Research Directions in Smart Legal Contracts

Events and State

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Agenda

- Context: Role of Legal Contracts

- Events

- State

- Research questions & directions

Role of Legal Contracts

1. Planning, agreeing and expressing intentions

2. Managing multiple business relations: structure & standardisation

3. Dispute resolution

4. Litigation

5. Controlling/monitoring behaviour during performance

   - Automated? performance of obligations, monitoring of behaviour

   - *"From dusty drawer to integrated component"*

Events

Events

- Contracts in performance: event-processing machines

  - Observe & create events

  - Calculate discharged and remaining obligations/prohibitions/permissions

  - Identify potential default, actual default, termination

- Events are the Sine Qua Non of legal contract performance

  - An event can be witnessed;   it can be determined as a fact;   it can have effect;   it can be cited as evidence during litigation

  - Prohibitions?   Missed payment?

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  - Prohibitions?   Missed payment?   *Time is an event!*

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Events: types of event

- Internal events:
  - A change in the internal "performative state" of the contract
- External events:
  - An action
  - The passage of time
  - A quantity or an attribute/property of an object
  - An external state-of-affairs
  - An external event caused by a smart legal contract

Events: expression

- Which events are relevant?
- *"An event is not relevant unless it is expressed in the contract"*
    - directly / definitively
    - or indirectly, e.g. in relation to their effect on the parties' ability to perform the contract (e.g. Force Majeure)

    - *Caveat: overriding force of law*

Events: complexity (1/3)

E.g. ISDA Master Agreement for swaps and derivatives
(McGonagle & Clack "Events within Smart Derivatives Contracts", IJBL 1, 2022. Clack & McGonagle "Smart Derivatives Contracts: the ISDA Master Agreement and the automation of payments and deliveries", arXiv, 2019)
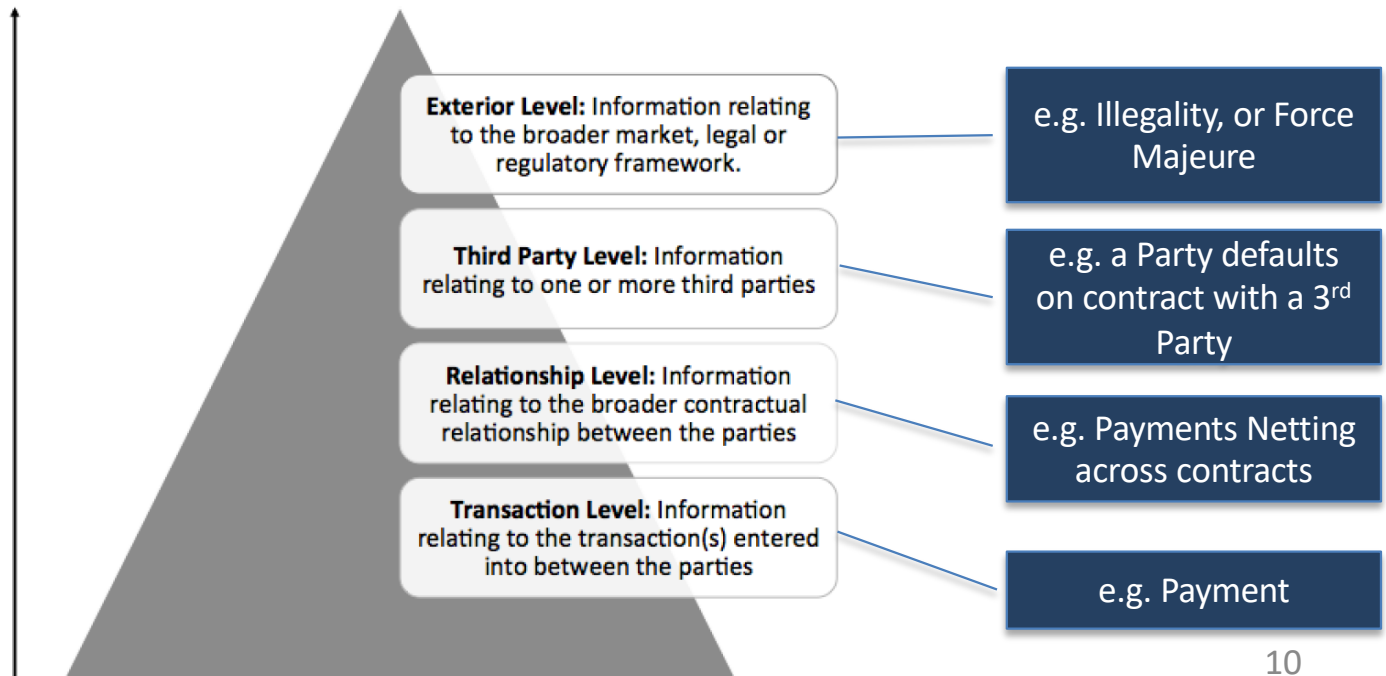
- *Events and circumstances (i.e. a pattern of events)*

  - *Deterioration in creditworthiness of a counterparty? or*

  - *Fundamental change in a counterparty's legal/regulatory/operating framework*

- Categorisation and Hierarchy of Events lead to complex processing

- Fault/non-fault events (default/termination). Events at different levels

Events: complexity (2/3)

Events occur at different levels

(Clack & McGonagle 2019)

Difficulty in observation

Exterior Level: Information relating to the broader market, legal or regulatory framework.

e.g. Illegality, or Force Majeure

Third Party Level: Information relating to one or more third parties

e.g. a Party defaults on contract with a 3rd Party

Relationship Level: Information relating to the broader contractual relationship between the parties

e.g. Payments Netting across contracts

Transaction Level: Information relating to the transaction(s) entered into between the parties

e.g. Payment

Events: complexity (3/3)

- One event $\Rrightarrow$ multiple Events (prioritised hierarchically)

- Events processing:

    - <u>Observation</u> (event/pattern)

    - <u>Determination</u> (significance/materiality $\Rrightarrow$ Event/s):
      criteria often objective, but may include <u>subjective</u> elements requiring
      human intervention   *(NB $\Rrightarrow$ dispute?)*

    - <u>Action</u> may involve choice and discretion (human intervention, different
      parties $\Rrightarrow$ different choices?)

State

State

- "Performative state":
  - Remaining obligations/prohibitions/permissions, + history of events

- Track and visualize changes in performative state

- Change of state can trigger an automated action (confirmation of which may be an observed event – an important feedback loop!)

State: automaton

- "Contracts in performance: event-processing machines"

- Example: *Flood & Goodenough "Contract as automaton: representing a simple financial agreement in computational form", JAIL 30, 2022*
    - Defined formally as a Deterministic Finite Automaton (DFA)
    - Finite number of internal states (1 start state, 1+ end states)
    - Transition function: *State × Event → State*

- Representations: graphical, tabular, regular expression

State: automaton uses

- Graphical, tabular and/or regexp representations. Could be used for

  - Contract analysis (parties/lawyer may only see results, not DFA)

  - Visualisation (seen by parties and/or lawyers) during
    - drafting and negotiation
    - performance
    - dispute resolution

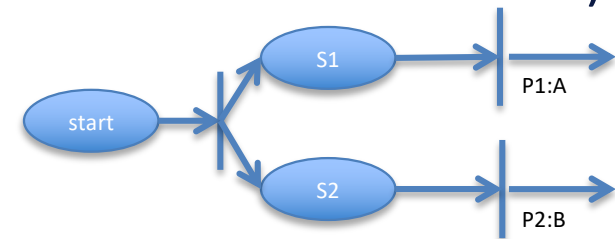 - Basis for automating actions/monitoring

  - Interactive drafting

State: visualisation

- DFA graphical representation: visually/intellectually attractive, but:
    - How to represent automated actions? (and expect confirmation event?)
    - How to represent complex transitions that require memory? (NB encoding path dependency into the graph is cumbersome)
- Stack automaton?
- Petri Net?

    (e.g. L4, R.Lee "*A Logic Model for Electronic Contracting*", Decision Support Systems 4(1) 1988)

Research questions/directions

Research questions/directions (1/5)

- ¬observed ⊢ ¬occurred ?

- Do parties/automaton see identical event sequences?

- Does performance always trace a single path (e.g. DFA) or possibly multiple simultaneous paths (e.g. parallel activities in Lee's Petri Net)?

  - Which is easier for lawyers to understand?

  - Which is better for analysis and code generation?

Research questions/directions (2/5)

- How much event history must a contract automaton remember?

    - *For a late-payment penalty that increases at each subsequent late payment?*

    - *For a set or sequence of events (within a stated time period) comprising a "circumstance" that triggers a state transition?*

    - Entire event history or only selected events?

- Represent/visualise "events" <u>and</u> "Events"?   *("Words-first")*

Research questions/directions (3/5)

- How should a contract automaton

  - process multiple simultaneous events?

  - support human interaction, including human-initiated intervention?

    - subjective decisions? discretion and choice?

    - agreed variation to the contract?

    - termination/variation due to changes in law?

Research questions/directions (4/5)

- Does a state have meaning?
  - If not, how does one state differ from another?
  - Who determines the meaning of a state?
- *Words-first:* How to convert contract clauses into states/transitions? How are the states/transitions defined?
  - By the drafting lawyer?   a programmer?   automatic analysis?
  - By an interdisciplinary team?
  - Conflicts resolved statically? Or during performance? Always resolvable?

Research questions/directions (5/5)

- Our work at UCL is primarily "words-first" and includes:

    - Real, large, complex contracts (e.g. financial, construction)

    - DSLs, formal representations, state machines, visualisations

    - Semantic/cultural/linguistic gap between programmers and lawyers

    - Vagueness and ambiguity in legal contracts

- All driven by an overriding, crucial question:

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- All driven by an overriding, crucial question:

How can we be sure the representation is faithful to the contract?

Questions?

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Computable Contracts Workshop
ICAIL, 19 June 2023