Data Governance using Blockchain
Literature Review

INFM 600 Project Team 3

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Scope and Methodology

To identify literature for our final project, we conducted searches on the University of Maryland, College Park's University Libraries website as well as on the internet. To perform our searches, we used a combination of the following keywords: *data governance*; *blockchain*; *smart contracts*; *intellectual property licensing and payments*; and *social entrepreneurship*. Our searches identified 17 resources that discussed a combination of the topics previously discussed. Below is a summary of the resources identified:

Source Type	**Count**
Peer-Review Journal Articles; Conference Proceedings; Law Review Articles	14
Website Articles and Technical Guidance	2
Books	1
Total	17

To identify relevant literature, we read information in the resources to further analyze the content. As a result, we determined 12 of the 17 resources to be relevant. Below is a summary of the resources by topics:

Topic	**Count**
Data Governance and Blockchain	4
Smart Contracts	3
Intellectual Property Licensing and Payments	2
Smart Contract; Intellectual Property Licensing and Payments	1
Social Entrepreneurship	2
Total	12

Below is a summary of topics discussed.

Data Governance and Blockchain

Lumineau, et al. (2021) outlined the fundamental features of blockchains and presented an analysis with a focus on their role as governance mechanisms. They argue that blockchains offer a way to enforce agreements and achieve cooperation and coordination that is distinct from both traditional contractual and relational governance as well as from other information technology solutions. They also examined the scope of blockchains as efficient governance mechanisms.

They discussed how blockchain governance interacts with traditional governance mechanisms in both substitutive and complementary ways. They focused on blockchains' social implications as well as their inherent challenges and limitations. Their analysis culminated with a research agenda that explored how blockchains may change the way to organize collaborations. This includes issues of:

- What different types of blockchains may emerge;
- Who is involved and impacted by blockchain governance;
- Why actors may want blockchains; and
- When and where blockchains can be more (versus less) effective, and how blockchains influence a number of important organizational outcomes.

Teperdjian (2020) provided an overview of blockchain technology that distinguishes between the variety of centralized and decentralized data governance models. They concluded that blockchains fit into the two categories of centralized and decentralized data governance models. This is because both permissioned, private, as well as permissionless, public, blockchains exist which fit into both models of centralized and decentralized data governance. In centralized and decentralized blockchains, different rules exist with different freedoms to each user(s). In a centralized data governance model, all of the information and data of the blockchain can be controlled by one person. In a decentralized data governance model, everyone only has information that pertains to them.

Smith (2019) noted that blockchains are data governance platforms by default. The sequence of events that brought the data into its current state is embedded into the data itself, and any participant may validate that sequence and refuse to engage further with invalid data. Additionally, because blockchain networks are organized around cooperating peer organizations, they can be a natural fit in situations where data governance requirements are truly a mutually-beneficial and cooperative endeavor between business units, or when the regulatory body that controls how the data is used is separate from the organization producing the data.

They stated that a blockchain system might be indicated when all three of the following are true:

1. The problem involves a consortium of cooperating organizational units, where the data needs to be moved and operated upon across organizational lines;
2. The history of data needs to be tracked and each change tied to its author, along with the capability to "roll back" data records to some previous state; and
3. At least one additional pattern from the last section is needed.

Furthermore, they stated a blockchain system should perhaps not be the first choice in the following situations:

1. Latency is paramount;
2. Storage is at a premium;
3. Sensitive data needs to be forgotten;
4. Network governance could break down; and
5. A single organization controls the data ecosystem.

Li, et al. (2019) discussed the application of blockchain technology, the existing regulatory problems and security problems. They concluded that blockchain is a decentralized core architecture, which is widely used in emerging digital encryption currencies. Blockchain technology has the characteristics of centralization, block data, no tampering and trust. As a result, it is sought after by enterprises.

Smart Contracts

Bashir (2018) discussed the history and definition of smart contracts, Ricardian contracts, Oracles, and the theoretical aspects of smart contracts. They noted that smart contracts are automated, autonomous programs that reside on a blockchain network and encapsulate the business logic and code needed to execute a required function when certain conditions are met. They can be programmed to perform any actions that blockchain users need and according to their specific business requirements. They have four properties:

1. They are automatically executable;
2. They are enforceable;
3. They are semantically sound; and
4. They are secure and unstoppable.

Smart contracts are a revolutionary feature of blockchain technology as it provides flexibility, speed, security, and automation for real-world scenarios that can lead to a completely trustworthy system with significant cost reductions.

Gürkaynak, et. al (2018) stated that the primary function of smart contracts is to automate the execution of contracts. The software incorporates the obligations of the parties, and if certain requirements defined by the parties are met (e.g., time of execution, specific currency rate, registration of an IP right, etc.), then a smart contract performs the ensuing obligation, such as the licensing of an IP right or the transfer of property, money or any other asset. By creating a smart contract, the parties to the contract no longer have to trust the other party not to breach their obligations under the terms of the contract. Nor do they have to depend on an intermediary party, such as a bank or a governmental body, to create trust or enforce the rules of the contract. With smart contracts, parties can trust the smart contract itself and rely on the immutability and verifiability of the underlying blockchain technology. Once the terms of the contract are agreed upon, the parties express their mutual understanding in the form of a smart contract code, which is triggered by digitally signed, blockchain-based transactions. Once the code in the smart contract is triggered and execution of the contract begins, it cannot be stopped unless the parties have previously agreed on a mechanism in the smart contract concerning this function.

They noted a future example, where one might have to pay a fee (in accordance with the smart contract located on the blockchain) to play a song on a device prior to playing it. In that scenario, the smart contract would check the balance of the account of the licensee before each play, and if the account balance is not sufficient to pay for the price of a single play, the smart

contract would automatically choose not to execute the license obligation. It would thus prevent the user from playing the song (otherwise, it would deduct the amount of the fee from the licensee's account and then play the song). They added that an example of such a blockchain system already exists: Choon, a music streaming service and digital payments ecosystem that aims (more or less) to provide the aforementioned services.

Khan, et. al (2021) provided a comprehensive survey of blockchain-enabled smart contracts from both technical and usage points of view. They presented a taxonomy of existing blockchain-enabled smart contract solutions, categorized research papers, and discussed existing smart contract-based studies. Based on the findings from their survey, they identified a set of challenges and open issues that need to be addressed in future studies. They also identified future trends.

They noted that in recent years, the rapid development of blockchain technology and cryptocurrencies has influenced the financial industry by creating a new crypto-economy. Next-generation decentralized applications without involving a trusted third-party have emerged thanks to the appearance of smart contracts. Despite the bright side of smart contracts, they stated several concerns continue to undermine their adoption, such as security threats, vulnerabilities, and legal issues. Challenges and open issues also included reliance on “off-chain” resources, immutability, scalability, and a consensus mechanism.

Lastly, Solidity technical guidance provided two examples for a simple smart contract: (1) a storage example; and (2) a subcurrency example. This technical guidance also described the basic concepts of blockchain including transactions and blocks.

Intellectual Property (IP) Licensing and Payments

Bodó (2018) discussed how some features of blockchain technologies, namely scarcity, trust, transparency, decentralized public records and smart contracts, seem to make this technology compatible with the fundamentals of copyright. They explained how authors can publish works on blockchain creating a quasi-immutable record of initial ownership, and encode ‘smart’ contracts to license the use of works. In theory, such an automated setup allows for the private ordering of copyright. Blockchain technology is thus presented as an opportunity (1) to reduce market friction, (2) and increase both licensing efficiency and the autonomy of creators. Yet, some of the old problems remain.

They examined the differences between the new, smart-contract-based private ordering regime and the fundamental components of copyright law, such as exceptions and limitations, the doctrine of exhaustion, restrictions on formalities, the public domain and fair remuneration. Despite the early stages of the application of blockchain technology to copyright goods and services, they concluded there is booming deployment of applications in this domain, in particular in the online music sector.

Savelyev (2018) discussed the core issues of copyright law in digital environment, namely: (1) lack of transparency about the legal status of copyrighted works; (2) piracy; (3) difficulties for authors to get compensated fairly and discusses how blockchain could fix them by:

- Introducing long-awaited transparency in matters of copyright ownership chain;
- Substantially mitigating the risks of online piracy by enabling control over digital copy;
- Creating a civilized market for “used” digital content;
- Simplifying licencing; and

- Allowing to combine the simplicity of application of creative commons/open source type of licenses with revenue streams, facilitating fair compensation of authors by means of cryptocurrency payments and smart contracts

They mentioned that however, these benefits do not come without a price and many new issues will need to be resolved to enable the potential of blockchain technologies. Among them are:

- Where to store copyrighted content (on blockchain or “off-chain”);
- Need to adjust the legal status of online intermediaries;
- How to find a right balance between immutable nature of blockchain records and the necessity to adjust them due to the very nature of copyright law; and
- Network effect issues.

They discussed potential ways of overcoming these issues and reiterated that blockchain as a kind of time stamping service cannot itself ensure the trustworthiness of facts, which originate “off-chain”. More work needs to be done on the legal side: special provisions aimed at facilitating user's trust in blockchain records and their good faith usage of copyrighted works based on them need to be introduced. Further, transactions with cryptocurrencies have to be legalized as well as the status of smart contracts and their legal consequences. Finally, the economics of blockchain copyright management systems need to be carefully considered in order to ensure that they will have necessary network effects.

Gürkaynak, et. al (2018) examined the possible opportunities that blockchain may offer with respect to the future of IP law and discussed its potential impact on the registration, management and enforcement of intellectual property rights. They proceeded to offer blockchain-based solutions to foster the operation of IP offices, reinforce customs procedures in detecting counterfeit products, and enhance the efficiency of IP rights management by the right holders.

They discussed five issues with current process of Intellectual Property licencing, namely:

1. Complex processes of registration;
2. Requirement to register in different jurisdictions;
3. Expertise required in the registration and opposition processes;
4. Fees attached to these procedures; and
5. Hardship to manage the rights create impediments in the protection of Intellectual Property rights.

They discussed how blockchain technology promises to overcome or at least minimize each of these challenges to a certain extent. The process of registration may be eased significantly by the adoption and recognition of the blockchain technology as a registry. Blockchain could be used as a unified database that enables anyone to reach out to the immutable, reliable information stored in there. These could support different applications running on these blockchains to provide the ability to register without involvement of an authority and an application process. The global nature of blockchain may also help overcome the issue of the requirement to register in different legislations and to deal with different procedures of these. Since the process would be carried out in a relatively automated way, fees and expenses that could be incurred would significantly increase. Finally, building a system, where the right-holders can control how they manage their intellectual property in terms of contracting and collecting royalties may foster significantly the motivation behind creation and inventions and may play an important role in directing consumers from the counterfeit products to the original products through enhancing accessibility of original intellectual property to consumers.

They concluded by providing some suggestions to pave the way for the advancement of blockchain technology and to increase the number of people that this technology reaches, as well as its successful integration into the various services and registration/transaction channels that we use today.

Social Entrepreneurship

Mukkamala, et. al (2018) noted that there has been growing research attention and practitioner interest in exploring the suitability of blockchain technology for decentralised applications in multiple domains. Their research investigated the application of blockchain technology to address some of the key challenges in the domain of Social Business (SB). SB is a business model for investments in social causes for the socio-economic development of under-privileged communities. They identified and discussed principles and applications of blockchain that enhance trust, transparency, and auditability in SB activities. They outlined the challenges related to creating a native cryptocurrency for SB, and barriers to infrastructure and technology adoption by different SB stakeholders.

According to their research, there are various blockchain technology opportunities exist for SBs, namely:

- Trust Factors;
- Transparency;
- Anonymity and Privacy;
- Decentralisation; and
- Auditability

The research also summarized the challenges in using blockchain for SB, relating to:

- Cryptocurrency;
- Infrastructure and Deployment; and
- Training and Adoption

They concluded by summarizing the article and how it explored the suitability of blockchain technology in addressing some of the challenges faced by social business organisations. They mentioned that the article had two major goals: first, they investigate the suitability of blockchain technology for SB by using an example of a microfinance use-case. It was found that the use of blockchain technology can help social business in establishing and enhancing the trust relationship with social investors and sponsors. Second, it identified the opportunities that blockchain technology can provide for the domain of social business, especially in terms of transparency, auditability, privacy and decentralisation. The article also outlined the challenges in implementing a blockchain-based solution that a social presence organisation might need to address in terms of technology adoption, infrastructure, and most importantly on how to deal with financial transactions with a cryptocurrency.

Chen (2018) noted that the rise of Bitcoin has brought attention not only to digital currencies but also to the underlying technology empowering digital currencies: blockchain technology. Besides empowering digital currencies, blockchain technology has given innovators the capability of creating digital tokens to represent scarce assets, potentially reshaping the landscape of entrepreneurship and innovation. They noted blockchain tokens may democratize (1) entrepreneurship by giving entrepreneurs new ways to raise funds and engage stakeholders,

and (2) innovation by giving innovators a new way to develop, deploy, and diffuse decentralized applications.

They also discussed blockchain technology being one of the most revolutionary general-purpose technologies, and how it may have far-reaching implications for entrepreneurship and innovation. Blockchain technology has brought to the world not only decentralized, digital currencies but also the capability of creating digital tokens to represent scarce assets. By enabling the creation of blockchain tokens, blockchain technology may reshape the landscape of entrepreneurship. They stated blockchain tokens:

- Enable entrepreneurs to raise funds directly from investors across the globe, democratizing access to financial capital;
- Give investors opportunities to invest in early-stage projects across the globe, democratizing access to investment opportunities;
- Have the potential to restructure fundraising and investing;
- Facilitate the building of user and developer communities;
- Help innovators build user communities by rewarding early adopters and active users with blockchain tokens; and
- Allow innovators to build developer communities by rewarding developers with these tokens.

They concluded blockchain technology and tokens have sparked a new wave of innovation, which may start to revolutionize entrepreneurship and innovation. Blockchain tokens allow open-source projects to capture some of the value they have created for society, they can retain their financial independence, support their continued development, and compensate their core developers.

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