



Smart contracts in banking: foundations, design landscape and research directions

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UNRESTRICTED

Agenda

1. Prototype
2. Industry summits
3. First research paper
4. Second research paper
5. Questions

1. Prototype – introduction

- *Team* – Barclays Investment Bank internal team in Barclays Accelerator
- *Challenge* – each bank maintains its own separate ledgers and systems, huge duplication of effort and cost
- *Solution* – shared ledgers and smart contracts
- *Piece in jigsaw puzzle* – smart contract templates
- *Our focus* – legal document templates to facilitate smart contracts
 - connect legal text to business logic, simplify legal documentation processes
 - drive standards adoption via reusable templates
 - mutualise costs via common components
- *Benefits* – cost reductions, efficiency improvements, risk reductions

1. Prototype – public demo

- *Aim* – showcase a vision of the future: the lifecycle of a “smart” standardised financial product
- *Software demo* – prototype web application to edit templates, edit agreements, enter trades, affirm trades, and view trades
- *History in the making* – first public demo of prototype application on R3’s prototype Corda platform
- *Venue* – The O2 in London, audience of 800, largest FinTech demo day ever anywhere
- *Collaboration* – Barclays Investment Bank, R3, University College London, ISDA, Societe Generale, Techstars

1. Prototype – software demo

Template Editor Agreement Editor Trade Entry Trade Affirmation Trade Viewer

Master Agreement 1992 - England and Wales

Close Save Delete

Add Field B / aA

ISDA®
International Swaps and Derivatives Association, Inc.

MASTER AGREEMENT

dated as of **Agreement Date**

Party A and Party B have entered and/or anticipate entering into one or more transactions (each a "Transaction") that are governed by this Master Agreement, which includes the schedule (the "Schedule"), and the documents and other confirming evidence exchanged between the parties confirming those Transactions.

Accordingly, the parties agree as follows:—

1. Interpretation

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Add New Field

Name: Party B

Type: CounterpartyName

Value:

Add Cancel

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Trade ID: TRADE102 Date: 2017-06-28

Confirmation & Agreements Floating Schedule Fixed Schedule

Type	Start	End	Factor	Days	Payment	Notional	Rate	Flow
Realised	2016-04-04	2016-07-05	0.2528	91	2016-07-05	USD 15,900,000	0.635%	USD 25,529.98
Realised	2016-07-05	2016-10-04	0.2472	89	2016-10-04	USD 15,900,000	0.635%	USD 24,966.40
Realised	2016-10-04	2017-01-04	0.2500	90	2017-01-04	USD 15,900,000	0.635%	USD 25,249.59
Realised	2017-01-04	2017-04-04	0.2500	90	2017-04-04	USD 15,900,000	0.635%	USD 25,247.21
Provided	2017-04-04	2017-07-05	0.2528	91	2017-07-05	USD 15,900,000	0.635%	USD 25,534
04	0.2472	89	2017-10-04	USD 15,900,000	3M USD RATE	-	-	-
04	0.2500	90	2018-01-04	USD 15,900,000	3M USD RATE	-	-	-
04	0.2500	90	2018-04-04	USD 15,900,000	3M USD RATE	-	-	-
05	0.2528	91	2018-07-05	USD 15,900,000	3M USD RATE	-	-	-
04	0.2472	89	2018-10-04	USD 15,900,000	3M USD RATE	-	-	-
04	0.2500	90	2019-01-04	USD 15,900,000	3M USD RATE	-	-	-
04	0.2500	90	2019-04-04	USD 15,900,000	3M USD RATE	-	-	-
05	0.2528	91	2019-07-05	USD 15,900,000	3M USD RATE	-	-	-
04	0.2472	89	2019-10-04	USD 15,900,000	3M USD RATE	-	-	-
06	0.2556	92	2020-01-06	USD 15,900,000	3M USD RATE	-	-	-
06	0.2500	90	2020-04-06	USD 15,900,000	3M USD RATE	-	-	-
06	0.2500	90	2020-07-06	USD 15,900,000	3M USD RATE	-	-	-

Template Editor Agreement Editor Trade Entry Trade Affirmation Trade Viewer

Credit Support Annex 1995 - England and Wales

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determined for each relevant currency and calculated for each day in that Interest Period on the principal amount of the portion of the Credit Support Balance comprised of cash in such currency, determined by the Valuation Agent for each such day as follows:

(x) the amount of cash in such currency on that day; multiplied by

(y) the relevant Interest Rate in effect for that day; divided by:

(z) 360 (or, in the case of pounds sterling, 365)

"Interest Period" means the period from (and including) the date on which the Local Business Day Amount has yet been transferred, the Local Business Day Amount transferred to or received by the Transferee) to (but excluding) the Local Business Day on which the currency interest accrues to be transferred.

"Interest Rate" means, with respect to an Eligible Currency, the rate specified in Paragraph 11(f)(i) for that currency.

"Local Business Day", unless otherwise specified in Paragraph 11(h), means:

(i) in relation to a transfer of cash or other property (other than securities) under this Annex, a day on which commercial banks are open for business (including dealings in foreign exchange and foreign currency deposits) in the place where the relevant account is located and, if different, in the principal financial centre, if any, of the currency of such payment;

(ii) in relation to a transfer of securities under this Annex, a day on which the relevant securities are delivered to the transferee.

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{
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  "type": "Expression",
  "value": "(CashAmount * InterestRate) / (if Currency = 'GBP' then 365 else 360)"
}
```

Template Editor Agreement Editor Trade Entry Trade Affirmation Trade Viewer

Bank A - Bank B - Master Agreement

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Agreement Date: 16-Mar-2016

Party A: Bank A

Party B: -

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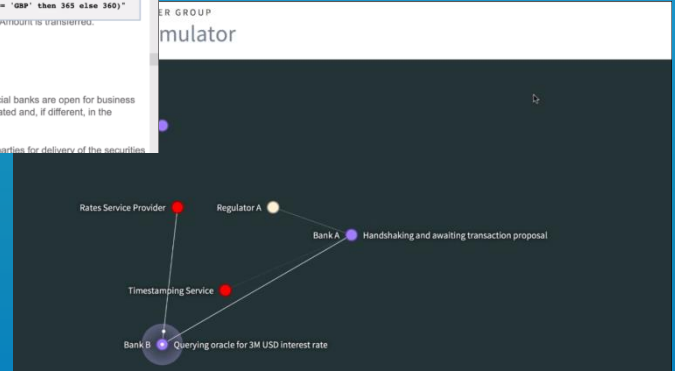
2002 MASTER AGREEMENT

dated as of **16-Mar-2016**

Bank A and Party B have entered and/or anticipate entering into one or more transactions (each a "Transaction") that are or will be governed by this 2002 Master Agreement, which includes the schedule (the "Schedule"), and the documents and other confirming evidence (each a "Confirmation") exchanged between the parties or otherwise effective for the purpose of confirming or evidencing those Transactions. This 2002 Master Agreement and the Schedule are together referred to as this "Master Agreement".

Accordingly, the parties agree as follows:—

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2. Industry summits

Smart Contract Templates Summit

- London and New York, June 2016
- 60 participants, 20 organisations
- Presenters: R3, Barclays, Norton Rose Fulbright, ISDA, University College London

Second Smart Contract Templates Summit

- London and New York, November 2016
- 200 participants, 25 organisations
- Presenters: R3, Barclays, CIBC, Nordea Markets, ISDA, FIA, Thomson Reuters, Norton Rose Fulbright, University College London, Cardoza Law School

Third Smart Contract Templates Summit

- London and New York, scheduled for June 2017

3. First research paper

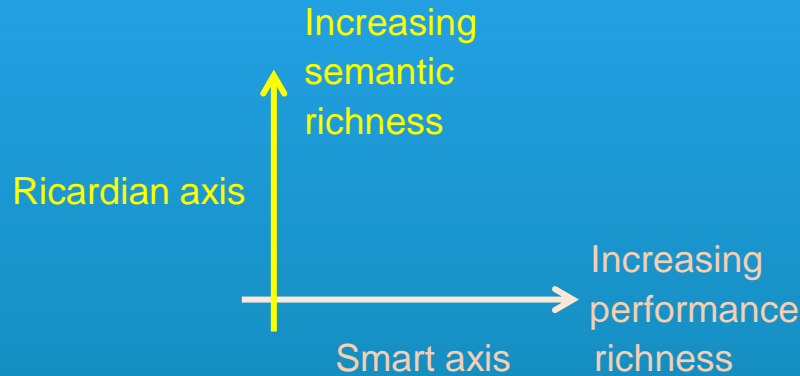
- “*Smart Contract Templates: foundations, design landscape and research directions*”
- Joint authorship: Barclays and University College London
- Position paper presenting our vision
- Publicly released on arXiv repository: <https://arxiv.org/pdf/1608.00771.pdf>
- Foundations: terminology, automation, enforceability, semantics
 - ***“A smart contract is an automatable and enforceable agreement. Automatable by computer, although some parts may require human input and control. Enforceable either by legal enforcement of rights and obligations or via tamper-proof execution of computer code.”***

3. First research paper

- semantics:
 - operational aspects: parts of contract we wish to automate
 - non-operational aspects: parts of contract we do not wish to automate
 - semantic analyses, e.g. semantic equivalence, risk assessment, legal context
 - two perspectives:
 - smart contract code: operational aspects expressed in code, automation by computer
 - smart legal contract: both operational and non-operational aspects of legal contract, some operational aspects must then be automated

3. First research paper

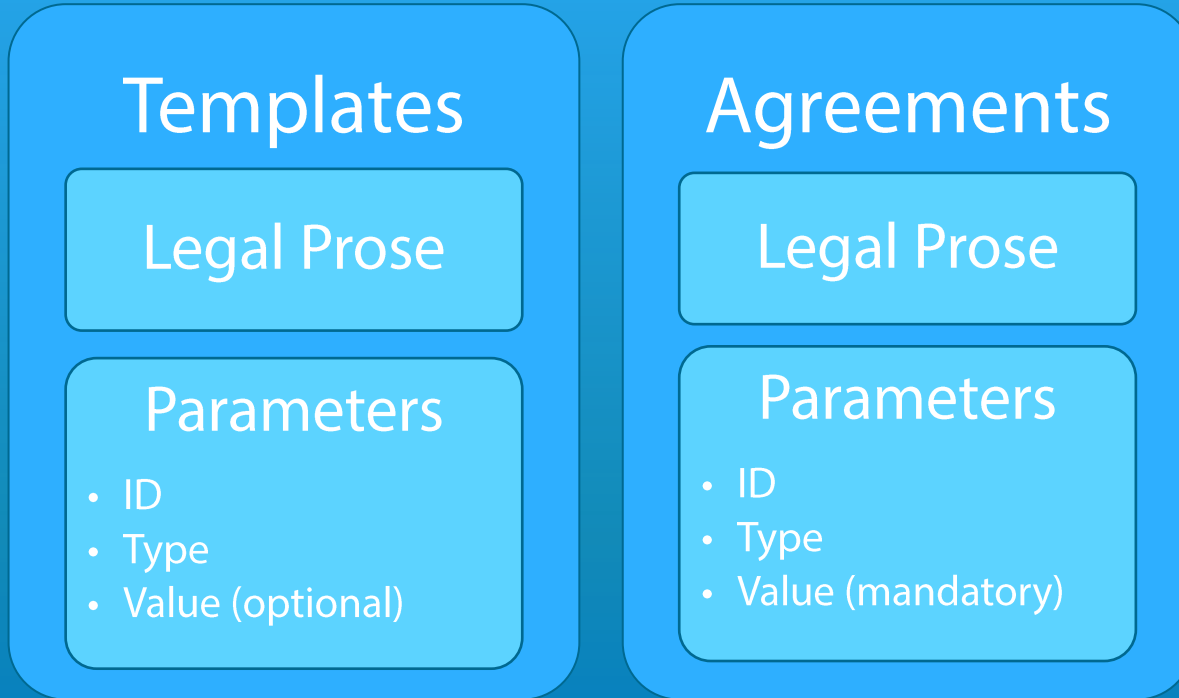
- Grigg’s “Ricardian axis” vs “smart axis”:



- design landscape: legal prose, parameter sophistication, code sharing
- long-term research: formal languages (lack of ambiguity, compositional, simple and natural to use by lawyers)

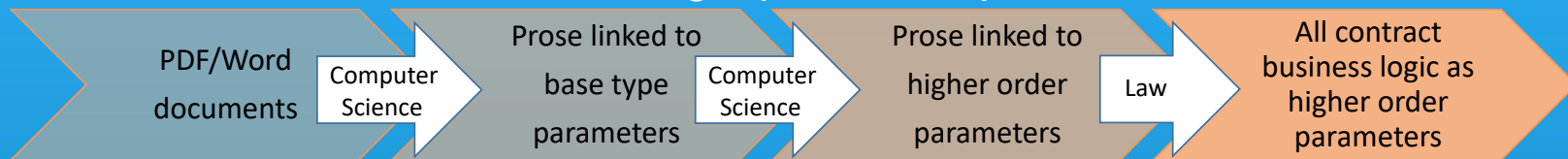
3. First research paper

Simple structure:

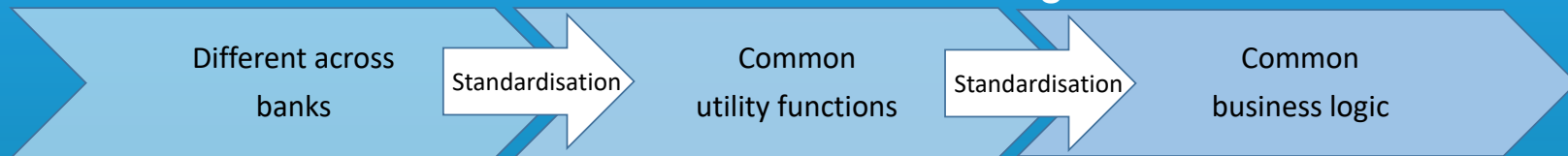


3. First research paper

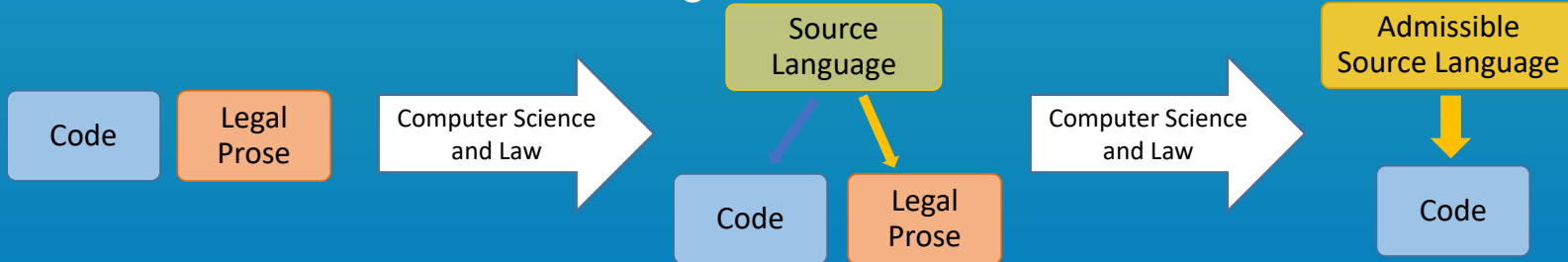
Evolution of legal prose and parameters



Evolution of code sharing



Long-term research



4. Second research paper

- “*Smart Contract Templates: essential requirements and design options*”
- Joint authorship: Barclays and University College London
- Deeper dive into design landscape of formats for storage and transmission of smart legal agreements
- Publicly released on arXiv repository:
<https://arxiv.org/pdf/1612.04496.pdf>
- Design landscape: essential requirements, design options, future developments

4. Second research paper

- Essential requirements:
 1. Methods to create and edit smart legal agreements, including legal prose and parameters
 2. Standard formats for storage, retrieval and transmission of smart legal agreements
 3. Protocols for legally executing smart legal agreements (with or without signatures)
 4. Methods to bind a smart legal agreement and its corresponding smart contract code to create a legally-enforceable smart contract
 5. Methods to make smart legal agreements available in forms acceptable according to the laws and regulations in the appropriate jurisdiction

4. Second research paper

- Abstract core specification:

smart-contract ::= smart-legal-agreement smart-contract-code**

smart-legal-agreement ::= legal-prose parameters* agreement-header**

- Metadata as markup:

markup ::= presentational-markup | descriptive-markup

Note that descriptive markup can convey structure and/or meaning

4. Second research paper

- Legal prose:

legal-prose ::= text markup text-with-markup**

text-with-markup ::= markup text*

Lists and tables, cross-references, redacted text, optional clauses

- Parameters:

*parameters ::= parameter**

parameter ::= parameter-name parameter-type parameter-value

4. Second research paper

- Other design topics:
 - agreement structures (e.g. definitions, schedules, annexes)
 - multi-document agreements: document groups, document types and statuses, document hierarchies, inter-document cross-references,
 - cryptographic hashing; binding legal prose with smart contract code
- Further work:
 - data standards (with trade associations such as ISDA)
 - process standards (with trade associations such as ISDA)
 - semantics (with universities such as UCL)

Questions?