Legal Schema

A Structured Data Format for Digital Contracts in the UK

LAWTECH UK

Contents

1 | Foreword

There are or were four impediments to the ubiquitous usage of on-chain smart contracts. A clearer understanding of the legal status of cryptoassets and smart contracts has been provided by the UKJT's Legal Statement at the end of 2019. One or more dependable Central Bank Digital Currencies will hopefully emerge soon. The UKJT's Digital Dispute Resolution Rules are to be published in April 2021.

The fourth impediment is the absence, thus far, of a universally accepted method of digitising commercial and legal documentation. The existing options are not uniform.

The UK Legal Schema aims to rectify this fourth impediment by providing a generalised universal structured data format for the creation of digital contracts. I wholeheartedly welcome the project. Uniformity in machine-readable text will be a great step forward for smart contracts and mainstream usage of cryptoassets.

Peter Hunn and his team are to be congratulated.

The Rt. Hon. Sir Geoffrey Vos
Master of the Rolls

2 | Introduction

In November 2019, the UK Jurisdiction Taskforce of the LawtechUK Panel[1] (the "UKJT") issued its Legal statement on cryptoassets and smart contracts (the "Legal Statement").[2] Following publication of the Legal Statement, the Government asked the Law Commission to review the law on both smart contracts[3] and digital assets.[4] Most recently, the UKJT launched its public consultation on a set of Digital Dispute Resolution Rules ("DDRR").

The Legal Statement has demonstrated the capability of the law of England and Wales to adapt to new forms of commercial coordination and property.[5] The Law Commission projects, together with the DDRR, are sure to add further legal certainty, providing an important and robust foundation for the development and adoption of these technologies.

Building on this legal foundation, and through the LawtechUK Sandbox, this white paper accompanies the publication of the open source code and associated documentation for a UK Legal Schema ("UKLS" or "Legal Schema"). The UKLS provides the first step towards this necessary technical foundation to support the mainstream adoption of digital documents (including smart contracts).[6]

The Legal Schema is an open source initiative that provides a common language for creating and managing legal documents as data, much like schema.org does for webpages. As we move towards a widespread digitisation of the contracting process (reflecting the digitisation of most aspects of society), the need for this common language is pressing. In the same way that schemas underpin and enable web development, the UKLS not only supports the development of individual digital contracts but, importantly, it enables them to interact with each other (and existing technologies). The result being that the emerging smart contract and digital asset industries in the UK can benefit from both strong legal and technical foundations.

The Legal Schema shares the vision put forward by the Government in the National Data Strategy, namely that "[w]e want the UK to be a nation of digital entrepreneurs, innovators and investors, the best place in the world to start and grow a digital business, as well as the safest place in the world to go online".[7] This whitepaper and the accompanying Legal Schema offer an important component for such a large scale digital transformation of the UK economy and jurisdiction.

In this paper, the authors provide context to the UKLS by setting out the nature and value of digital documents. They anchor this discussion in two practical use cases SmartCo and Smart Trade. Both case studies demonstrate how the UKLS can be used now, with existing technology and largely within existing systems. Finally, the authors acknowledge that building a legal schema that encompasses the wide variety of legal documentation and relationships that exist will take time. It also necessitates collaboration and consensus across the private and public sectors, as well as academia. Nonetheless, the growth of the sharing economy and the rise of consensus-based projects in the technological space (most notably schema.org for websites) show that a project like this is achievable and within reach. We hope that the launch of this whitepaper, alongside legalschema.org is the first step in that collaboration.

The Legal Schema is a critical component of the future of lawtech and would not have been possible without the support, guidance, and input of:

- Lawrence Akka QC, Twenty Essex
- Victoria Birch, Norton Rose Fulbright
- Nick Davies, HMRC
- Dr Anna Donovan, UCL and LawtechUK Panel
- Professor Sarah Green, Law Commission and LawtechUK Panel
- LawtechUK and the UK Jurisdiction Taskforce
- Alexandra Lennox, LawtechUK
- Maja Mazur, Norton Rose Fulbright, seconded to LawtechUK
- David Quest QC, 3 Verulam Buildings
- Jenifer Swallow, LawtechUK
- Sir Geoffrey Vos, Master of the Rolls

This discussion paper, co-edited by Peter Hunn, Lawrence Akka QC, David Quest QC, Dr Anna Donovan, Victoria Birch, and Maja Mazur is intended to provide an introduction to digital contracts, the technology, and its purpose and benefits. It accompanies the UKLS codebase and documentation at www.legalschema.org.

3 | Summary

Contracts are typically documented in word-processed formats. Even though represented in digital form they remain purely textual documents. By contrast, a digital contract represents an agreement, enforceable at law, in a data structured format. The inclusion of structured data enables a contractual document to be transformed from a static textual document to a natively digital format that facilitates new forms of functionality for contractual agreements and documents by enabling "open access"[8] to, and sharing of, contract data such as (i) search and analysis of data within contracts; (ii) integration of contract data with external systems for e.g. automated reporting and operations; and (iii) the creation of "smart legal contracts" and integration with cryptoasset systems.

The UKLS provides a generalised universal structured data format for the creation of digital contracts. At its core, the Legal Schema consists of a Legal Schema Language (LSL) that enables users to build an ontological structure into contracts and other legal documents. By doing so, documents are rendered machine-readable as well as human-readable. This means that the document, by way of its data structure, can be integrated with external software systems and indexed, queried, and analysed in a manner similar to web pages. Notably, machine-readable documents can be integrated with distributed ledger-based cryptoassets to provide a contractual basis for their usage.

Digital contracts will typically be constructed using markup languages and, increasingly, code components (see figure 6). The UKLS operates as the core foundation (or "narrow waist") of a contract technology stack (see figure 5) meaning that it functions as a minimal, universal, and implementation agnostic approach to representing data in contracts. The narrow waist widens to accommodate and support innovation at other levels of the contract technology stack, including by:

- providing compatibility with current and future markup languages for digital contracts;
- integrating with existing domain specific schema languages, such as Companies House and Crown Legislation Markup schemas (see p.19);
- enabling contracts to be converted into other machine-readable structured data formats such as XML and JSON and human-readable formats such as PDF and DOCX; and
- facilitating a standardised means of integration of contractual data across different distributed ledger technologies (e.g. Ethereum, Hyperledger Fabric, Corda), smart contracts, and cryptoassets.

The UKLS represents the first stage in the development of an open source format for digital contracts in the UK. Further development will be undertaken with LawtechUK, University of Oxford, University College London, and other industry stakeholders.

This whitepaper introduces the first phase of the UKLS development in three stages. Sections 5-7 introduce the value of digital contracts, the technology, and its implementation, respectively. Section 8 introduces two example applications developed with Norton Rose Fulbright and HMRC showcasing the use of UKLS. Section 9 concludes by introducing the next phase of development of the UKLS. The Annex provides further technical detail.

KEY TAKEAWAYS

- Contracts, even in "electronic" form, have not kept pace with advances in information technology. Most are word-processed in DOC/DOCX format (e.g. Microsoft Word) and may be converted to PDF for electronic signature and storage in document management systems. Word processing software is specifically intended to document the legal and commercial data, rather than to structure the document as usable data in the same way as a database or web page, for example. The process of documenting that sales contract serves to effectively capture important data in a digital paper equivalent, rather than digitising the underlying agreement itself.

- This paper introduces the Legal Schema (UKLS) initiative. UKLS provides a minimal, universal, and technology implementation agnostic approach to representing structured data in contracts.

- Structured data enables contracts and other legal documents to take a natively digital format (a "digital contract") that facilitates new forms of functionality by enabling "open access" to, and sharing of, contract data such as (i) search and analysis of data within contracts; (ii) integration of contract data with external systems; and (iii) the creation of "smart legal contracts" and integration with cryptoasset systems.

- A digital contract is both machine-readable and human-readable. The former is provided by the structured data model for the contract, expressed using schemas constructed using the Legal Schema Language (LSL).

- This work is complementary to existing work and advances in this area. Future development of the UKLS will be undertaken with a range of stakeholders to set the foundations for an 'Open Agreements' framework for digital contracting in the UK. Such a framework will provide a universal specification and technical framework for developing and using structured contractual data to:

  - enable all contracting parties to utilise a single modeling language and ontological basis for contract data; thereby ensuring that contracts between parties 'speak the same machine-readable' language and can be used by each contracting party in their own software systems that support the common contract data standard; and
  - foster innovation in lawtech, and specifically contract technology, such as document markup languages, APIs, cryptoasset systems, artificial intelligence, contract analytics and similar software tools and products.

4 | From Documents to Data

The legal and commercial worlds operate through documents. The universe of these documents is expansive, covering everything from the sale of goods to financial instruments such as bonds and derivatives, company formations and dissolutions, mortgages, mergers and acquisitions, capital financings, international trade, and much more. Invariably, most of these documents are uniform in terms of the technology used to represent them. Most are word-processed in DOC/DOCX format (e.g. Microsoft Word) and may be converted to PDF (e.g. Adobe Acrobat) for electronic signature and storage in document management systems.

These documents and the technologies can be seen as an "operating system" for business. There is, however, an increasing recognition that these formats are suboptimal in nature.[9]

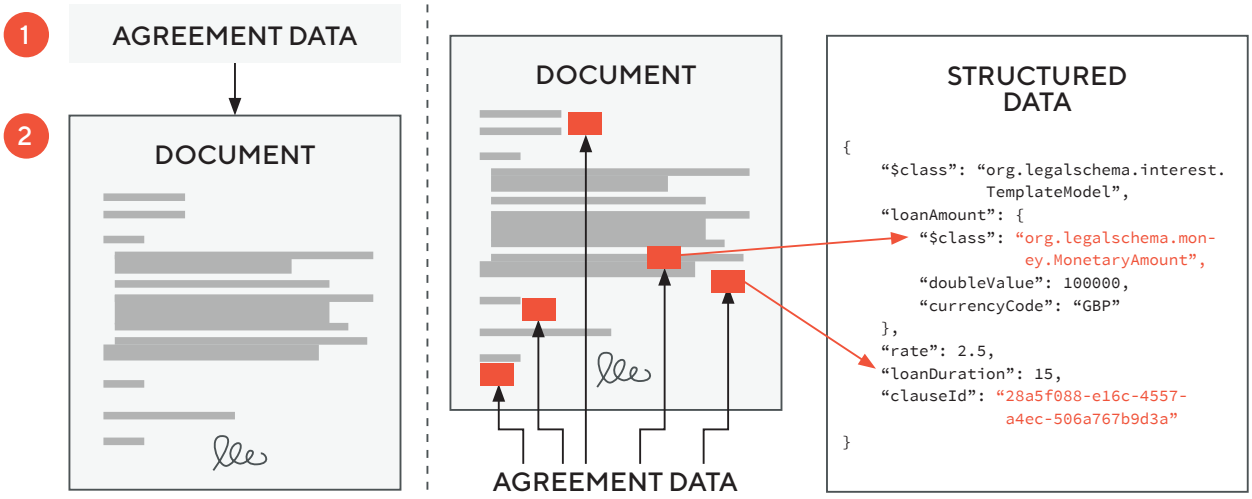
Legal documents, even in "electronic" form, have not kept pace with advances in information technology. Web technologies that enable web pages to be constructed and shared, by contrast, have undergone considerable development and maturation.

Take a simple contract for the sale of goods, for example. That contract may be documented as a word-processed file and subsequently electronically signed by the parties. That document contains business critical information pertaining to the rights and obligations of both the buyer and seller of the goods. That information is stored as text. It is not data in the same form as one would see within a database of, say customer information, or an enterprise resource planning system. It cannot, consequently, be directly integrated with these systems. As such, it exists as information siloed from other systems that may benefit from access to it, and incapable of being used with many of the technologies that are now commonplace in enterprise.

The core reason is that the software is specifically intended to document the legal and commercial data, rather than to structure the document as usable data in the same way as a database or web page, for example. The process of *documenting* that sales contract serves to effectively capture important data in a digital paper equivalent, rather than *digitising* the underlying agreement itself.

By representing the document in a format that natively digitises the underlying data, it becomes feasible to simultaneously achieve the goals of: (i) documenting the agreement; and (ii) representing the agreement in a form that provides access to, and usage of, the critical business data held within that document.

FIGURE 1 | Contrasting documentation and digitisation of contractual agreements



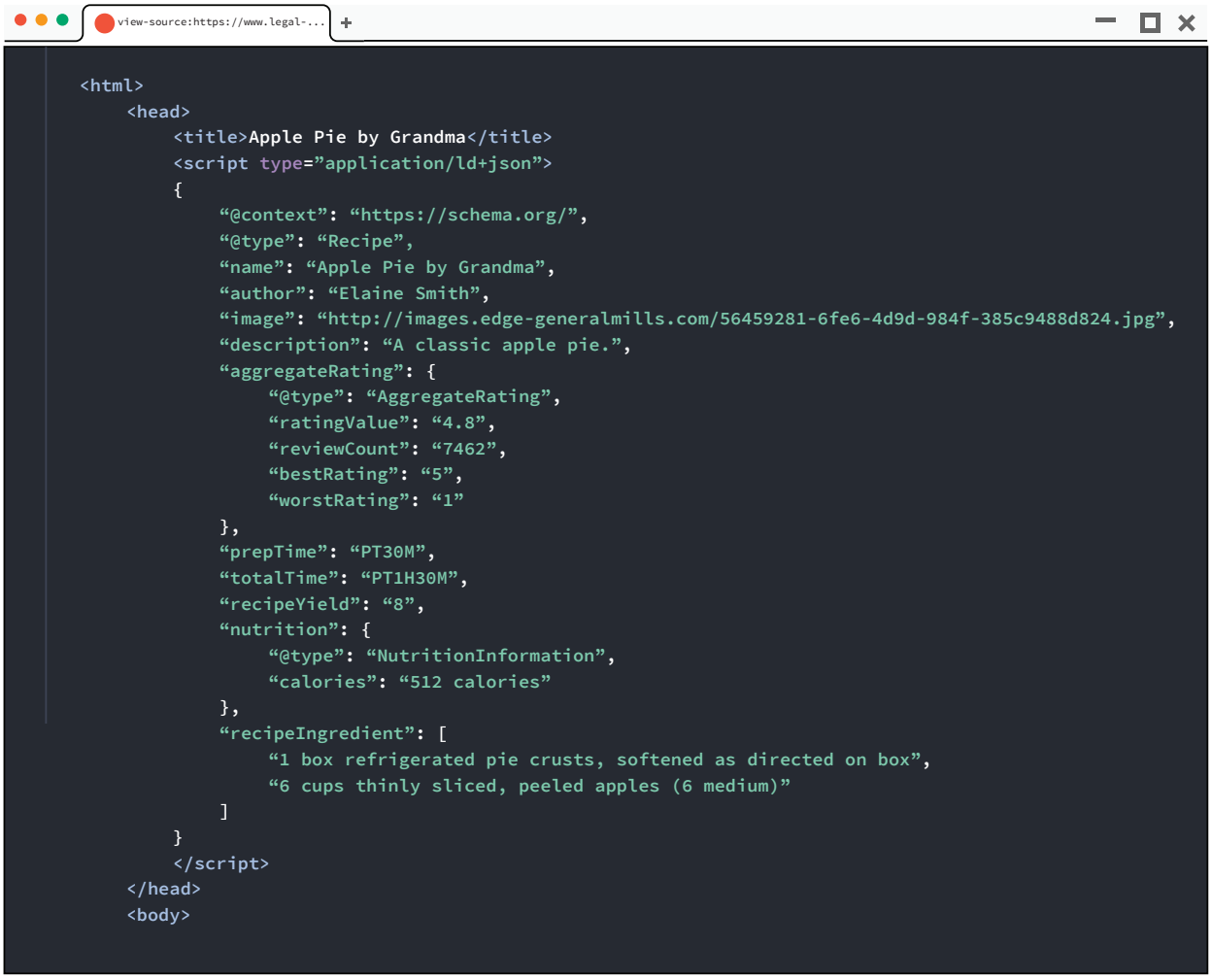
There are many reasons as to why this may be beneficial. Ultimately, these are reducible to two core principles: (i) access; and (ii) analysis.

The former enables the document to integrate with other software-based systems by exposing the underlying data in a manner in which these technologies can interpret and interact with. Rather than having to manage documents "by hand" to perform these business processes, they can be managed using software using the data within the document. As the average cost of managing a *simple* contract averages around $7000 according to data collected by IACCM — largely attributable to post-signature business processes[10] — the transaction cost value of automating these cost intensive manual processes is considerable. The latter, enables the document to be introspected and analysed directly using its core data rather than attempting to interpret the document through indirect means such as natural language processing (NLP).[11] The document can be treated just like any other data, meaning documents can be queried just like databases, and existing data analytics techniques can be applied to extract insights across a corpus of documents.

Digital Contracts

Contracts, like most other legal documents, are outliers in a digital world even if the document itself is digital.[12] Other digital documents, like web pages, are formed of 'structured data'.[13] This enables all of the web-based functionality we have become accustomed to. It enables data to be shared between web-based applications and resources,[14] indexed and searched using search engines,[15] and tracked and analysed using analytics tools.

FIGURE 2 | Structured data usage in web pages



https://developers.google.com/search/docs/guides/intro-structured-data

A word-processed document is typically formed of 'unstructured data', meaning that the information contained within the document is not organised, or modelled, in a predefined manner. The overwhelming majority of data is unstructured in nature . By extension, most contracts are unstructured—the documentation of the agreement consists solely of formatted text. By contrast, 'digital contracts' or 'computable contracts' are terms used to describe agreements expressed in the aforementioned manner through structured data formats.[17] A digital contract is an agreement, enforceable at law, represented using 'structured data' organised using a predefined model (a "data model") for how that contract is represented in documentary form.

KEY TAKEAWAYS

- Word-processed documents are typically made of unstructured data, which means that the machines cannot "read" them in the same way humans can. Unstructured data can be interpreted, understood, and managed by humans, but often needs to be structured to be used by a machine.

- A digital contract is an agreement documented and represented using structured data, which means that the information within a digital contract is organised using a predefined model (a data model) that allows different applications, e.g. a contract review tool (looking for a liability clause cap) to read its context and potentially communicate to deliver data insights, or an enterprise resource planning system to update obligation dates using the contract document. This is similar to how different applications can read and use data on websites.

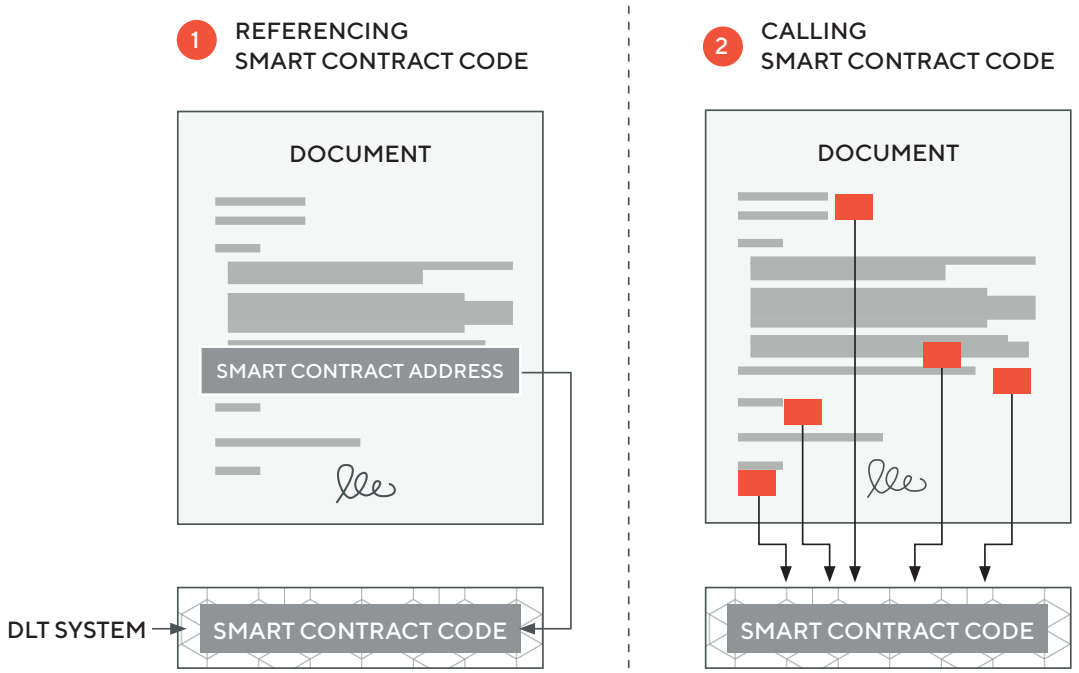
— Digital Assets

The rise of distributed ledger technologies has also facilitated the advent of new forms of digital assets, such as "cryptoassets".[18] A digital asset may represent a currency; title to digital, physical, or real property; financial instruments; governance rights; computational resources and more, as data. Cryptoassets are "digital representations of value that can be transferred, stored or traded electronically which use some type of distributed ledger technology".[19]

The Cryptoassets Taskforce concluded in 2018 that "[distributed ledger technology] has the potential to enhance system resilience; improve the efficiency of end-to-end settlement processes and reporting, auditing and oversight; and enable greater [contract] automation [including] "the potential to lower barriers to investment, improve liquidity and tradability, and increase efficiency".[20]

In order to maximise these opportunities,[21] it will often be necessary to create, transfer, and dispose of legal rights and obligations over cryptoassets. A cryptoasset representing a tangible good will often take the form of a smart contract[22] — code that exists and runs on a distributed ledger — that defines the attributes of the asset. Only when the code meets the requirements of contractual validity will a smart contract itself be a contract at law.[23] In many instances this will not, without more, be so.

FIGURE 3 | Associating digital contracts with digital assets



Whilst there is no impediment under English law to a smart contract being a valid contract at law,[24] often a contract consisting of natural language, not just code, will be required to set the smart contract within an appropriate legal "wrapper" in which the former executes performance of all or part of the latter.[25] Digital contracts provide a mechanism to associate a digital asset with a legally enforceable agreement that contains the data needed to operationalise the asset. The structured data within the digital contract can be passed to the smart contract in order to trigger a transfer at a given time (e.g. a set period of time after legal execution of the digital contract) or upon a defined event (e.g. a payment being made), the consideration payable under the contract (e.g. the price payable in a cryptocurrency or fiat currency), the number of digital asset "units" or "tokens" that should be transferred in consideration, and more.

Such a structure will often enable smart contracts to be used exclusively for defining the asset and transactional performance (e.g. a transfer of a particular asset upon payment) and the digital contract to define the details of that transaction needed to operationalise the smart contract (e.g. the price payable and details of the parties). This promotes reuse of the smart contract by separating the asset from any individual contract that may interact with it. When an asset may itself be the subject of multiple documents simultaneously and/or over time (e.g. real property transactions) this is likely to be a critical quality. Digital contracts are therefore likely to become an imperative to facilitate the use of digital assets.

KEY TAKEAWAYS

- Cryptoassets are a digital form of asset enabled by smart contracts on distributed ledger technologies, such as a blockchain, that represent physical and natively digital assets.
- A smart contract may not necessarily be a contract at law. A digital contract may incorporate a smart contract to add a legal "wrapper" to the smart contract.
- Digital contracts facilitate the use of cryptoassets by integrating with smart contracts to operationalise the performance of the digital contract using the data within the digital contract. A digital contract can be used to pass structured data from the document to a smart contract to initiate an operation relating to the cryptoasset (e.g. a transfer between the contracting parties) based upon the data from the digital contract (e.g. the number of "units" of the digital asset and the price payable per "unit").

What are the benefits of turning documents into data?

Digital contracts and assets provide for a new paradigm that will cut across almost every aspect of the organisation of commercial relationships, the representation and registration of legal rights and obligations, and the processes that underpin and interact with them. The opportunity presented by such a paradigmatic shift is arguably equivalent to that experienced with the advent of the internet. Digital contracts and assets are to paper as the encyclopedia is to the internet. By digitising contracts and assets, we are able to technologically structure contracts and read, extract and use the critical data within them, in a manner similar to web pages.

The reasons for moving to digital documents are numerous, including:

- **Contract data is hugely valuable.** As discussed above, the status quo involves trapping this data within a documented form, rather than facilitating access to it within digital form as is the case with other forms of natively digital documents, such as web pages. Contract data should be as accessible and functional as any other form or source of commercial data. It is critical for business planning, intelligence, compliance, optimisation, and more. Valuable types of primary data typically trapped in contracts and hard to extract from non-digital documents include everything from counterparty information, contract deal points, renewal dates, notice periods, to substantive obligations. Secondary data can be derived from analysis of this primary data such as quantifiable levels of legal risk—the likelihood of a particular type of legal action against a company and the potential cost of responding to it. Documents in digital form enable comparing such data points across a vast number of contracts, across subsidiaries and various companies within a group. As a result, management teams are better able to make data-driven decisions in relation to managing legal risk.

- **Understanding contracts.** AI systems aimed at contractual analysis attempt to understand the content of contracts by interpreting the natural language of the agreement. Although still fairly in its infancy, it is hoped that the AI-driven contract analysis market will lead to higher standardisation of contracts across the board and as a result make high quality, robust contractual protections accessible not only to those able to pay for bespoke legal advice, but to everyone, including

individuals and small to medium enterprises. Using AI to review and create contracts offers potentially huge cost and time savings and increases access to justice for many small businesses and individuals whose legal needs are often of repetitive, lower complexity nature, but nonetheless essential (e.g. employment contracts, repetitive procurement contracts, tenancy agreements). Structured data is vastly more valuable to AI systems than raw, unstructured, text, as it provides the semantic context for the content of the document. By contrast, most AI systems have to infer the semantic meaning directly from the natural language text.[26] In much the same way as the content of a web page can be understood by a search engine from its structured data.

- **Technical interoperability.** Structured contract data can be converted to other data formats like JSON[27] and XML[28] and document types such as PDF and DOCX natively. The consequence being that a universal data format for digital contracts facilitates near frictionless use of contract data with existing technologies. A major ecosystem benefit is that the contract data comes along with the document and is not lost when opened and edited in various different editors and tools. This quality can enable parties to share not only the document, but both have access to the underlying data for use in their internal systems.

- **Contract data becomes easily accessible to external systems.** In the same vein, contracts can natively act as sources of commercial data capable of integration with other information technology systems. Structured data within contracts can be formatted for compatibility with commercial software systems. Contracts can effectively become interfaces[29] that pass data to all manner of enterprise systems, such as accounting, payments, trade finance, business intelligence and analytics systems, supply chain management, enterprise resource planning, customer record management, and many more. This enables contracts to function as integrated components of IT infrastructure, not separate silos of information. As a result, business processes can be substantially automated by integrating contract data with such systems with reduced need for manual human management. The 'SmartCo' and 'Smart Trade' use cases below[30] are demonstrative of the value of contract data integration with external systems.

- **Digital contracts enable digital assets.** At the time of writing, the global cryptoasset market capitalisation sits at over $2 trillion[31] and is expected to grow substantially as new forms of natively digital asset are created and tangible assets are represented in digital form.[32] Digital assets or cryptoassets will often require interaction with contracts for transactions pertaining to those assets to

be performed. For example, title to a digital asset representing a good may often need to be transferred pursuant to a sale of goods contract, a mortgage over real property represented as a digital asset will require creation through a deed. Digital contracts are a key integration point between digital assets and traditional legal infrastructure and transactions. Without such integration, digital assets will be encumbered by legacy documentary forms that reduce their utility, and undermine the benefits they are capable of providing.

- **Existing software approaches are inadequate.** Most technology-based solutions to managing contract data involve the use of Contract Lifecycle Management (CLM) software to extract and store contract data and NLP/AI systems to analyse, order, and interpret that data. Such solutions are arguably a symptom rather than a cure given they exist in an attempt to address the deficiencies inherent within representations of contracts as documentary forms, rather than 'contracts as data'. The consequence being that much of the data is dealt with indirectly and, as such, is often inaccessible, captured inaccurately, or devalued as systems fail to interpret and classify it correctly.

5 | Digital Contract Technology

A digital contract may be viewed, at least technically, as analogous to a web page. A web page is itself a document designed to be displayed in a web browser like Google Chrome or Safari. It typically consists of: (i) a markup language (Hypertext Markup Language) and schemas that describes the semantic structure of the web page document;[33] (ii) a presentation language (Cascading Style Sheets) that describes the style (e.g. fonts, colours, and spacing) of the markup document;[34] and (iii) programming or scripting languages (such as Javascript) that adds functionality to web pages, transforming a web page document into a dynamic, interactive, document.

Whilst digital contracts may take multiple technical forms,[35] typically, a digital contract implementation similarly includes: (i) a markup language; (ii) an underlying data model or schema to represent the structure of the agreement content; and (iii) may, additionally, include code through the use of a programming or scripting language to enable the agreement to become executable or "smart" in nature.

Markup

A digital contract markup language is used to express the structure of the contract document conceptually, rather than visually as is the case with most contract document forms. The conceptual structure includes: (i) the natural language text of the document; (ii) textual formatting (e.g. headings, quotations, and text presentation); and (iii) the structured data that exists within the contract.

FIGURE 4 | Markup with embedded data parameters

```
{{#clause clauseName}}
## Loan payments
This is a fixed interest loan in the amount of {{loanAmount}} at an
annual interest rate of {{rate}}% with a term of {{loanDuration}}.
{{% monthlyPaymentFormula(loanAmount,rate,loanDuration) %}} is due on
the {{day}} of each month.
{{/clause}}
```

Various forms of markup language exist for different domains, such as HTML for web pages,[36] MathML for integrating mathematical notation and formulae into web pages,[37] and Markdown for plain text documents.[38] The notable difference is that such a digital contract markup language enables contract specific functionality to be embedded within the natural language. These may take various forms, but at a basic level include:

- **Formatting** - `{{#clause clauseName}}` to define a clause as a component within a contract and ## to indicate a heading for the clause.
- **Parameters** - Syntactically distinct elements within the text of the document such as `{{rate}}` which operates as a placeholder to indicate that some value for the interest rate should be entered. These, together, comprise the structured data model for the document and are discussed below in section 6 and the Annex.
- **Expressions and code** - Expressions such as `{{% monthlyPaymentFormula (loanAmount,rate,loanDuration) %}}` enable calculations to be performed within the document using the other parameters in a manner similar to spreadsheets. The example in Figure 4 may be extended to include code to initiate a business process such as a transfer of the monthly payment amount on the stipulated date during the loan period.

— Schema

Schemas are used to model domains. A domain may be any specified sphere of activity or knowledge, and can be general or specific in nature. The purpose of schemas is to create open standards for expressing document data, which in turn facilitates interoperability and promotes universality. Schema.org is an example of a foundational domain schema to define and describe core types, such as an event,[39] organisation,[40] person,[41] place,[42] product,[43] and many more. It was devised to create and maintain common schemas for structured data on the internet so that search engines can understand the contents of web pages.[44]

Open data standards also exist to facilitate the creation and use of structured, useable, data across government.[45] Legislation in the UK is structured using Crown Legislation Markup Language (CLML) Schema.[46] For example, the Video Recordings Act 2010 can be accessed online at http://www.legislation.gov.uk/ukpga/2010/1 and the underlying structured data using the CLML Schema by adding /data.xml at the end. The same structured data can be viewed in PDF by adding /data.pdf. Companies House also publish schemas for structuring data on the register,[47] enabling users to submit digital documents programmatically in structured data through the Software Filing service[48] instead through a static document form, as discussed above. For example, the schema for submitting a valid officer appointment is accessible at: http://xmlgw.companieshouse.gov.uk/v1-0/schema/forms/OfficerAppointment-v2-8.xsd. Both are prominent examples of critical legal data in documentary form being designed to be intentionally accessible in an open format. These schemas are important to ensure : (i) the validity and accuracy of the structure of data submitted (as in the case of forms filed at Companies House); and (ii) to facilitate the standardisation, interoperability, and ultimately, use of data contained in these documents with external systems (such as Companies House registration systems or software products using legislation data).

Contracts represent a major category of critical data that can benefit from the same approach for the reasons cited above. The movement towards structured data in contracts is already underway in specific industries. Both the International Swaps and Derivatives Association (ISDA) and the International Securities Lending Association (ISLA) have developed schema for modelling the data that occurs in derivatives trades[49] and lending transactions,[50] respectively. As ISLA states:

> *"We are on an inevitable journey to data-orientated legal agreements, with a representation of the written contractual terms in a manner that follows a consistent, predictable, and structured data format.*
> *[T]o move from current word-based contracts to those which allow for the automation and application of the data elements to the wider business, meaning must be given to the structured data variables and allowable values of those variables"*[51]

Contracts are different from government forms or legislation in that the content of a documented agreement can be substantially richer and more varied than the attributes of a piece of legislation, the set fields of data for a particular form that requires submission to Companies House,[52] or derivatives trade events.[53] There is a need for a *generalised* legal schema technology that can accommodate the easy creation and management of a corpus of highly extensible and standardised structured data for digital contracting (see section 6 and the Annex).

Such a generalised legal schema is likely to provide numerous benefits, including but not limited to:

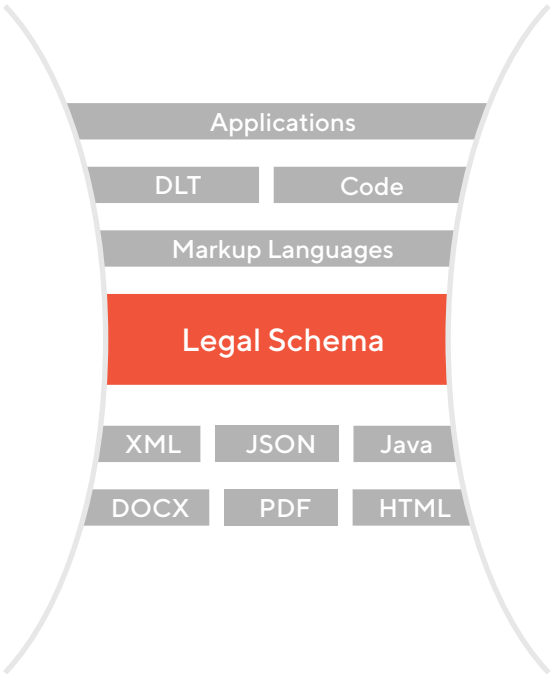
- Providing a single, common, representation of data that exists within a contract for the benefit of all contracting parties;
- Fostering a 'platform' for innovation through the use of a universal ontology and method for structuring contract datal; and
- Integrating with systems of record and automating business processes using the structured data contained with the contract.

— Code

The advent and growth in the use of digital ledger technologies has fuelled interest in the concept of 'smart contracts'.[54] Whilst a digital contract may interact with distributed ledger technologies, digital contracts may more generally include expressions and scripts that perform calculations, transactions, business processes, or provide other functionalities in a similar way to web pages.

Notably, a digital contract does not need to include code or be a "smart contract", just like a web page may be static in nature and not include interactive componentry. As a consequence, the issue of code in contracts sits outside the core scope of the current paper. It is important to note, however, that digital contracts will likely increasingly trend towards the inclusion of coded elements[55] and, by implication, digital contracting technologies should therefore accommodate the same. Importantly, a legal schema can provide structure to the data used by the expressions and scripts embedded within the contract markup language (e.g. by passing structured data into the code/smart contract), as demonstrated by Figure 4. The schema provides the 'narrow waist' of the digital contract technology stack:

FIGURE 5 | Position of the schema within a contract technology stack



The Legal Schema is a core technology that enables digital documents to be created in markup languages and integrated with code and other applications. The Legal Schema also enables documents to be rendered into other formats including: (i) machine-readable structured data formats such as XML and JSON; and (ii) human-readable document formats such as DOCX and PDF.

KEY TAKEAWAYS

- Digital contracts may be viewed as analogous to web pages. A web page is a form of digital document constructed using various technologies to define its formatting, structure, content, and functionality.
- Schemas are widely used to model structured data. Existing schemas are used to model data in digital documents such as web pages, legislation, registers, and financial instruments.
- The key components of a digital contract may include: (i) text formatted using a markup language; (ii) schema to model the structured data for the contract, embedded into the text using parameters; and (iii) code, where applicable, to perform operations using the structured data.
- A digital contract is both machine-readable and human-readable. The former is provided by the structured data model for the contract, as defined by the schema. The latter is generated by rendering the document using the values input into the parameters in the marked-up version of the document (see figure 6).

6 | A Legal Schema for the UK

Schemas are a formal description of the structure of data. A schema provides documents with common, well defined, and well understood, formats. A schema may be seen as analogous to the grammar of a language—the vocabulary and system of constraints for forming a valid, meaningful, structure with that vocabulary.

Expressing and integrating the structured data within a contract is critical to its transformation from document to data. As discussed above, the schema that provides the structure for the data contained within the contract is the core component that enables contracts to become valuable, usable, data.

Through the Lawtech Sandbox the first version of a generalised schema system has been released for the legal domain. This whitepaper accompanies the publication of the open source code[56] and technical documentation for a UK Legal Schema. The purpose of which is to provide both the core technology to create digital contracts using a common language and standard, much like schema.org does for webpages. The Legal Schema can be accessed at legalschema.org The technical aspects are described in greater introductory detail in the annex below.

The Legal Schema, in its current form, consists of three main components:[57]

- **Legal Schema Language (LSL):** A language to build legal schemas and embed LSL defined schema data into the marked-up document text to create digital contracts and other structured legal documents. The Legal Schema operates in a similar manner to schema.org but instead of being devised for use on the internet through web pages, it is designed for use within contracts and other legal documentation.
- **Conversion Framework:** A code library that transforms template documents using the LSL into other document formats, including PDF, HTML, and DOCX[58] so as to enable LSL structured documents to remain capable of being rendered in existing natural language text formats.
- **Schemas**: An initial set of readily defined schemas developed using LSL to build digital contracts and other documents. A number of base models to initiate the schema system have also been released.[59] The examples below demonstrate some of these schemas.

Figure 6 demonstrates a simple example in which the contract text can be marked up with the schema parameters embedded:

FIGURE 6 | The three 'views' of a contractual provision using structured data

Markup

```
{{#clause clauseName}}
Upon the signing of this Agreement, {{buyer}} shall pay {{amount}} to
{{seller}}.
{{/clause}}
```

The *same* content of the contract can then be both represented in human-readable **text** with the appropriate values replacing the parameter placeholders in a manner similar to the text one would see on a web page, and the **structured data** version that provides the machine-readable version of the same.

Textual Representation

```
Upon the signing of this Agreement, Alice shall pay 100.00 GBP to Bob.
```

Structured Data Representation

Using the markup and schema, the document is also organised as a data model describing the semantic structure and details contractual text. The technical details of how this operates are available in the annex:

```
{
    “$class”: “org.legalschema.ExampleContract”,
    “contractId”: “1f3a4329-6a99-4c2d-86b5-febe0815823a”,
    “buyer”: {
        “$class”: “org.legalschema.contract.Party”,
        “partyId”: “Alice”
    },
    “seller”: {
        “$class”: “org.legalschema.contract.Party”,
        “partyId”: “Bob”
    },
    “amount”: {
        “$class”: “org.legalschema.money.MonetaryAmount”,
        “value”: 100.00,
        “currencyCode”: “GBP”
    }
}
```

The Legal Schema provides a means to add structured data into legal documents using a common, well defined, format. The LSL provides a language to build schemas or models of the data embedded into the text. Importantly, each such model does not need to be written uniquely for each document. Much like schema.org, new types can use existing models to build up a rich vocabulary to describe and structure the data that exists within contracts and other legal documents.[60] For example, Figure 6 demonstrates a simple marked-up clause using three parameters and two underlying types: `Party` and `MonetaryAmount` to define the structure of the data. Each of these models has different properties:

- **Party:** Both ‘buyer’ and ‘seller’ are named parameters. “Alice” and “Bob” are values assigned to the single partyId property and are displayed in the textual representation in lieu of the `{{buyer}}` and `{{seller}}` ‘placeholder’ syntax. The Party type forms part of a wider Contract model[61] that itself defines the constituent data elements that may comprise a valid contract.

- **MonetaryAmount:** The 'amount' parameter differs as it comprises two properties – `value` and `currencyCode`, each of which is defined by a more primitive type. `currencyCode`, for example, is an enumerated type consisting of all recognised currency codes. The details and structure for the `Money` model.[62] Similarly, a `Party` type could also be extended to define the legal structure of the party (e.g. a private limited company, limited liability partnership, unincorporated association, etc). The structure of these types is discussed in further detail in the Annex at p. 42.

Through these notions of extensibility and reuse, powered by an open source modelling language, the Legal Schema aims to provide a universal and standard foundation for structured data in digital legal documents, just as schema.org is for web pages. The library of data models within the Legal Schema initially contains a series of base models that can be openly extended to build a vast open vocabulary. LSL makes it easy to build around common base types needed for defining legal concepts, transactions, participants and assets.[63] In addition, the open source nature of LSL enables users to build their own proprietary models independently, using other published models (e.g. by regulators, law firms, industry standards bodies), or within the Legal Schema library.

The Legal Schema is the core of a digital contracting technology stack. A universal format and structure for contractual data provides numerous benefits, not least the ability to provide a common reference for data within all contracts as they transition to digital form. In doing so, standardised structured data drives down transaction costs by providing a standard reference usable by all contracting parties; avoiding the need for parties to build proprietary models or use models that are inconsistent. For example, an asset like a trade mark can be described and referenced consistently using a common language and model rather than each party having to interpret non-standard structured data, a result that would itself mitigate the value of structured data. This is the same rationale that supported the creation of web schemas.[64]

In much the same way, as Open Banking[65] standardised the technical foundations for the use of financial data, the Legal Schema provides a foundation for 'Open Agreements'—an open source technology for digital contracting. The major milestones towards achieving this include:

- Developing the Legal Schema into a robust common standard for use in the UK with the establishment of an interdisciplinary governance group to oversee the development of UK legal schemas;

- Liaising with government departments and industry bodies to integrate with existing schemas such as the Legislation and Companies House schema, as well developing extensions to the Legal Schema for specific models and subject matter e.g. HMRC for taxation and customs related schemas; and

- Building an industry consensus for an open source technology stack with research institutions and other key stakeholders, including collaboration and involvement of existing contract technology providers.

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KEY TAKEAWAYS

- The Legal Schema is a generalised format for structured data in legal contracts. It enables contracts and other documents to be constructed to be simultaneously human-readable and machine-readable.

- Schemas can be embedded into human-readable documents using a markup language. Legal Schema Language (LSL) is a modelling language that enables schemas of any arbitrary complexity to be developed for contracts and other documents. LSL provides the machine-readable components of a digital document. The technical background to LSL is detailed further at docs.legalschema.org. The markup structure provides the human-readable component.

- New schemas can be built by extending existing types, and schemas can be published for use in any document. By extending and reusing schemas, a rich foundation of structured data for contracts, assets, and legal artefacts can be developed.

- The goal of the Legal Schema project is to develop a common, extensible, standard for the UK that will advance the adoption of digital contracts and assets. The project will be developed in conjunction with leading stakeholders and research institutions.[66]

7 | Projects

The increased use of digitization and new technologies by companies in their daily operations requires a corporate digital infrastructure that can integrate with existing and developing software based systems to streamline company administration. In recent years, a number of jurisdictions have looked to incorporate digital characteristics into their corporate governance models to accommodate this. At the same time, new forms of entity have emerged or evolved, such as foundations and decentralised autonomous organisations (DAOs) and companies.

While new forms of entity can provide many benefits, particularly in terms of their practical operation and their ability to interoperate with a company's wider technology platforms, company stakeholders, such as regulators, investors, funders and management, require confidence that basic corporate protections and accountability are maintained. The SmartCo project intends to address this by enabling existing UK corporate forms (initially a private limited company) to be operated and administered using Legal Schema. This has the dual benefit of creating a form of entity that has the required technology capabilities but which also operates within a legal and regulatory corporate framework which is understood and recognised by the market.

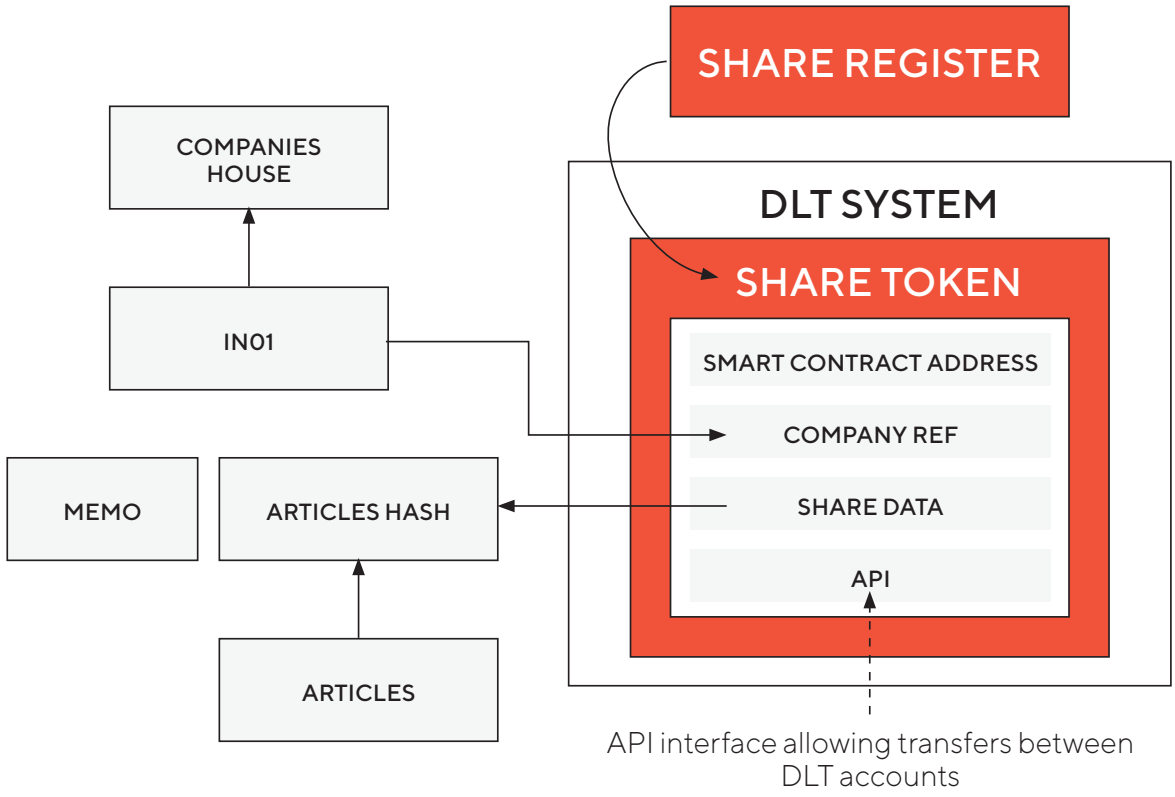
The SmartCo project provides a number of potential benefits, including:

- a digital framework to potentially automate or facilitate compliance with ongoing statutory filing and disclosure requirements;
- the ability to digitalise the upkeep and maintenance of company records and registers with the potential to improve the security of those records and accessibility thereto; and
- enabling potential interoperability with other technology platforms and products being developed. As the use of technology becomes more prevalent in company operations, this benefit will become more significant.

PHASE 1 | Incorporating a "Smart" private limited company (the "SmartCo") and creating a "Smart" share register (the "Smart Register")

The initial proposal is to demonstrate the ability to incorporate a private limited company using Legal Schema and to create a smart share register on a distributed ledger platform (the "Smart Register"). Each share held in the SmartCo will then be represented by a token that is recorded on the Smart Register. It is intended that additional features will be added in Phase 2 (see below).

FIGURE 7 | Structure of the SmartCo and Smart Register



Share Data includes:

- Unique ID – On-chain address + company reference taken from IN01 data from CH
- Share class and nominal value - link to the section in articles or the filed share class particulars which set out the rights of that class.
- Date of issue/transfer.
- Shareholder address - the recipient DLT address of the share from the on-chain contract that creates the shares
- The extent to which the shares are paid up (assume fully paid up)

a | Incorporation of SmartCo

The intention is to build on existing methods of incorporating English companies electronically at Companies House through the use of Legal Schema.[67] In so doing, the project is making use of existing legislative tools, such as Section 1068 Companies Act 2006, which gives Companies House the power to approve the form and manner of delivery of documents by electronic communication and the way in which they are authenticated in place of being signed. An API with Companies House would be used to file the Form IN01 and for a Certificate of Incorporation to be issued, at which point the SmartCo would be incorporated.

For the purposes of the initial use case, it is intended that Model Articles will be used for the SmartCo. It is intended that the use of bespoke constitutional documents will be explored as part of Phase 2.

b | Smart Register

During Phase 1, the intention is to create a register of members for the SmartCo using Legal Schema. The Smart Register will be maintained and updated on a distributed ledger platform with each share represented by a token that is recorded on the Smart Register. The intention is that this will provide a more immutable and secure record than manual documentation (and therefore is well suited to act as primae facie evidence of membership under section 127 Companies Act 2006). Although, as noted in the UKJT Legal Statement on Cryptoassets and Smart Contracts, further work may be required to enable it to be deemed the definitive record of legal rights.

In addition, it is intended that the Smart Register will ultimately provide a more efficient method for SmartCo to comply with its statutory obligations to maintain and update its register of members (as required under the Companies Act 2006, for example under sections 554 and 771) and provide significant operational benefits in removing the overheads, accuracy challenges and inefficiency inherent in current methods of share register administration. It will also, through the APIs with Companies House, have the potential to streamline required statutory filings in respect of share capital, such as confirmation statements and SH01s.

The distributed ledger platform and the tokens to be issued to the subscribers of the SmartCo will be created and the data populated as part of the incorporation process. However, they will not take effect until the Certificate of Incorporation for the relevant SmartCo is issued by Companies House and the SmartCo is incorporated.

In order to comply with company law requirements, the information contained on the Smart Register will match that required for a traditional share register. In particular, and in accordance with section 113 Companies Act 2006, it will record the following in respect of each member:

- Names and addresses
- Date on which such person was registered as a member
- Date on which such person ceased to be a member
- Number and class of shares held
- Amount paid for shares held

As such, it will contain the information required for a traditional share register but this will be represented in a digital form using Legal Schema. It will also have the capacity to be reproduced in a natural language form for access rights required under Companies Act 2006, including under sections 116 and 117.

c | Tokenised Shares

It is intended that each share issued in SmartCo will be represented by a token that is then recorded on the Smart Register. The initial tokens will be created as part of the incorporation process and activated upon the issue of a Certificate of Incorporation for the relevant SmartCo by Companies House. The ownership of that share will then be represented by its corresponding token on the Smart Register.

Each token will contain the following data:

- Unique ID – on-chain address plus company number
- Share class and nominal value – this will include a link to the relevant sections on share class rights in SmartCo's articles of association or filed share class particulars
- Date of issue/transfer
- Shareholder address – this will be the recipient DLT address
- Extent to which shares are fully paid up.

At present, it is intended that a share certificate will also be available to the relevant shareholder if required and in accordance with the Model Articles.

In the future it is intended that subsequent issues of shares will also be in token form so that the tokens recorded on the Smart Register represent the entirety of the share capital in the SmartCo and the Smart Register can operate as a definitive record of share ownership. Future issuances and share transfers will be further addressed in Phase 2 (see below) to enable them to be effected by transfer of tokens and corresponding updating of the Smart Register.

d | Initial questions to be addressed

It is intended that the incorporation process and creation of the Smart Register will mirror existing processes, save using Legal Schema and distributed ledger technology. As such, the intention is that the existing company law requirements will be accommodated within its framework.

However, a number of initial legal questions will need to be addressed, including:

- Will the operation of the Smart Register on a distributed ledger platform satisfy the requirements as to the location of the register of members (for example under section 114 Companies Act 2006 and regulation 3, The Companies (Company Records) Regulations 2008 (SI 2008/3006))?

- If the entire share capital of SmartCo is reflected on the Smart Register (and represented by the corresponding tokens) is this sufficient to ensure the integrity of any share issue and the acceptance of the Smart Register as the definitive record of ownership?

- Could a token ultimately be used as an alternative to share certificates for the SmartCo (or will a right to receive a share certificate "off chain" still be required)? In particular, will it (a) satisfy required execution formalities, such as under section 44(4) Companies Act 2006, and (b) be sufficient to provide a "certified" interest to the relevant shareholder, for example for the purposes of tax legislation?

PHASE 2 | Additional Features

For the purposes of Phase 1, the use case will demonstrate the ability to incorporate an English private limited company using Legal Schema and to issue shares in token form to be represented on the Smart Register. Once the feasibility of this use case is established, it is intended that additional features will be added to further digitalize company administration and provide further efficiencies in terms of compliance obligations and the practical administration of English companies.

Some of the areas that will be considered in Phase 2 include:

- enabling share transfers to be completed by a transfer of tokens as recorded on the Smart Register. Certain formalities will need to be considered or may need to be completed "off-chain" in the interim, such as the execution of stock transfer forms. In addition, requirements such stamping and approval requirements (such as shareholder approvals) will need to be accommodated. With regards to stamping, one possibility in the future may be that this can be completed through an API with HMRC.
- enabling filing obligations at Companies House in respect of share capital to be completed through an API with Companies House.
- providing a mechanism for complying with disclosure obligations in respect of shareholdings – for example, PSC requirements but also, potentially wider disclosure obligations, such as FCA disclosure requirements.
- enabling other company records to be represented using Legal Schema with a corresponding ability to make relevant filings in respect thereof through the API with Companies House.
- potentially providing a secure mechanism for corresponding and interacting with shareholders – for example, in respect of decision-making, meetings, and other correspondence.

The intention of the SmartCo project is to operate within the existing legal framework for English private limited companies to provide shareholders and other stakeholders with the security it provides. In so doing, it will replicate (through the Legal Schema) the required components for an incorporation of an English private company. As the project develops this will continue to be monitored and the project will liaise with the Law Commission and the relevant authorities in respect thereof.

As stated above, the basis for the incorporation process will be existing legislative tools, such as Section 1068 Companies Act 2006 and it will also build on the existing model for electronic incorporation that Companies House has developed and used in recent years.

KEY TAKEAWAYS

- The Legal Schema enables the constitutional documentation of a private company limited by shares to be formed in a data structured manner.
- Structured data enables new, increasingly efficient, forms of administration of existing processes such as company incorporation and management.
- The structured data in the corporate documents of the company can be used, in conjunction with data submitted to Companies House using the Companies House Schema during incorporation, to generate a 'Smart Register' of members for the company.
- The Smart Register will be maintained and updated on a distributed ledger platform with each share represented by a token that is recorded on the Smart Register. The Legal Schema will be used to provide the structure of data for the Smart Register.
- The SmartCo project will be extended to include other stages of a company lifecycle beyond incorporation.

Digital Documentary Intangibles

English law distinguishes between 'choses in possession' and 'choses in action'.[68] Each creates proprietary interests, distinct in the manner in which they may be enforced, and dependent on the possessory nature of the subject object. A 'chose in possession' represents rights which can be enforced or acquired through physical possession. By contrast, a 'chose in action' is a bundle of property rights capable of being assigned, sold, or held in trust that are enforceable by legal action such as debts, contractual rights, and proprietary interests over intangible objects created and recognised at law.[69]

Intangible property takes two forms: *pure* intangibles (such as intellectual property rights) and *documentary* intangibles, which are so closely identified with the obligation embodied in them that the appropriate way to perform or transfer the obligation is through the medium of the document:

> *"The abstract intangible right acquires such a degree of concretized expression that it takes on some of the characteristics of a chattel. The document recording the right it itself a tangible thing and thus a chattel, and the right is thoroughly fused with the document."*[70]

Documentary intangibles may be: (i) documents of title to money; (ii) documents of title to goods; and (iii) documents of title to negotiable securities.[71] Bills of exchange, bearer shares, promissory notes, bills of lading, certificates of deposit and depository receipts are notable examples.

Historically, the concept of possession was used to distinguish between those things that were enforceable only against a particular party, and those which were enforceable against everybody.[72] If something was a "bare right", it had no existence separate from the person with the right to enforce it. This meant that no other party could take it or benefit from it, and its presence in the world was dependent upon there being both a party and a legal system willing to recognise it. Something which a party possessed, by contrast, was something separate from any individual: parties could lay claim to it, but it would continue to exist whether they did or not, or indeed whether any law recognised such claims.

Until relatively recently, the tangible/intangible dichotomy tracked precisely the distinction between possessory and bare rights. Tangibility therefore became synonymous with the former, and intangibility with the latter. As the nature of commerce has changed, particularly with the rise of the information age, the instance and value of intangible assets has grown significantly. When most personal property was tangible in form, "tangible" was a *description* capable in its own right of discriminating between those things which had a physical existence and those which did not. It was, however, always just a description and not an *explanation* of the difference between choses in action and choses in possession. Tangible things do have a material existence, but this is not caused by their tangibility. This distinction has, however, settled as a necessary criterion for possession[73] rather than a description of a physical attribute. As such, dematerialised documents are considered incapable of possession.[74] Often, however, digitised material has features that make it, in terms of possession, more like a physical asset than a contractual right.

The general rule of possession requires exclusive physical control.[75] Digitised material, such as documents, are not so easy to categorise as being capable of possession in a *priori* way. A digital document may be capable of exclusive control but this does not necessarily follow.[76] For example, a digital document may be replicated and distributed, thereby extinguishing its capability of being subject to exclusive control. Where it is however so amenable, there is no reason to deny its amenability to possession.

The 'Smart Trade' use case set out to demonstrate the application of the Legal Schema to create and manage structured digital documents—in this case a digital bill of lading—capable of being provably subject to exclusive control.

Digital Bills of Lading

Bills of lading (B/L) are documentary intangibles issued by a carrier of goods (or their agent) and acts as: (i) a conclusive receipt of the goods;[77] (ii) a contract of carriage or evidence thereof; and (iii) a document of title to the goods.[78] The B/L is considered to symbolise the goods and its transfer leads to the transfer of the rights to the cargo, if such is the parties' intention. Thus, possession of the B/L is equivalent to possession of the goods.[79] The B/L, evidencing the contract of carriage, enables an action in contract law and also facilitates an action in the tort of conversion[80] which requires the claimant to have a proprietary right to immediate possession of the goods. With such security, the B/L can be used as a pledge of the goods in carriage by the purchaser,[81] knowing that the seller has relinquished their control of the goods.

Various initiatives are underway to transition towards paperless trade,[82] including the use of electronic B/Ls.[83] Paperless trade is predicted to contribute significantly to the reduction of trade costs and an increase in trade activity.[84] Estimates from the UN Economic and Social Commission for Asia and the Pacific (ESCAP) suggest an export increase of $36bn-$257bn annually.[85] Digital bills of lading present a number of potential benefits:

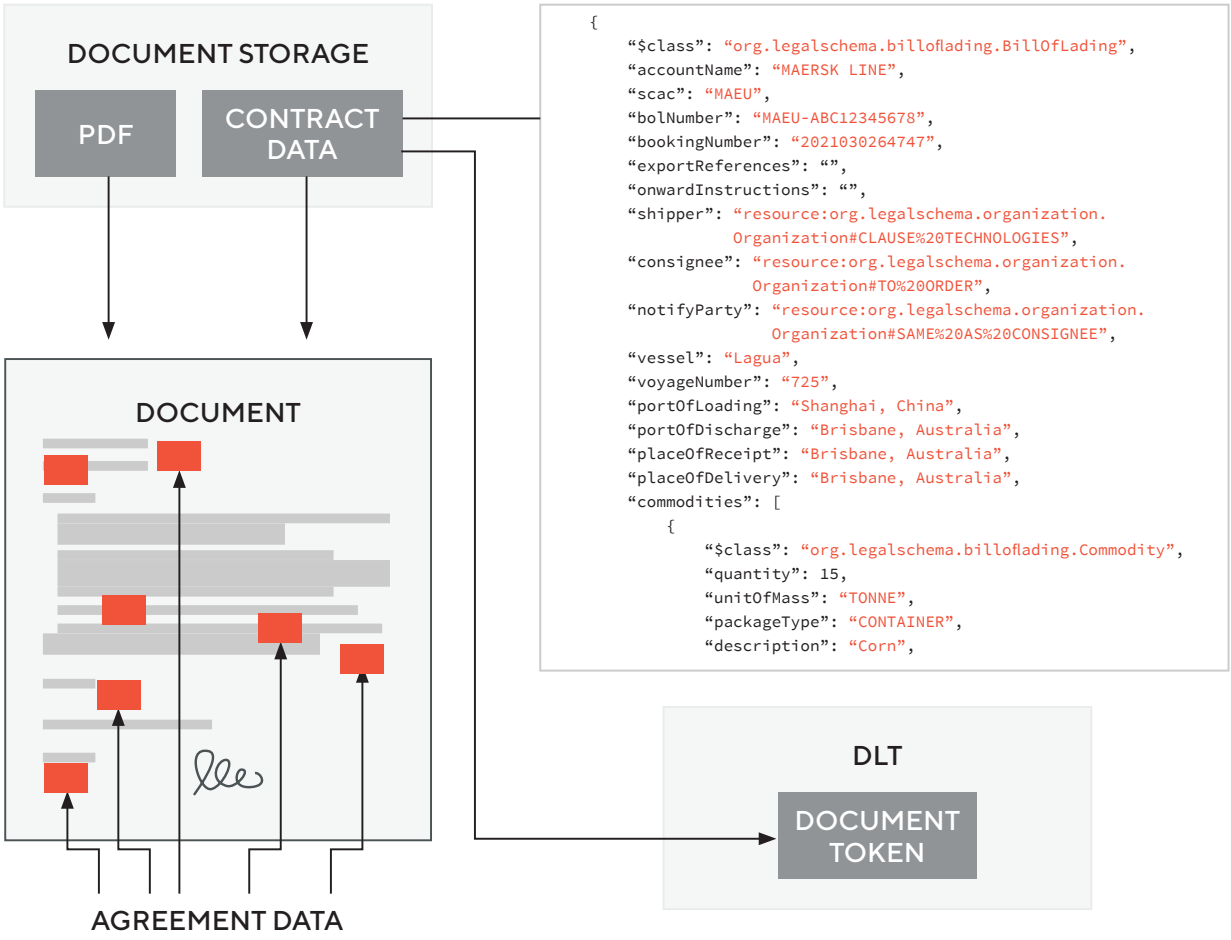
- **Reduction in exposure to fraud.** As a matter of English law, delivery against a forged bill of lading is a misdelivery and it is no defence that it was done innocently.[86]

- **Efficiency and speed.** Digitised transfer enables a B/L to pass through the international trade system and still be at the discharge port when the vessel arrives, removing the need for letters of indemnity. Paperless trade can also help businesses meet regulatory compliance obligations more efficiently and at a lower cost.[87]

- **Transparency and traceability.** Electronic data exchange can enable improved tracking of the goods declared – in some manual systems, exporters might over-declare to maximize tax recovery, while an importer might under declare to pay less import duties.[88]

Dematerialising a B/L does not, in principle, pose an issue in respect of the receipt and contractual functions.[89] As a B/L is indicative of constructive possession of the goods,[90] the issue of exclusive control does, however, present potential issues pertaining to its function as a document of title.[91] The UNCITRAL Model Law on Electronic Transferable Records 2017 (MLETR) envisages the possession requirement to be met with respect to an electronic transferable record if a reliable method is used to: "(a) establish exclusive control of that electronic transferable record by a person; and (b) identify that person as the person in control".[92] The United Kingdom has yet to implement legislation adopting the MLETR.[93] The Law Commission is undertaking a project considering law reform to allow for the digitisation of trade documentation including bills of lading.[94] The "Smart Trade" use case is developed in conjunction with the HMRC Innovation Team to demonstrate the capabilities of the Legal Schema to underpin a "Digital B/L" (DB/L)[95] capable of being exclusively controlled and therefore capable of possession.

FIGURE 8 | Digital Bill of Lading schematic



The DB/L is generated using the Legal Schema to create a machine-readable and human-readable document that replicates a tangible form of B/L. The DB/L is rendered in human-readable PDF form, much like a traditional B/L, and machine-readable form as structured data. Both are stored in a file storage medium. This storage medium may be local storage, a distributed storage medium,[96] or a hybrid of the two.[97] The structured data is then passed into a smart contract-based token on a distributed ledger network. The D/BL data includes the substantive details of the B/L along with a unique identifier (a cryptographic hash) representing the content of the data.[98] Taken together with the address of the token, this data provides a *single, unique, representation* of the D/BL capable of exclusive possession. This occurs because both the content of the D/BL and the instance of the D/BL are uniquely identifiable:

- **Content:** The data held within the D/BL is uniquely represented by the content-addressed hash of the structured data. Only the exact structured data yields the stored cryptographic hash. If the data were to change, the hash would similarly change. This ensures that the content of the DB/L cannot be tampered with.
- **Instance:** The unique content-addressed identifier is then stored within a token that is itself uniquely identified on a distributed ledger system. Taken together, the smart contract address and the structured data hash uniquely demonstrate an instance of the exact D/BL. The smart contract also includes time-stamped transactions of all events, including the creation of the D/BL.

The smart contract provides a tokenised representation of the D/BL capable of being transferred between parties on the distributed ledger system. In doing so, the D/BL can be shown to be exclusively possessed by the holder of the token that references the DB/L data. The tokenised B/L is accessible at: https://rinkeby.etherscan.io/address/0xee45b41d1ac24e9a620169994 deb22739f64f23. The B/L document in structured format can be accessed at https://templates.legalschema.org/bill-of-lading@0.1.0.html.

KEY TAKEAWAYS

- The dematerialisation of documents presents a challenge to existing legal doctrine in which possession is inextricably associated with tangibility.
- The Legal Schema enables the critical trade documentation, such as bills of lading, to be dematerialised into a structured data representation. The structured data can be used in conjunction with other technologies. The Smart Trade project demonstrates how the Legal Schema structure can be used with digital assets on a distributed ledger—in this case to exhibit exclusive control, and thus possession, of a digital documentary intangible.
- The Smart Trade project will be extended and incorporated into the HMRC Reducing Friction in Trade initiative.

8 | Future Development

Digital contracts and assets are attracting increased attention as new mechanisms for commercial coordination. The UKJT and the Law Commission have undertaken projects to establish a robust legal foundation for their application in the UK.[99] In order to utilise and build upon these foundations, there is a need for an open contracting format to drive the development, adoption, and usage of digital contracts within the UK.

To this end, the Legal Schema project will extend into a second phase of research and development to deliver this open source format together with leading UK stakeholders:

- LawtechUK and the UK Jurisdiction Taskforce;
- University of Oxford; and
- University College London.

The second phase aims to include the development of research reports and the creation of a series of sub-projects, including the further development of the two detailed herein. The future development of the UKLS is intended to set the foundations for an 'Open Agreements' framework for digital contracting in the UK. Such a framework will provide a universal specification and technical framework for developing and using structured contractual data to:

- enable all contracting parties to utilise a single modeling language and ontological basis for contract data; thereby ensuring that contracts between parties 'speak the same machine-readable' language just like JSON and can be used by each contracting party in their own software systems that support the common contract data standard; and

- foster innovation in lawtech, and specifically contract technology, such as markup languages, APIs, cryptoasset systems, artificial intelligence, contract analytics and similar software tools and products.

Annex:
Introduction to the UKLS

1 | Introduction

This whitepaper accompanies the publication of the open source code[100] and accompanying documentation for a UK Legal Schema. The purpose of which is to provide both the core technology to create digital contracts using a common language and standard, much like schema.org does for webpages. The Legal Schema can be accessed at legalschema.org.

The Legal Schema, in its current form, consists of three main components:

- **Legal Schema Language (LSL):** A language to build legal schemas[101] along with a markup reference language for embedding LSL defined schema data into the document text to create digital contracts and other structured legal documents.
- **Conversion Framework:** A code library that transforms documents using the LSL into other document formats, including PDF, HTML, and DOCX.
- **Schemas:** An initial set of readily defined schemas developed using LSL to build digital contracts and other documents. The examples below demonstrate some of these schemas.

The following annex serves the purpose of introducing the basic technical background to the UK Legal Schema.

2 | Schemas and Structured Data

Schemas are a formal description of the structure of data. A schema provides documents with common, well defined, and well understood, formats. A schema may be seen as analogous to the grammar of a language – the vocabulary and system of constraints for forming a valid, meaningful, structure with that vocabulary. The result is to provide documentation that is both human-readable and machine-processable. A schema language is used to:

> (i) define constructs for 'types' of objects – the elements and attributes in a vocabulary and to associated 'data types' (e.g. 'price' must be a floating point number) with values (e.g. £100.00) in documents; and
> (ii) constrain relationships between data types, define where objects can Pappear, and define properties describing those objects. Structured hierarchies can be built (e.g. 'Thing'[102] ⊶ 'House') with each object having their own properties.[103] For example, a house must have an address. An address may itself be defined as having a street, each street must be in a town or city, and each

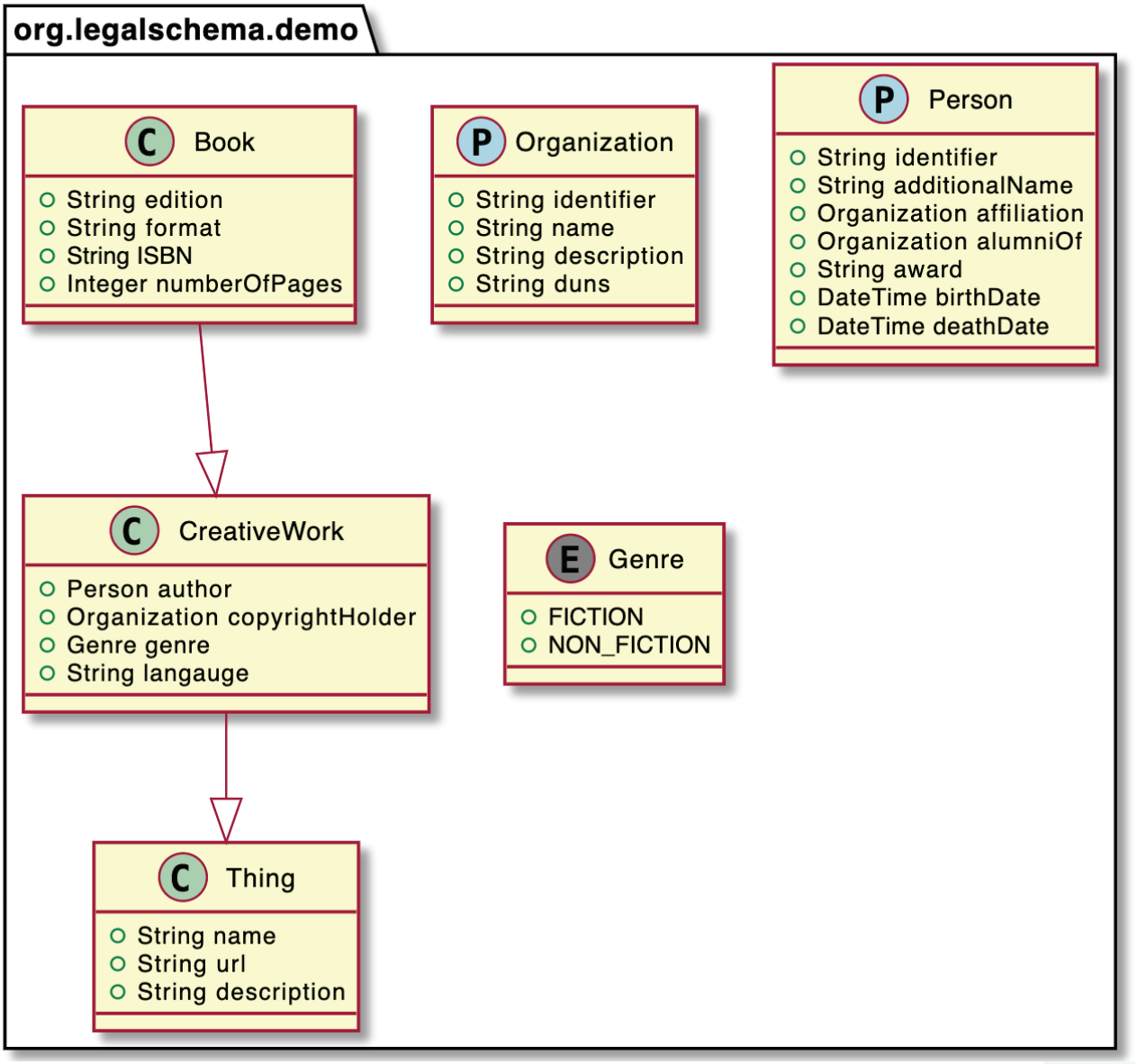
town or city must have an associated postal code. Constraints as to the type of data (the data type) that each property may store can be defined. For example, a street address must be text.[104] A data type helps to ensure that the data that is stored within the structure corresponds to a valid attribute for that data (e.g. that a telephone number is numeric, not alphanumeric).

As a simple example, a schema may be used to document the attributes of a person[105] in a structured form:

```
{
  "firstName": "William",
  "lastName": "Blackstone",
  "isAlive": false,
  "age": 56,
  "address": {
    "streetAddress": "55 Lincoln's Inn Fields",
    "city": "London",
    "postalCode": "WC2A 3PF"
  },
  "children": "8",
  "spouse": {
      "firstName": "Sarah",
      "lastName": "Clitherow"
    }
  ],
}
```

Schemas are used to model domains. A domain may be any specified sphere of activity or knowledge, and can be general or specific in nature. The purpose of schemas is to create open standards for expressing document data, which in turn facilitates interoperability and promotes universality. Schema.org is an example of a foundational domain schema to define and describe core types, such as an event,[106] organisation,[107] person,[108] place,[109] product,[110] and many more. It was devised to create and maintain common schemas for structured data on the internet so that search engines can understand the contents of web pages.[111] Domain extensions to schema.org[112] and other independent schemas for specific domains, such as the GS1 Web Vocabulary standard for describing products, such as clothing[113] and footwear[114] to fruit and vegetables.[115] Similar systems are used for commercial data such as the Electronic Data Interchange (EDI) format.[116]

FIGURE 9 | An example schema data type



The bibliographic data[117] schema may be used to describe a book in structured form. A 'Book' is a 'CreativeWork' which itself is a 'Thing'. The Book is described used properties from a 'Book'[118] type, from a 'CreativeWork'[119] type, and the most generic, 'Thing'[120] type. The former describes properties unique to a book, such as it's edition, format, ISBN, and number of pages. The 'CreativeWork' type describes properties of creative works such as author details, copyright holders, genre, language. The latter describes more generic attributes that are not unique to creative works or books, such as a name, web address, descriptions, etc.

Common examples of widely used schema languages include JSON Schema[121] and XML Schema.[122] Both define how a JSON[123] or XML[124] document must look, ways to extract data from it, as well as ways to interact with it. These technologies are used by many of the applications and services online, often without the user realising through exposure to their operation or even their existence. Google Search uses structured data in JSON using schema.org[125] to provide information about a page and classifying the page content.[126] For example, on a recipe page, details about the ingredients, the cooking time and temperature, calorific values, and other such data.[127] Structuring the data in this way enables users to search for specific pages (e.g. recipes as opposed to travel guides or restaurants) and specific elements (e.g. ingredients) across recipes. Legislation in the UK is structured in a form of XML using 'Legislation Schema'.[128] For example, the Video Recordings Act 2010 can be accessed online at http://www.legislation.gov.uk/ukpga/2010/1 and the underlying structured data using the Legislation Schema via the Legislation API by adding /data.xml at the end. The same structured data can be viewed in PDF by adding /data.pdf.

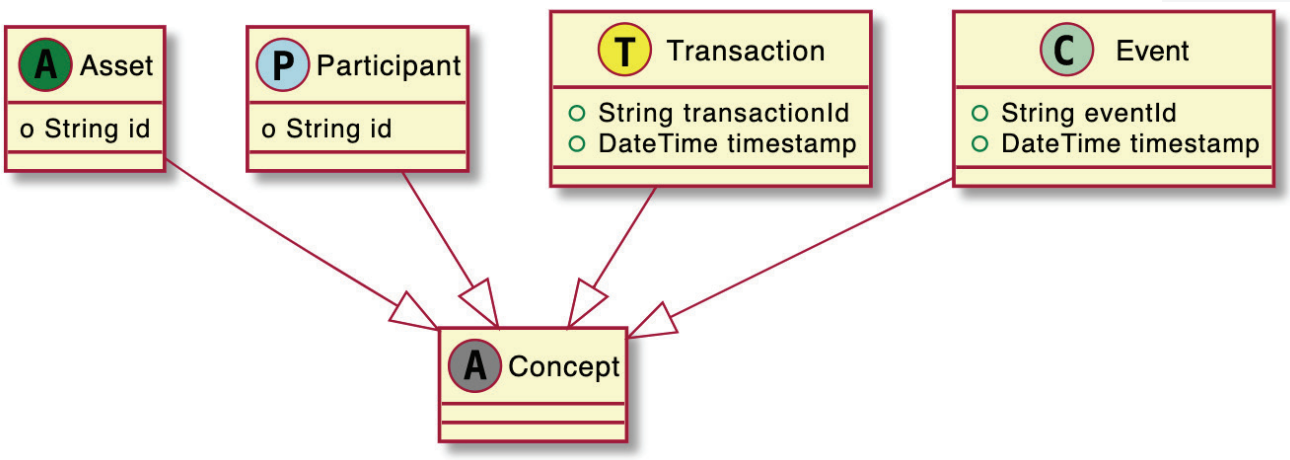
3 | A Legal Schema

JSON and XML documents and their associated schema systems are devised for software development environments where data structure and validity is critical. As discussed above, other document types, like contracts, may benefit immensely from schema systems to structure and validate data contained within them.

The Legal Schema defines base types that are used to describe and define each type within the schema system; each of which represents a legally relevant construct:

- **Concepts** – to describe an abstract entity or 'thing' within a contract (e.g. a trade mark number registered at the UK Intellectual Property Office or a company number at Companies House).
- **Assets** – to define property or other contractual subject matter within a contract (e.g. an instrument, chattel, real property, etc.) and the associated identifying properties, such as the VIN of a vehicle or the legal description of land.
- **Participants** – to describe contracting parties and other identifiable entities within a contract (e.g. the details of a company, an agent, auditor, beneficial owner).
- **Transactions** – to describe events that occur within a contract, such as the transfer of an ownership interest of an asset from one contracting party (a participant) to another.
- **Events** – to describe abstract legal events such as an obligation generated by a contract (e.g. an obligation to pay upon receipt of legal title to an asset).

FIGURE 10 | Relationships between types in the Legal Schema



By using such a system, it becomes possible to build up arbitrary complex data structures that represent contracts and other legal documents not simply as text, but as rich data.

A digital contract may, in many ways, be viewed as analogous to a web page. A web page is itself a document – one designed to be displayed in a web browser as opposed to a desktop word processing application. It typically consists of: (i) a markup language e.g. Hypertext Markup Language (HTML) that describes the semantic structure of the web page document;[129] (ii) a presentation language e.g. Cascading Style Sheets (CSS) that describes the style (e.g. fonts, colours, and spacing) of the markup document;[130] and (iii) scripting or programming languages, such as Javascript, that adds functionality to web pages, transforming a web page document into a dynamic, interactive, document. The schema provides descriptive structure to the content of the webpage. For example, the markup of a web page for a movie can utilise the 'Movie schema'[131] to structure the data within the document by structuring the HTML to describe the name, director, genre, and trailer information about the movie:

FIGURE 11 | Schema data embedded within HTML

```
<div itemscope itemtype =”http://schema.org/Movie”>
  <h1 itemprop=”name”>Avatar</h1>
  <span>Director: <span itemprop=”director”>James Cameron</span>
                  (born August 16, 1954)</span>
  <span itemprop=”genre”>Science fiction</span>
  <a href=”../movies/avatar-theatrical-trailer.html”
  itemprop=”trailer”>Trailer</a>
</div>[132]
```

By comparison, the components of a digital contract may consist of equivalents devised for contractual documents as opposed to web pages. Instead of HTML, a markup language can be used to specify the structure of the contract document, for example, that a particular element within the document is a clause:

FIGURE 12A | Formatting using a markup language

```
{{#clause clauseName}}
Upon the signing of this Agreement, Alice shall pay 100.00 GBP to Bob.
{{/clause}}
```

The textual content of the clause can be structured using a legal markup language . This enables the text to be formatted appropriately using bold, italics, paragraphs, heading structures, lists, quotes, links and other formatting methods.[134]

Schemas built using the LSL can be embedded within the markup language to provide structure to the legal content. This is the functional equivalent of schema types being embedded within HTML (Figure 9). Schemas can be embedded using parameters within the natural language text of the contract document. For example:

FIGURE 12B | Schema-based parameters within markup

```
Upon the signing of this Agreement, {{buyer}} shall pay {{amount}} to
{{seller}}.
```

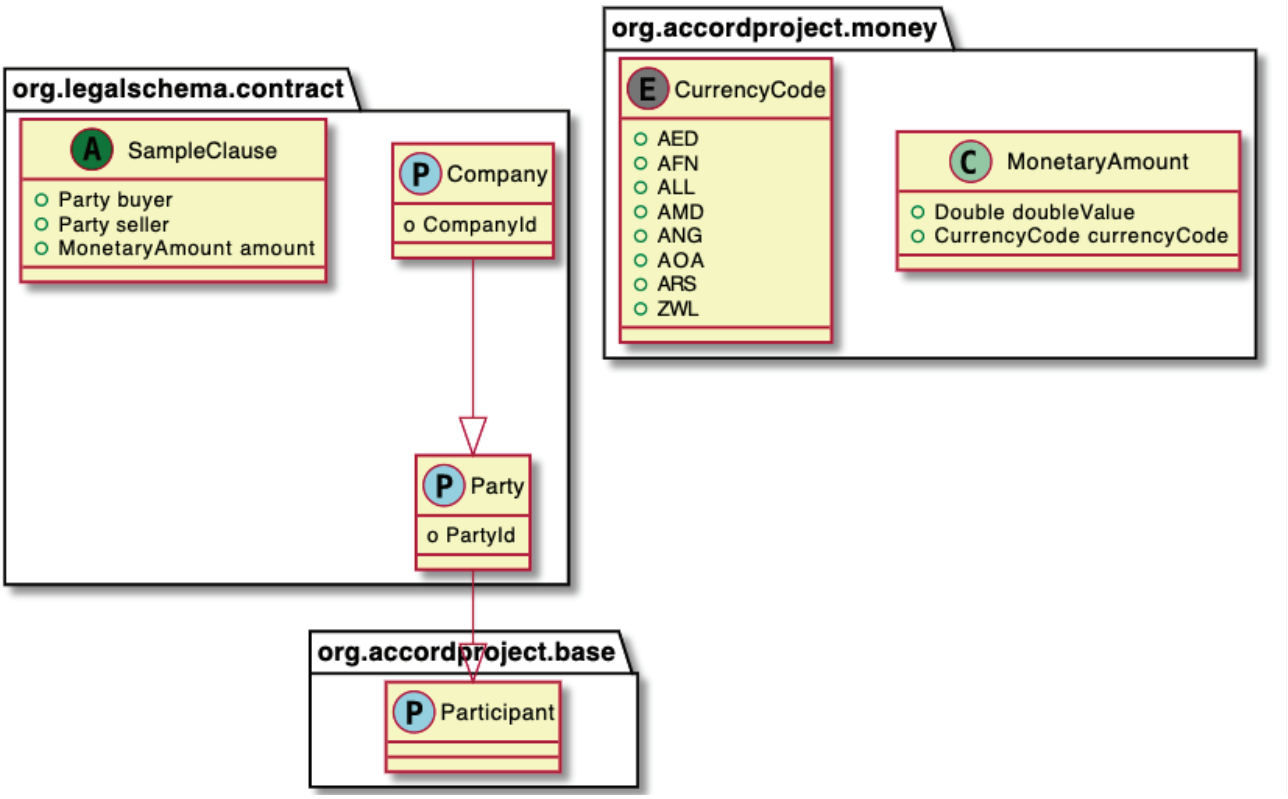
A machine can understand that in this snippet there are two parties and a payment amount because of this underlying schematic structure:

- **Buyer**: The 'buyer' parameter is named as such data structure for this particular contract. It is of a 'Party' type (inherited from the 'Contract' schema which defines the types that comprise a 'Contract' type). The Party type has a property – 'partyID' – which is a 'string' data type, meaning that it is represented as text and holds the value we wish to assign to the 'buyer' parameter, typically the name of the buyer. The Party type is of the 'Participant' type, inherited from the base types as aforementioned. The buyer can therefore be said to be a Participant and, more specifically, a Party, to the contract. To demonstrate the expressiveness of a legal schema, in this example the 'Party' type is extended further by defining the 'buyer' to be a legal person (e.g. a company).

- **Seller:** The 'seller' parameter has the same schematic structure as the 'buyer', just named differently to indicate the distinction and role that Party holds in the contractual data structure.

The three parameters highlighted above are syntactically distinguished from the accompanying text by the use of curly braces. The parameters are placeholders for data values (e.g. 'Alice' as the 'buyer' and 'Bob' as the 'seller'). The parameters, taken together, represent the data structure for this simple example:

FIGURE 12C | Relationships between types in the Legal Schema



The aforementioned data structure can itself be expressed as a 'Contract' type (a 'Concept' base type). The result is that this gives us a data structure, identifiable as a 'Contract' wherein the data is organised in accordance with the various schemas used to define the content of the contract. As such, the aforementioned snippet can represent a contract wherein the text reads:

```
Upon the signing of this Agreement, Alice shall pay 100.00 GBP to Bob.
```

and through use of the Legal Schema, represents the contract in a structured data form[135] that is both: (i) human-readable - as we know through use of the schema types how to interpret the structure and the associated values; and (ii) machine-readable - such that it can be interpreted and used in a form that is understandable by computers:

FIGURE 12D | Structured contract data with Legal Schema types highlighted

```
{
    “$class”: “org.legalschema.ExampleContract”,
    “contractId”: “1f3a4329-6a99-4c2d-86b5-febe0815823a”,
    “buyer”: {
        “$class”: “org.legalschema.contract.Party”,
        “partyId”: “Alice”
    },
    “seller”: {
        “$class”: “org.legalschema.contract.Party”,
        “partyId”: “Bob”
    },
    “amount”: {
        “$class”: “org.legalschema.money.MonetaryAmount”,
        “Value”: 100.00,
        “currencyCode”: “GBP”
    }
```

The data structure tells us that the aforementioned snippet is a contract with an identifier. It has three parameters that define the buyer, seller, and amount. Each of which is of their respective type, and with values expressed as properties of those types.

It is important to note that the latter is not intended to replace the former. They operate as two representations of the same content (i.e. the contract). To reprise the web page analogy, the former is analogous to the content displayed to the user through the browser, and the latter is analogous to the HTML that represents the structure of the page being displayed.

For further detail, a full working technical specification is available at docs.legalschema.org with the initial schema models discussed in this paper.

Notes

1 https://technation.io/lawtechukpanel

2 https://technation.io/lawtechukpanel/#statement

3 https://www.lawcom.gov.uk/project/smart-contracts

4 https://www.lawcom.gov.uk/project/digital-assets

5 See *AA v Persons Unknown* [2019] EWHC 2556 (Comm).

6 Extension of www.github.com/accordproject

7 https://www.gov.uk/government/publications/uk-national-data-strategy/national-data-strategy

8 "'Open access' requires the information to be described and classified in a uniform and organized way so that content is structured into meaningful elements that can be read and understood by software applications, so that the content is made "machine readable" and more sophisticated applications than on-screen display are made possible". See Akoma Ntoso-UN Project for XML in Parliamentary, Legislative and Judiciary Documents: http://www.akomantoso.org.

9 H. Surden, *Computable Contracts* (2012-2013) 46 U.C.D. L. Rev. 629; J.G. Allen, *Wrapped and Stacked: 'Smart Contracts' and the Interaction of Natural and Formal Languages* (2018) 14(4) European Review of Contract Law 307; H. Haapio et al., 'Contract Continuum: From Text to Images, Comics, and Code' in E. Schweighofer *et al*. (eds.), *Trends and Communities of Legal Informatics.* Proceedings of the 20th International Legal Informatics Symposium 2017. Available at http://dx.doi.org/10.2139/ssrn.2928604.

10 https://blog.iaccm.com/commitment-matters-tim-cummins-blog/the-cost-of-a-contract

11 For example: https://www.thecodinglawyer.com/what-is-the-deal-with-structured-data-and-why- should-firms-care

12 Notable exceptions include efforts on legislation and regulation (http://www.akomantoso.org; https://www.legislation.gov.uk/developer/formats/xml; https://xml.house.gov; https://www.regulatorygenome.com); derivatives (https://www.isda.org/a/z8AEE/ISDA-CDM- Factsheet.pdf), and companies registers (http://xmlgw.companieshouse.gov.uk/SchemaStatus).

13 See S. Abiteboul et al., *Data on the Web: From Relations to Semistructured Data and XML* (Morgan Kaufmann, 1999).

14 By way of API, for example: http://spec.openapis.org/oas/v3.1.0.

15 See https://developers.google.com/search/docs/guides/intro-structured-data

16 A. Gandomi and M. Haider, *Beyond the Hype: Big Data Concepts, Methods, and Analytics* (2015) 35(2) International Journal of Information Management 137.

17 On occasions, the term is also used to defer to a subset of digitally or electronically signed contracts.

18 See UKJT (n.2), [24]-[34]; Financial Conduct Authority PS19/22. Available at https://www.fca.org.uk/publication/policy/ ps19-22.pdf; https://www.jbs.cam.ac.uk/wp-content/ uploads/2020/08/2019-04-ccaf-global-cryptoasset-regulatory-landscape-study.pdf.

19 HM Treasury, FCA, and Bank of England, *Cryptoassets Taskforce: Final Report* (October 2018), p.11. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads / attachment_data/file/752070/cryptoassets_taskforce_final_report_final_web.pdf.

20 *Ibid*., p.21.

21 See *Ibid*., p.21-25; 31-32.

22 See UKJT (n.2), [135]-[167].

23 UKJT (n.2), [137-141].

24 See UKJT (n.2), [141].

25 See Allen (n.9); UKJT (n.2), [143]-[144].

26 For a brief overview see R. Dale, *Law and Word Order: NLP in Legal Tech* (2018) 25(1) Natural Language Engineering 211.

27 https://www.json.org/json-en.html; https://www.ecma-international.org/publications-and-standards/standards/ecma-404

28 https://www.w3.org/XML.

29 Effectively, Application Programming Interfaces (APIs). See n.13.

30 See p.29-p.40

31 https://coinmarketcap.com (accessed 14/04/2021).

32 P. Raj, *Empowering digital twins with blockchain (2021)* 121 Advances in Computers 267.

33 For an introduction to HTML see https://html.spec.whatwg.org/#a-quick-introduction-to-html

34 For an introduction to CSS and HTML see https://www.w3.org/Style/Examples/011/firstcss

35 For an overview see J. Cummins and C. Clack, *Transforming Commercial Contracts through Computable Contracting* (2020) arXiv:2003.10400.

36 See n.33.

37 http://www.w3.org/Math.

38 https://www.markdownguide.org

39 https://schema.org/event

40 https://schema.org/organization

41 https://schema.org/person

42 https://schema.org/place

43 https://schema.org/product

44 For a general overview see: http://bid.ub.edu/en/34/sule.htm. Schema.org represents the schema data in JSON-LD (https://json-ld.org), HTML Microdata (https://www.w3.org/TR/microdata), and RDFa (https://www.w3.org/TR/rdfa-primer) formats.

45 https://www.gov.uk/government/collections/open-standards-for-government-data-and-technology; https://www.w3.org/TR/gov-data.

46 https://www.legislation.gov.uk/developer/formats/xml; https://www.legislation.gov.uk/schema/legislation.xsd. For background see: https://www.nationalarchives.gov.uk/about/freedom-of-information/information-requests/developer-user-documentation-in-relation-to-the-legislation-gov-uk-api. For background see: https://blog.law.cornell.edu/voxpop/tag/crown-legislation-markup-language.

47 http://xmlgw.companieshouse.gov.uk/SchemaStatus

48 http://resources.companieshouse.gov.uk/toolsToHelp/efilingfaq.shtml

49 For technical details on the ISDA Common Domain Model see: https://docs.rosetta-technology.io/cdm/index.html.

50 International Securities Lending Association, Legal Clause Library & Legal Data Standards White Paper (February 2021). Available at: https://www.islaemea.org/wp-content/uploads/2021/02/D2LT-ISLA_Legal_Clause_Library_Legal_ Data_Standards_White_Paper.pdf

51 *Ibid.*, 10.

52 See CLML (n.46) and Companies House (n.47).

53 See ISDA (n. 49).

54 See Cummins and Clack (n.35).

55 See Section 6.

56 http://www.github.com/legalschema

57 See (3) below for details on the specifics on the language for building legal schemas.

58 www.github.com/legalschema/template-transformation

59 http://schemas.legalschema.org

60 For further detail on the structure of types and models see Annex.

61 https://models.accordproject.org/cicero/contract.html

62 https://models.accordproject.org/money@0.2.0.html

63 See Annex.

64 https://schema.org/docs/faq.html

65 https://www.openbanking.org.uk

66 Section 8.

67 See https://schemas.legalschema.org/companies_house/company_details.html

68 See M. Bridge, *Personal Property Law* (4th ed.) (Oxford: OUP, 2015), chs. 1 and 7.

69 *Re Bank of Credit and Commerce International SA (No 8) [1998]* AC 214.

70 Bridge (n.68), 19.

71 On documentary intangibles and negotiable instruments generally: M. Smith and N. Leslie, *The Law of Assignment* (3rd ed.) (Oxford: OUP, 2018), ch. 9.

72 D.R. Harris, 'The Concept of Possession in English Law' in A. Guest (ed.), *Oxford Essays in Jurisprudence* (Oxford: OUP, 1961).

73 UKJT (n.2), [114]; Smith and Leslie (n. 71), para 2.79: "[I]n the case of documentary intangibles, the document is essential to the right, and it is the transfer of the document that is critical to the transfer of the right."

74 UKJT (n.2), [116]; Smith and Leslie (n. 71), para. 32.49.

75 See L. Rostill, *Possession, Relative Title, and Ownership in English Law* (OUP: Oxford, 2021), 16-19; *Fairstar Heavy Transport NV v Adkins* [2013] EWCA Civ 886.

76 See s.9-105 of the Uniform Commercial Code (UCC) which sets forth the relevant standard for 'control' over electronic chattel paper: "[A] secured party has control of electronic chattel paper if a system employed for evidencing the transfer of interests in the chattel paper reliably establishes the secured party as the person to which the chattel paper was assigned". This "leaves to the marketplace the development of systems and procedures, through a combination of suitable technologies and business practices, for dealing with control of electronic chattel paper in a commercial context".

77 s.4 Carriage of Goods By Sea Act 1992.

78 s.2 Carriage of Goods By Sea Act 1992.

79 See C. Debattista, Bills of Lading in Export Trade (Bloomsbury: London, 2009) p.26-27.

80 See S. Green and J. Randall, The Tort of Conversion (Hart: Oxford, 2009), ch. 3; *Sang Stone Hamoon Jonoub Co Ltd v Baoyue Shipping Co Ltd (Bao Yue)* [2015] EWHC 2288 (Comm); *Sze Hai Tong Bank v Rambler Cycle* [1959] AC 576 per Lord Denning.

81 By being delivered to a creditor as security for a debt raised, for example, to finance the goods.

82 United Nations Center for Trade Facilitation and Electronic Business, *A Roadmap Towards Paperless Trade* ECE/TRADE/371 (2006); World Economic Forum/UNECE White Paper, *Paperless Trading: How Does It Impact the Trade System?* (2017) Available at: http://www3.weforum.org/docs/WEF_36073_Paperless_Trading_How_Does_It_Impact_the_Trade_System.pdf

83 DCSA (https://dcsa.org/standards/ebill-of-lading); TradeLens eBL (https://www.tradelens.com/marketplace/tradelens-ebl); Bolero (https://www.bolero.net/carriers-electronic-bills-of-lading/).

84 World Economic Forum/UNECE (n.79).

85 https://www.unescap.org/sites/default/files/Benefits%20of%20Cross-Border%20Paperless%20Trade.pdf

86 *Motis Exports Ltd v Dampskibsselskabet Af 1912 Akleselskab ('the Motis')* [2000] 1 Lloyd's Rep 211 at 217 per Mance LJ; *Transpacific Eternity SA v Kanematsu Corporation and another* [2002] 1 Lloyd's Rep 233.

87 See n.82.

88 *Ibid*.

89 See J.F. Wilson, Carriage of Goods by Sea (7th ed.) (Pearson: London, 2010), 166.

90 *Barber v Meyerstein* (1870) LR 4 HL 317. For historical background of bills of lading and the issue of possession see M.D. Boals, *The Bill of Lading* (LLP: London, 1997), ch. 7 and Aikens et al., *Bills of Lading* (2nd ed.) (Informa: London, 2016), ch. 1.

91 As the law currently stands, only physical documents may be documents of title (n.70 and n.73). To circumvent this, parties may often provide in their contracts that certain electronic documents shall be treated, as between the parties, as documents of title.

92 Art.11.

93 As an example see Singapore's Electronic Transactions Act (Amendment) Bill.

94 See n.4.

95 Envisaged and permitted by s.1(5) Carriage of Goods By Sea Act 1992.

96 See https://ipfs.io

97 For example, the PDF stored locally and the structured data stored in a distributed system.

98 https://docs.ipfs.io/concepts/content-addressing

99 See n.2-n.4

100 http://www.github.com/legalschema

101 See (3) below for details on the specifics on the language for building legal schemas.

102 A 'Thing', as a broadest possible item, may also be intangible, see https://schema.org/intangible.

103 The hierarchical structure may be of any arbitrary complexity. See, for example, the schema.org hierarchy for a 'House' (Thing > Place > Accommodation > House) and the defined properties of each object type.

104 See https://schema.org/streetaddress

105 For a detailed person type see: https://schema.org/person

106 https://schema.org/event

107 https://schema.org/organization

108 https://schema.org/person

109 https://schema.org/place

110 https://schema.org/product

111 For a general overview see: http://bid.ub.edu/en/34/sule.htm.

112 Such as health and life sciences: https://schema.org/docs/health-lifesci.home.html and bibliographic data: https://schema.org/docs/bib.home.html.

113 https://www.gs1.org/voc/Clothing

114 https://www.gs1.org/voc/Footwear

115 https://www.gs1.org/voc/FruitsVegetables

116 Many EDI standards exist, including: UN/EDIFACT (https://unece.org/trade/uncefact/introducing-unedifact); ASC X12 (https://x12.org) and domain specific derivatives such as SCRIPT for US medical prescriptions (https://standards.ncpdp.org/Access-to-Standards.aspx); and GS1 EDI standards for global supply chains (https://www.gs1.org/standards/edi).

117 https://www.w3.org/community/schemabibex/wiki/Bib.schema.org-1.0

118 https://schema.org/Book

119 https://schema.org/CreativeWork

120 https://schema.org/Thing

121 The example above is represented in JSON.

122 https://www.w3.org/standards/xml/schema

123 https://www.ecma-international.org/publications-and-standards/standards/ecma-404/

124 https://www.w3.org/TR/xml/

125 https://developers.google.com/search/docs/guides/intro-structured-data. Google Search uses a derivative called JSON-LD: https://json-ld.org.

126 Schema.org was established to standardise data for webpages by leading search engine providers, including Google: https://schema.org/docs/about.html

127 https://developers.google.com/search/docs/guides/intro-structured-data.

128 https://www.legislation.gov.uk/developer/formats/xml; https://www.legislation.gov.uk/schema/legislation.xsd. For legislation metadata, see: https://www.legislation.gov.uk/schema/schemaLegislationMetadata.xsd

129 See n.32

130 See n.33

131 https://schema.org/Movie

132 https://schema.org/docs/gs.html#schemaorg

133 See for example: https://docs.accordproject.org/docs/markup-ciceromark.html.

134 https://commonmark.org/help

135 JSON in this example, although capable of being converted into other formats such as DOCX, PDF, HTML: https://github.com/legalschema/template-transformation.

www.legalschema.org