisdiction due to, for instance, nationalization or governmental authority default.
Other risks	Risk of a default by any custodian with which the assets are held or the imposition of legal or regulatory restrictions which prevent the assets being sold or transferred.

29 See, ISDA Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement, available here: https://www.isda.org/a/23iME/Legal-Guidelines-for-Smart-Derivatives-Contracts-ISDA-Master-Agreement.pdf

These risks typically (but not exclusively) arise in the context of emerging market currencies and developers should pay particular regard to how these can be addressed by designing appropriate functionalities in the context of FX.

The 1998 FX Definitions provide a series of fallbacks if the events above (if specified or deemed specified for a transaction) occur, including postponing the Settlement Date, termination of the transaction or conversion of a deliverable transaction to an NDF where the impediment presented by the relevant disruption event is specific to deliverable transactions. Technology developers should consider the extent to which technological systems and operations will be able to interact with an oracle (as discussed above) or other information source notifying it that a disruption event has occurred, so that it can accommodate the necessary fallbacks through an automated process when this takes place. Some fallbacks may lend themselves more easily to automation, for instance, the conversion of a deliverable transaction to an NDF upon a disruption event is one area in which a seamless transition can be effected provided there are pre-agreed terms between the parties for the resultant NDF. However, it is likely that in some cases the ability to temporarily halt the automatic processes to allow for manual intervention may also be required, particularly where some element of discretion is required to be exercised or where parties deem that it is appropriate to apply manual techniques.

Technology developers should also have regard to how such disruptions and fallbacks interact with standard FX documentation, such as the EMTA templates, which are widely used in the market.

Settlement

In addition to using smart derivatives contracts to automate certain aspects of the valuation and calculation process, it is also possible to use technology (potentially using DLT) to automate settlement of certain payment or deliveries that are determined to be due and payable and mitigate certain risks associated with the settlement of FX transactions (although challenges could arise where banks still agree settlement mechanics on a trade-by-trade basis).

This is further explored in the *Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement.*[30]

Use cases

(i) *Daylight risk*

One area in which smart contracts and DLT may have great utility in addressing existing risks in the FX market is in the context of deliverable FX. In deliverable FX transactions, there is a risk of loss when one party to the FX transaction delivers the currency it sold but does not receive the corresponding amount of currency it bought (referred to as settlement risk). This arises where the parties have not arranged to use a mechanism for payment-versus-payment ("**PvP**") or where it is impossible for payments falling due on the same day to be made simultaneously. This is typically referred to as "daylight risk" or "Herstatt risk". As a party's payment obligations under a deliverable FX transaction are denominated in a different currency than those of its counterparty, payment netting does not mitigate this risk. Time zone differences between the principal financial centres of each currency further contribute to this settlement risk. There may be a lag, for instance, in the payments of foreign exchange amounts due under the FX contract. A counterparty may accordingly be exposed to loss equivalent to the gross amount of its payment obligation under the FX contract, which may be far in excess of its market value. There is a clear use-case, therefore, for smart contracts in this context, to develop methods to counter the risk and operational inefficiencies for FX market participants.

A number of other initiatives are examining the potential that DLT and smart contracts present for synchronized settlement or 'atomic' settlement, where the transfers of currency pairs are linked to ensure that the transfer of one currency occurs if and only if the transfer of the other currency also occurs. Accordingly, the outcome of synchronized settlement is either all parties successfully exchanging the assets, or no transfer taking place, thereby avoiding daylight risk.[31] Atomic settlement can be viewed as a type of PvP settlement method, but while PvP methods typically involve some time lag between final settlement on both legs as one transaction settles before the other, with funds on the other leg being reserved for settlement, atomic protocols may be designed so that settlement occurs simultaneously and does not rely on coordination of timing or the intervention of a third party to ensure PvP settlement. Atomic

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30 See, ISDA Legal Guidelines for Smart Derivatives Contracts: The ISDA Master Agreement, available here: https://www.isda.org/a/23iME/Legal-Guidelines-for-Smart-Derivatives-Contracts-ISDA-Master-Agreement.pdf

31 The Bank of England is, in particular, currently exploring the possibilities with regard to synchronized settlement through its Real-Time Gross Settlement (RTGS) service. Its blueprint for a new RTGS service for the UK is available here: https://www.bankofengland.co.uk/-/media/boe/files/payments/a-blueprint-for-a-new-rtgs-service-for-the-uk.pdf?la=en&hash=56424C6BC6D9E056F05476A96B482D4779377E45

settlement could therefore also reduce counterparties' reliance on third-parties who facilitate the payment of foreign exchange amounts due under FX. Counterparties, accordingly, would be less exposed to the risks of settlement failure. Because smart contracts and DLT systems involve automated processes, time zone differences may not pose an impediment to the settlement of currencies on platforms in different jurisdictions, thereby facilitating atomic settlement, subject to the opening hours of the payment systems involved. A key issue counterparties currently face in this context is the need to coordinate Business Days and banks being open in different jurisdictions for delivery of currencies on a cross-border basis, the necessity for which would not arise in an automated system that operates on a continuous (twenty-four hours a day, seven-days-a-week) schedule. A smart derivative contract that provides for synchronised settlement in theory may be less workable where simultaneous cash or physical delivery is difficult in practice.

Heavy chain systems (as more fully described below) would make atomic settlement easier and provide greater certainty as transfers would happen on-ledger and discrepancies between on-ledger records and off-ledger systems could be avoided. They would, however, necessitate the creation of cash (or cash-like instruments) on-ledger, which raises a number of legal and regulatory considerations. Where the instruments are in the nature of stablecoins that derive value from an underlying currency or a basket of currencies, further consideration may also have to be given to how their value may be affected in times of market stress and if they will be redeemable at par.

(ii) *Monitoring external events*

Other use cases also exist for smart contracts in the context of FX settlement risk. The interbank market in foreign currencies, for instance, is open twenty-four hours on a global basis. The hours of operation during which parties to the FX contract may value the contract, calculate margin and settlement amounts, issue margin calls and settle collateral delivery or return amount, may not conform to the hours during which the underlying currencies are most traded. Significant changes in foreign exchange rates, as well as market, economic and political conditions, and consequently the value of the FX transaction and the extent of a counterparty's credit exposure, may take placing during times when it is difficult for a counterparty to monitor or react. Smart contracts could, however, offer certain functionality that would allow counterparties to react automatically to these changes when certain conditions are fulfilled, or when defined events take place. This further reduces the risk for market participants in FX transactions and could reduce operational risks.

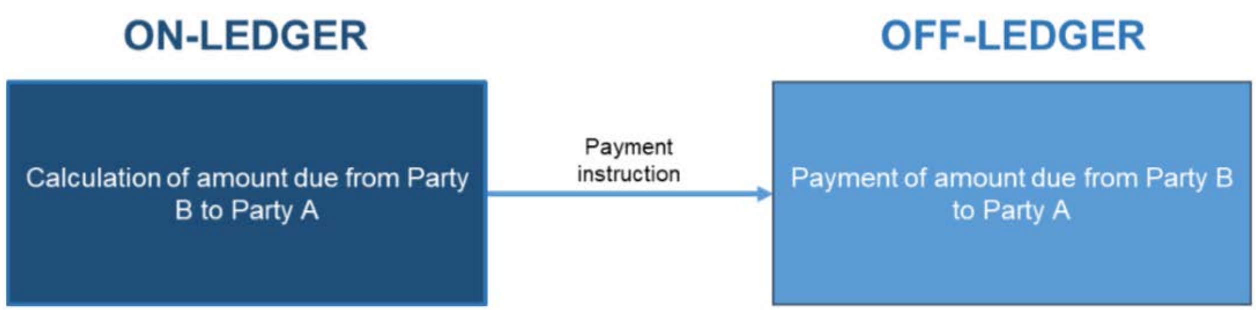
Developers will also need to take into consideration how changes to relevant laws and regulations impacting FX transactions might impact DLT systems.

Light and heavy chains

In considering the use of DLT in this context, it is useful to recall the distinction made in the ISDA *Guidelines for Smart Derivative Contracts: Introduction*[32] between different types of potential DLT implementation that are capable of supporting smart derivatives contracts.

In the context of the FX market, a 'light chain' system (see Figure 8 below) would allow market participants to exchange information in relation to the FX transaction in a more automated, digitized way, and carry out certain trade processes (for example, calculation of foreign exchange amounts) on-ledger, but following such calculations, the payments would be made off-ledger. In this case, the ledger would in effect serve as a messaging system between the participants in the run-up to payment, with settlement being effected through the existing banking system (as for a traditional FX transaction today). The parties' payment obligations would be recorded on the ledger, but the actual payments would take place off-chain. The parties would therefore need to use an existing payment system to initiate transfers of cash.

Figure 8



A 'heavy chain' system (see Figure 9 below), by contrast, would be a settlement system in itself, through which payments would flow. In this scenario, digital assets would be constituted on the ledger (either in native form or as representations of "real-world" assets) and the ledger would also facilitate and record the transfer for parties to meet their payment or delivery obligations. Therefore, both the obligations of the parties and the transfers of value would be recorded or occur (as applicable) on the ledger, without the need for external payment or settlement systems.[33] It is possible for the 'heavy chain' to be implemented as complementary components of a system, where parts of the system are operated by independent parties, and possibly using different ledgers. For example, one party might operate a component for recording the payment obligations on-ledger, and an independent party might operate the on-ledger settlement system.

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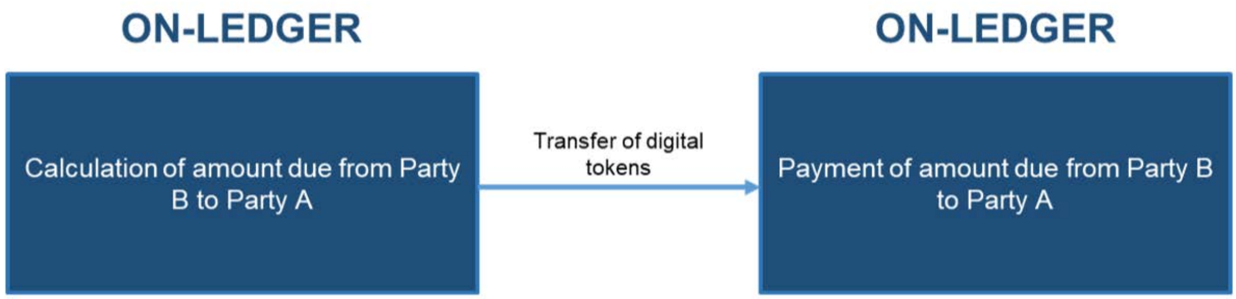
32 See ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction available at: https://www.isda.org/a/MhgME/Legal-Guidelines-for-Smart-Derivatives-Contracts-Introduction.pdf

33 For further discussion of these issues, see the Bank for International Settlements' Committee on Payments and Market Infrastructures paper on wholesale digital tokens (December 2019) available at: https://www.bis.org/cpmi/publ/d190.pdf

Figure 9



As described in the *ISDA Guidelines for Smart Derivative Contracts: Introduction*, the approach taken in this regard will have an impact on the considerations developers should be mindful of in designing the relevant technology. Where external systems are being used to effect payments, the need to accurately identify payment flows and address the interoperability of systems will be a significant aspect in the context of structuring the system. The identification and timing of payment flows under FX will be impacted by a number of the issues already discussed in this paper, including the application of Business Days and Business Day Conventions to payment dates, complexities around the calculation of the foreign exchange amounts to be paid and potential fallbacks/disruption events. Divergences between outcomes on and off-ledger would also have to be addressed. For example, where a payment is recorded to have been made on the ledger but settlement off-ledger has not been executed, the parties will need to ensure that there is a robust reconciliation mechanism capable of addressing such scenarios. Failing that, one would have to look to potential legal solutions and how such payment failures may be treated under applicable law. It may also be possible to structure for such potential consequences and have pre-determined remedies. Ultimately, a robust, clear and enforceable legal solution will be key to achieving legal certainty in such situations.

Reconciliation and remediation measures may also have to be considered separately from a technological standpoint. The “immutable” nature of the transactions executed on some DLT platforms, whilst often cited as a key benefit of such platforms, can also be detrimental in instances where a transaction has been executed in error. Although solutions exist, this may be a design choice for technologists which participants in financial markets may seek to test and analyse, with regard to the ability to reverse or correct erroneous transactions or other system entries.

Where the DLT platform is designed to house a settlement system as described above, using digital or dematerialized assets to meet payment or collateral obligations, the system or platform design may have an impact on the laws governing operations involving the asset itself. Such issues will involve legal aspects, but new platforms are increasingly coming to rely on operational and technological governance techniques to resolve them. Systems have started designing operational playbooks (in addition to legal rulebooks) to address relevant concerns.

One key development in recent months that is highly relevant for this discussion and has the potential to resolve a number of issues associated with payment-versus-payment and delivery-versus-payment settlement is the potential emergence of central bank digital currencies

(“**CBDCs**”). Central banks in several jurisdictions (including U.S., Canada, U.K., France, Germany, and a number of other European and Asian jurisdictions) are exploring the possibility of issuing CBDCs with a range of possible functionalities and use-cases (consideration is being given to both wholesale and retail markets)[34], and have published research proposals and consultation papers, with some conducting preliminary trials. Many have stressed that their consideration of this topic remains at an initial stage, and the question as to whether a CBDC should be issued within their relevant jurisdiction, or the form that should take, has not yet been determined. There are many complex, inter-dependent considerations raised in pronouncements by central banks in this area, and developments are unlikely to unfold in the immediate term. Nevertheless, there is considerable focus on the potential benefits that might accrue from the issuance of one or more CBDCs, and technologists may wish to consider the potential implications on any platform under development.

[34] https://www.bankofengland.co.uk/-/media/boe/files/paper/2020/central-bank-digital-currency-opportunities-challenges-and-design.pdf?la=en&hash=DFAD18646A77C00772AF1C5B18E63E71F68E4593; https://www.bankofcanada.ca/2020/02/contingency-planning-central-bank-digital-currency/; https://www.coindesk.com/bank-of-france-cbdc-experiments; https://ledgerinsights.com/digital-euro-central-bank-digital-currency-cbdc/; https://www.ledgerinsights.com/china-central-bank-digital-currency-pilot-cbdc-dcep/

Clearing

Only a small proportion of the OTC FX market is centrally cleared, as noted in the introductory section to this paper. As such, the need to take into account the impact of CCP structures and processes is likely not as material to the current overall market in the context of FX as with IRDs (where cleared derivatives occupy a much larger proportion of the market), but to the extent that the intention is to seek to apply these new technologies to cleared FX, technology developers should be aware of special considerations which apply in this part of the market (many which will be similar to those in the IRD market).[35]

Reporting

A number of jurisdictions require the reporting of FX details throughout the life of the transaction to certain authorized bodies, as part of initiatives to allow regulatory authorities to better understand and regulate the derivatives market as a whole. This can involve reporting under the same regulatory regime by both counterparties to the FX transaction, and the reconciliation of data received by the relevant authorized body to ensure that the reported trade details match and that the view the regulators have of the market is accurate.

Requirements regarding regulatory reporting of FX are detailed and precise. To take the requirements under EMIR[36] in the European Union as an example, the details of each FX transaction entered into, modified or terminated and which has (in most circumstances) at least one EU counterparty will need to be reported to an EMIR registered or recognized trade repository. There are prescribed requirements in delegated legislation around the content and format of these reports, with a view to harmonization of standards and to reduce the need for reconciliation of data between trade repositories. This includes the use of specific identifiers (*e.g.*, LEIs with respect to relevant parties such as the counterparty or CCP, or unique product identifiers to identify the derivative type), as well as detailed information concerning, for instance, the settlement date, the notional value, the quantity and maturity of the FX.

Depending on the counterparties to the FX transaction and the jurisdictions in which they are located, multiple regulatory reporting regimes may be relevant, each of which will have different detailed requirements. However, while significant differences still exist between different regulatory regimes (*e.g.*, in the collection of data under EMIR and Dodd-Frank), regulators are working towards a goal of harmonizing the data and audit trail to reduce redundancies and inefficiencies.[37]

Smart derivative contracts and other initiatives for automation more generally could facilitate counterparties' compliance with regulatory obligations like reporting. Reports containing information about their FX could, for instance, be generated or automatically sent to the relevant

[35] See ISDA, "Legal Guidelines for Smart Derivatives Contracts: Interest Rate Derivatives" available at: https://www.isda.org/a/I7XTE/ISDA-Legal-Guidelines-for-Smart-Derivatives-Contracts-IRDs.pdf

[36] Regulation (EU) No 648/2012 of the European Parliament and of the Council of 4 July 2012 on OTC derivatives, central counterparties and trade repositories (as amended).

[37] See OICU-IOSCO Report, "Market Fragmentation & Cross-border Regulation" available at: https://www.iosco.org/library/pubdocs/pdf/IOSCOPD629.pdf

regulator with the required information. The smart contract may also generate reports for the counterparties to aid their compliance with other regulations, such as regulatory capital requirements, by calculating a counterparty's exposure in an FX context. Smart contracts could additionally provide holistic overviews of a counterparty's FX portfolio, to aid their classification under regulations such as EMIR, although this does depend on some level of interoperability between different smart contract platforms. Properly-structured smart contracts can help ensure that regulators only receive necessary data at required frequencies, avoiding transmission of superfluous information to regulators by market participants.

Consideration is already being given to the possible application of technology to regulatory reporting requirements. For example, ISDA is working with the UK Financial Conduct Authority, the Bank of England and participating financial institutions to explore how the ISDA CDM can support the digital regulatory reporting pilot for derivatives.[38]

Given the short timeframes under many regimes for compliance with regulatory reporting requirements following the conclusion of the transaction, the ability to automate and streamline this process would be highly beneficial. Technology providers in this space will need to ensure that they are familiar with the detailed format and content requirements of these reports. Liability for a failure to make the report, or errors in the report, will need to be carefully considered, as compliance with the regulatory reporting regime will ultimately remain with the market participant.

The requirement to protect data and information collected and to build separate silos to protect parties' confidential information from unauthorized disclosures would also have to be considered in this context. Only information that is permitted to be disclosed to each participant in the system (*e.g.*, CCPs, regulators, brokers, parties) should be made available to them even where data is collected centrally. Technology developers should consider designing appropriate information barriers that can be integrated into the relevant platform to address this concern.

It would be beneficial if technological solutions are built with an eye on the other regulatory reporting regimes that may be relevant to market participants, to improve interoperability and remove the need to build multiple systems to comply with these requirements. This includes both multiple jurisdictional reporting regimes which may apply to FX, but also reporting regimes which apply to other similar products (such as securities financing transactions under the SFTR[39]).

[38] A report on the deployment of ISDA CDM to deliver a UK digital regulatory reporting pilot is available at: https://www.isda.org/2019/05/21/isda-cdm-deployed-to-help-deliver-uk-digital-regulatory-reporting-pilot/

[39] Regulation (EU) 2015/2365 of the European Parliament and of the Council of 25 November 2015 on transparency of securities financing transactions and of reuse and amending Regulation (EU) No 648/2012.

Conclusion

These guidelines provide an overview of the existing legal framework for FX and highlight areas in which there is significant scope for further digitization and adoption of new technologies which can lead to increased efficiencies. While there are specific complexities in the context of FX due to certain bespoke features arising mainly from their cross-border nature, this very feature also presents potential opportunities for deployment of new technologies as some of the risks inherent in existing structures could be addressed through enhanced automated processes and the development of digital instruments for valuation and/or settlement.

However, it is important to give careful consideration to the development of smart derivatives contracts in the context of FX given the size of the market and their widespread use by many different types of market participants. The paper discusses aspects that technology developers should have regard to in this respect and particularly in the context of the valuation/calculation process, where the greatest potential for increased automation and application of new technologies exists.

ISDA encourages members to contribute to this work to ensure their views are taken into account and that each of these various projects and initiatives benefit from broad-based market feedback and expert insight.

Members can participate in ISDA's work by joining the following working groups:

- **ISDA Legal Technology Working Group**: Established to promote greater standardization and digitization of ISDA documentation through the ISDA Clause Library Project.
- **ISDA Fintech Legal Working Group**: Established to raise and discuss areas of legal and regulatory uncertainty in the application of new technology (such as smart contracts, DLT, digital assets and AI) to derivatives trading.
- **ISDA FX Operations Group**: Established to focus on the standardization, development and updates in the FX market for paper confirmations, market practices and regulatory changes.
- **ISDA CDM Architecture and Review Committee**: Established to define a standard representation of derivatives trade events that are asset class and product agnostic, and to develop a common domain model across transaction and legal agreement data required for processing of such events.

Members can join these Working Groups through the My Committee Dashboard on the ISDA website: http://www.isda.org/committees.

If you have any questions on any of the issues raised in this paper, please contact ISDALegal@ISDA.org

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