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Chapter #

The Decentralized Autonomous Corporation as Knowledge Commons

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Abstract

This chapter evaluates the autonomous business entity of the 21st century, embodied in the decentralized autonomous organization, or DAO, as a case study of knowledge commons. DAOs rely primarily on socio-technical infrastructures supplied by blockchain technology rather than on human-and-law corporate governance based on human beings and law. As systems for resource governance within financial and commercial contexts, DAOs ostensibly improve entity decision making at scale by reducing or even eliminating weaknesses implicit in reliance on human judgment.

Because DAOs consist substantially of combinations of shared computer code and shared data, we consider them using the Governing Knowledge Commons (GKC) research framework. We contrast the GKC perspective with long-standing views of the corporate form as representing one among several related modes of resource governance: as a nexus of contracts, as an instance of hierarchy and decision theory, and as a complex system. We situate our analysis in the context of earlier work on the corporation as commons. The chapter concludes that the GKC framework focuses

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attention on elements of governance that often are not salient in conventional accounts of the corporation: how governance responds to and generates social dilemmas associated specifically with practices of sharing knowledge, information, and data.

1. Introduction

Corporations and governments are conventional intermediaries that record, process, and validate information in the modern economy. Blockchains reduce and in some instances eliminate reliance on these intermediaries for recording information. Like firms and states, blockchains address social dilemmas associated with resource coordination and allocation. As governance institutions, blockchains offer distinct and different approaches to power imbalances and trust concerns associated with conventional intermediaries. And blockchains offer general purpose platforms for deploying governance strategies in specific sectors of market and other cultural activity.

This chapter examines one such deployment: the decentralized autonomous organization (DAO), which combines blockchains, smart contracts, and distributed payment systems. The examination is organized under the Governing Knowledge Commons (GKC) framework to draw out features of DAOs that emphasize structured resource sharing in a collective, collaborative, or community context – the hallmark of commons governance – and to sharpen similarities and contrasts between DAOs, on the one hand, and conventional corporations, on the other hand, as specific instances of the general phenomenon of knowledge commons. In both the narrower case (the DAO) and the broader one (the corporation), we reinforce earlier arguments positing knowledge commons governance as a productive way to understand knowledge sharing within markets (Dekker and Kuchař 2021), rather than as a mode of resistance to market dynamics. We focus on the GKC framing in order to expand beyond reliance on a transactions cost perspective on DAO governance and corporate governance (Micheler, Werbach, and Krenner forthcoming).

The chapter has the following sections. Section 2 describes DAOs, blockchains, and corporations as related yet distinct sociotechnical governance institutions in order to facilitate the analysis of these organizations from the GKC perspective. Section 3 sketches the GKC framework, briefly. In Section 4, we examine the basic model of the DAO using the tools provided by that framework. Section 5 briefly considers

how a knowledge commons examination of DAOs illuminates analyses of corporations and corporate governance generally and offers implications and suggestions for future research.

2. Understanding DAO Governance as the Interweaving of Blockchain Governance and Corporate Governance

a. A Short Review of DAOs and Blockchains

We start with a simple and perhaps simplistic definition of DAOs, from Investopedia: “A decentralized autonomous organization (DAO) is an emerging form of organizational structure with no central governing body and whose members share a common goal of acting in the best interest of the entity. Popularized by blockchain enthusiasts, DAOs make decisions using a bottom-up management approach.”¹

The simplicity of that summary hints at definitional and analytic complexity. Neither researchers nor practitioners have settled on a single, standard definition of “autonomous corporation” or “decentralized autonomous organization” (Hassan and De Filippi 2023). DAOs consist of groups of people who coordinate participation in decision making via technological systems in pursuit of a shared goal (or goals) or purpose(s). As Davidson, De Filippi, and Potts have noted (2018), blockchains are a new institutional technology, meaning a new configuration of people, practices, and resources. To blockchain promoters, these configurations offer “trustless” governance solutions to coordination dilemmas, in that decision making is irrevocably and traceably recorded on blockchains rather than subject to interpretation by managers or government regulators. They offer inclusiveness in the sense DAO “membership” is documented by ownership of tokens that are recorded on the blockchain that enables the members to participate in governance, by voting.

DAOs offer specific uses of blockchains: they consist of blockchains, executable software code operating as autonomous “smart contracts,” and digital assets stored in cryptographic wallets. Wright (2021) divides DAOs into algorithmic DAOs in which software coordinates everything (examples include Bitcoin, Ethereum,

¹ “What Is a Decentralized Autonomous Organization (DAO)?”, <https://www.investopedia.com/tech/what-dao/> (June 15, 2024).

and other permissionless blockchains) and participatory DAOs that raise investment capital and engage in traditional commercial endeavors, such as venture capital investing or other financing.

Wright (2021) describes blockchains as the backbone of coordination and smart contracting as the glue that holds members to other members, including through transactions. Smart contracts are rules embodied in code that structure the facilitation and operations of DAOs. For example, investment capital may be raised by humans (often, of course, acting through firms) and pooled and recorded on the blockchain in the form of a named DAO, as a blockchain-based entity. The series of smart contracts that constitute the DAO in the first place are extended through investments of that pooled capital *by* the members of the DAO, investments that are likewise recorded via smart contracts on the blockchain (Reyes and Hurt forthcoming). Not all DAOs are investment vehicles or businesses, however. Their technical design and purpose-driven framing mean that the DAO form may be directed to social, philanthropic, or educational uses.

A DAO is characteristically decentralized rather than centralized or hierarchical because decisions are taken and recorded via the computer code that comprises the organization rather than via the design of a legally recognized fiction such as a corporation. Membership and participation in the DAO may be pseudonymous. It is autonomous in the sense that it owes its existence and functionality to coordinated social activity that is documented in code rather than assigned by legal rule to a corporate form. It is an organization in the casual sense of “a group of people or other actors,” rather than a corporation or other legally recognized entity, such as a partnership or a cooperative.

We do not suggest that DAOs are bounded definitionally by purposes or goals, as some have suggested (El Faqir, Arroyo, and Hassan 2020). DAOs often operate amid ecologies of DAO-enabling platforms, peer relationships, teams, guilds, squads, and tools (Rawson 2021). Despite the intuition that DAOs operate entirely on blockchains, in practice conversations, negotiations, and other DAO-relevant coordinating activity may take place in adjacent communications environments, such as the chat apps Discord and Telegram.

DAOs can be thought of as *autonomous* corporations in two senses. One, they do not depend on legal recognition for their existence and operation. They are, in an important sense, “autonomous” of corporate law and therefore of the state. Two, they represent distinct organizational solutions to contracting and other resource

management dilemmas that have been addressed conventionally and classically by corporations. DAOs are in a sense “autonomous” of theories of corporate identity. How can law, policy, and practice determine whether actions or activities are appropriately and accurately associated with the corporation in the first place rather than with human decision makers (Gindis 2016)? How should law, policy, and practice distinguish among appropriate behaviors associated with corporate functions and purposes, on the one hand, and appropriate behaviors associated with humans who have ownership or management roles in the corporation, on the other hand (Berle and Means 1932; Jensen and Meckling 1976)? Which decisions and activities are properly undertaken within the formal boundaries of the corporation, and which engage the corporation in relationships with outside parties (Coase 1937)?

Their “autonomy” is therefore as much conceptual as technological, something that we note initially in order to create a broad potential space for our analysis and to sharpen the distinction between DAOs, conceptually, and conventional legally-recognized corporations. By virtue of legal requirements of corporate organization, in contrast to the fluid motivational impulses that may drive participation in DAOs, the formal boundaries of the corporation are defined by law. Employees, managers, and shareholders may come and go, but as a matter of identity, the corporation remains the same actor. Gindis, Kuchař, and Cole (this volume) describe this as the “corporate mask.” A given DAO remains “the” DAO as transactions are recorded on the blockchain and members participate, or not, not by virtue of the DAOs legally-mandated identity but instead by virtue of the rules of technical recognition that permit DAO transactions to be recognized. To borrow metaphorically a slogan of early cyberlaw scholarship, in a DAO, as in a blockchain generally, code really is law (Lessig 2006). A point of alignment in these recent perspectives is that recognition is essential, whether legal and social in the case of the corporation, or technical, legal, and social in the case of DAOs.

Building conceptually on that foundation, Wright (2021) notes that the software engineer who first proposed the idea of a DAO referred to it as a “decentralized autonomous company” in which the source code serves the function of bylaws. Reyes (2021) draws attention to the idea of “autonomous corporate personhood” in the form of automated businesses operated entirely through computer code, embedded in socio-technical architectures while acknowledging that several states have moved toward legal recognition of DAOs. Hence, technical, social, and legal recognition are in some cases converging.

b. Studying DAOs and Blockchains as Knowledge Commons

The role of code does not exempt DAOs from being classified as sociotechnical systems for resource governance. Despite the promise of efficient and adaptable “trustless” transacting, neither DAOs nor blockchains can neither fully escape social dilemmas associated with human beings interacting with one another, nor fully convert social dilemmas into technical solutions. Inevitably, despite their arguably “trustless” character, DAOs and DAO members interact with humans and with other human-designed systems, including conventional corporations and legal structures. They are, therefore, participatory sociotechnical systems rather than purely “private” governance. DAOs are not governance-free. Rather, they instantiate governance in distinct ways.

In that respect DAOs can be understood as extensions of commons-based peer production and open-source collaboration of the sort imagined by Benkler (2004; 2013). We emphasize, however, that in pointing to commons concepts we do not argue that DAOs (or blockchains) “are” commons. Nor do we equate knowledge commons with commons-based peer production. Instead, we argue that there are important insights to be gleaned from characterizing DAOs as species of knowledge commons governance, community- or collectivity-based responses to social dilemmas associated with shared knowledge and information resources, building on the definition of knowledge commons developed in the *Governing Knowledge Commons* (GKC) literature (Frischmann, Madison, and Sanfilippo 2023).

Our emphasis on a GKC perspective joins analysis of blockchains as resource governance systems, with transactions “on” a blockchain providing an exhaustive and accurate record of resource ownership and transfer with respect to some relevant resource pool.

Blockchains are decentralized or distributed peer-to-peer computer networks that record information, including transactions. Human-specified rules as to what information and how it is recorded are embedded in the code of the computer networks themselves. Blockchains are “trustless” in the specific sense that they do not require trusted third parties to process or validate transactions. Permissionless or algorithmic blockchains enable essentially anyone to participate in transactions that are recorded on the blockchain. Permissioned or participatory blockchains, such as DAOs, may be more structured and involve additional rules, embedded in

computer code, that determine who has the power to conduct and record transactions on the blockchain and what sorts of transactions may be included, and what cannot be.

The technical requirement that blockchains effectuate transactions by computational consensus rather than by human decision making implies that they formally involve fewer opportunities to exert human-based power or influence than organizations that rely on conventional managerial hierarchies. They are, therefore, represented by blockchain enthusiasts as both less corruptible and authoritative than conventional ledgers, or records of transactions. They can, for this reason, be thought of as comparatively free from power imbalances, thus contributing to opportunities for self-governance (Ferrari, Leiter, and Mannan 2023; Spelliscy et al. 2024). This feature can be considered a response to economic power (in that blockchains and blockchain-based organizations may be regarded as providing alternatives to corporations) or to government power (in that blockchains may provide alternatives to recording systems administered by central banks) (Cowen 2019). By design, blockchain protocols constitute governance of the resources whose ownership and identity they record, of the actors who engage in transactions on the blockchain, and *by* the actors who control the code that makes blockchain-based transactions possible. The protocols are both literally and metaphorically constitutional structures that define “citizenship” in any given blockchain network (Alston 2020).

As cryptocurrencies are a well-known application of blockchain governance, we draw on that sector for a brief illustration. According to De Filippi and Loveluck (2016), the two distinct governance mechanisms in the best known blockchain-based currency, Bitcoin, are the technical infrastructure for cooperating in transactions and recording transactions, which governs all blockchain members (the operational layer, interpreting the underlying code) and the technical infrastructure for cooperating in managing the underlying code, which governs and is governed by a small group of core developers. Another aspect of governance involves the response to actor entry and exit in permissionless blockchains, such as forking (Berg and Berg 2020). Focusing on the infrastructural character of blockchains yields yet another governance dimension, in that they offer structural solutions to downstream resource use. Blockchains can be thought of as innovation commons: institutions that facilitate cooperative pooling of innovation resources, including capital, ideas, and talent, thereby facilitating entrepreneurial discovery (Potts 2019).

Alston et al. (2022) question the static view of blockchains as complete contracts and trustless transactions. Rather, blockchains are evolving organizations where the threat of exit by users conditions the mechanism of change in the protocol, which entails a layered and dynamic set of governance forces. Internal governance consists of protocols and collective choice rules, while external governance includes competitive pressure from public and private institutions relative to a blockchain's performance, subject matter scope, and internal governance, shaped by competitors' governance choices.

Murtazashvili et al. (2022) consider blockchains as knowledge commons. They consider (1) institutionalized community governance with sharing of resources (code developers, miners, users, founders, each with shared access to code, internet, etc.); (2) social dilemmas (social and economic systems require describing objects and assets in secure, reliable, and timely ways); (3) resource sharing (shared resources include knowledge, data, and opportunities to use outputs; general openness of blockchains to entry and exit, especially algorithmic blockchains).

c. DAOs and Corporations as Knowledge Commons

The conceptual affinity between DAOs and corporations as organizational forms motivates analysis of affinities between DAOs and corporations as resource governance systems. In both contexts, we offer the GKC perspective as a critical analytic tool.

Looking at corporations, our GKC focus intervenes in a well-established debate on the character of the corporation as a resource governance system, contrasting a "communitarian" or "political" framing, identified long ago March (1962) and updated by Whitford and Zirpoli (2016), and Levinthal and Pham (2024), with a predominantly contractarian or Coasean perspective (Alchian and Demsetz 1972; Hart 1988). The scholarly debate has struggled at times to accommodate the fact of "corporate personhood," or the factual and legal identity of the corporation as a recognized legal and market actor (Gindis and Hodgson 2025). The emergence of DAOs as "autonomous" entities with sociotechnical resource governance features has sharpened the terms of that struggle and opened a new front in the existing corporate governance debate (Reyes 2021).

Scholarship, in a way, is also struggling to keep up with practice. Questions as to both governance by the corporation and governance of the corporation have been extended recently via technology developments that are stretching the notion of a corporation's boundaries even from a Coasean "nexus of contracts" perspective (The Economist 2023). These challenges include a blurring of the conventional boundaries of firms with increasing use of AI (Petrin 2024).

This chapter examines this cluster of challenges by extending the argument initiated by Deakin (2012), who considers the corporation as commons in the Ostrom tradition, treating the corporate entity as a governance strategy for coordinating the development and distribution of many sorts of material and immaterial resources. In starting with DAOs, we focus on knowledge commons analysis rather than on Ostrom's framework and on the knowledge governance attributes of both DAOs and corporations broadly. The distinction between the GKC framework and Ostrom's approach originates in differences between social dilemmas associated with knowledge resources as opposed to those associated with biophysical or material resources (Madison et al. 2022). In practice, the two may not be sharply differentiated, and the style of analysis is similar. The choice of framework may speak less to its functional importance and more to analytic emphasis and the potential for results to be generalized beyond the corporate governance context to other knowledge commons settings. By applying the GKC framework to DAOs, we aim both to clarify understanding of corporations as solutions to governance dilemmas and to confirm the utility of the GKC framework as part of, rather than in opposition to, governance in market contexts.

Hassan and De Filippi (2023) draw attention to the history of decentralized community governance generally and its role in adapting blockchain technologies to corporate and commercial applications. DAOs activate with specificity the instinct described by Allen and Berg (2020) that blockchain governance can be analyzed profitably with reference to corporate governance. The Coasean "nexus of contracts" framing of the corporation has a material analog in the manner in which DAOs are defined by transactions recorded via smart contracts.

Contrasts are as important as similarities. Some of the significant differences between DAOs and conventional corporate organizations include: (1) DAOs lack a centralized structure featuring formal managers or a managerial hierarchy in a traditional sense; (2) DAO membership is not viewed as necessarily durable or long-lasting; rather than a board of directors, distributed consensus – meaning transactions performed and executed by members of the DAO at any given time –

is the basis for governance; (3) DAOs operate with relative autonomy from external validation and regulation by traditional legal institutions. That list can be expanded as follows.

- *Source of law:* DAOs are “rule by code,” where it is hard to change rules that establish procedures for anyone interacting (De Filippi and Wright 2018). Corporations exist by virtue of and rely on law as text, as social institution, and as social practice. As Davidson (2025) emphasizes, there exists an important distinction between “on chain” governance, or governance of the DAO by the DAO, and “off chain” governance, that is, (possible) governance of the DAO by external authorities.
- *Nature of interactions:* DAOs are comparatively decentralized, by virtue of the underlying peer-to-peer network structure; corporations are comparatively hierarchical (Williamson 1996).
- *Scale:* DAOs have potentially unlimited geography and participation; conventionally, corporations – though their structures can transcend geographical boundaries, and outlive their founders - are linked to specific places and people.
- *Management:* DAOs can have essentially no management (as in permissionless blockchains) or have a defined structure of core operators. Traditional legal entities are run by boards or managers. Participatory DAOs enable members to set parameters needed by the underlying smart contract and to update those parameters as needed, with governance determined through votes measured with blockchain “tokens” that represent records of transactions.
- *Membership:* For DAOs, membership is tracked with smart contracts and an underlying blockchain, with membership purchased or allocated as a reward for computing effort directed to maintaining the blockchain. “Membership” in a corporation is a legal relationship defined by role: shareholder, director, manager, or employee. For communitarian characterizations of the firm, “membership” may extend to the practical implications of long-term partnerships and supplier/customer relationship and to interdependencies associated with the firm’s physical presence in a

community. For contractarian characterizations, “membership” is typically an inapt perspective with which to view the firm.

3. The GKC Framework

We use “knowledge commons” as an organizing principle not because we draw a sharp distinction between commons governance and corporate governance (or network governance, platform governance, or any other genus of governance), but because it offers a useful methodological gateway to collecting and organizing critical information about the phenomenon we are interested in. “Commons,” as we use the term, is not an ontologically distinct category. Instead, it is a governance practice by which members of a community or collective govern production and use of shared resources in order to address social dilemmas (Madison, Frischmann, and Strandburg 2010). For knowledge commons, the topic of interest here, the relevant resources are knowledge, information, data, and related immaterial resources. Even that limitation is subject to adjustment; immaterial knowledge resources are characteristically linked in complicated ways to systems of material resources.

GKC-based research searches out instances of shared knowledge, information, and data that prompt the need for, even the demand for, governance: mechanisms for people in communities or collectives to get along in creating, using, and storing it (Frischmann, Madison, and Strandburg 2014). Knowledge commons is neither a place, a thing, nor the resource or resources as such (such as a data pool, or a patent pool, or a body of knowledge or content). Knowledge commons is a governance system relative to one or more sets of shared resources. Knowledge commons may succeed, even thrive; it may fail, or produce harm rather than social benefit.

Material in a knowledge commons system is not simply or necessarily fully free and open. There are rules and guidelines indicating and sometimes determining appropriate production and contribution, appropriate extraction and use, and appropriate curation, preservation, and even destruction. Knowledge commons governance consists of systems (plural) of formal and informal rules and norms by which members of a community or collective coordinate to resolve problems, plan their affairs, and achieve their goals. Governance sometimes consists entirely of “law,” sometimes entirely of “social norms,” sometimes of sociotechnical devices, and often of blends of the three. Governance sometimes exists by design and

intentionality. Governance sometimes emerges out of history, culture, path dependence, and accident.

The GKC research framework encourages researchers to examine a case of knowledge commons governance by breaking that brief summary into clusters of related questions that can be asked and answered in a systematic way. Is there a shared knowledge, information, or data resource? (There may be more than one.) What individual and social problems arise by virtue of the shared character of the resource? (Those problems, or social dilemmas, may operate at smaller or larger scales, may emerge at different points in time, and may both prompt the emergence of governance solutions and be caused by those solutions.) Is there a community or collective that produces or manages that knowledge, and how is that community defined and organized? (Again, there may be more than one, leading to questions about their nested or polycentric character.) What are the various rules and social norms that define the resource, define the community (including roles and responsibilities and processes for inclusion, exclusion, and participation), and determine how the resource is produced and managed, presumably to respond to the problems with governance strategies and solutions? What are the expected and unexpected outcomes, positive and negative, associated with the practice of those rules and norms? What feedback loops connect responses to those different questions? What spillover effects follow from this governance system?

The terminology of the GKC framework corresponds in part to the terminology developed by Ostrom for the Institutional Analysis and Development (IAD) framework (Ostrom 2005). The GKC framework, like Ostrom's IAD framework, encourages researchers to open their examination with questions about social dilemmas caused by or linked to resource sharing, which is to say, conflicts between self-interested behavior and other-directed or collective interests. The "classic" social dilemma in a shared resource context is the "tragedy of the commons" popularized by Hardin (1968). In the GKC environment, a "tragedy of commons" is not necessarily a starting point for researchers; openness to multiple possible social dilemmas, including dilemmas of other sorts, is key (Madison et al. 2022).

The affinities between the GKC framework and the IAD framework are important. Differences are important as well. While Ostrom's work is not always perfectly consistent or clear, three bear emphasis here.

First, “resources” in the GKC context are not “biophysical” or given as they are the IAD setting; knowledge, information, and data resources are produced, defined, and identified by human systems, including legal systems. Law is characteristically integral to knowledge commons governance but may be exogenous to natural resource commons.

Second, the IAD framework – indeed, much of the corpus of Ostrom’s research on commons governance – is premised on “resources” constituting “CPRs,” or “common pool resources,” things that are shared but depletable. Fisheries, grazing meadows, forests, and water systems are paradigmatic cases of Ostrom’s commons governance vision. These are contexts where the “tragedy of the commons” may have applied because of over-consumption (that is, opportunistic behavior) and which Ostrom wished to show could be managed successfully by pro-social collectives. The GKC framework assumes the opposite, at least initially. Knowledge and information resources are non-depletable, though they may be linked in complex ways to depletable resources. Given their (potentially) blended character, the framework recognizes social dilemmas related to abundance and associated prospects for sharing and combining knowledge resources.

Third, the IAD framework relies heavily on the assumption that “actors” are individuals operating on a rational decision making basis. Commons governance is explicitly and almost entirely linear and functional, and the individual actors play central analytic roles – even accounting for a diversity of motivations and practices among real human beings. Pro-social governance is both observed and rational, in that it sustains the resource over time for both individual and collective benefit. The GKC framework makes no such assumption. Story, myth, history, and culture, including preexisting and changing normative values, expectations, and objectives, play potentially important roles in knowledge commons governance. (That fact may disrupt the characteristic focus of IAD-motivated analysis on “action arenas,” defined sociotechnical environments where actors regularly make decisions about resource generation and consumption.) The community as such may be the central analytic focus, rather than the decision making individual. The reciprocal linking of governance patterns to resource and community formation and identity is a key theme of the GKC framework and documents that possibility. One key product of the Wikipedia community, an oft-touted example of knowledge commons governance, is the Wikipedia community itself.

4. DAOS as Knowledge Commons

The DAO form can be and has been applied to numerous sectors and forms of commercial and social collaboration. That diversity motivates the focus of this section, which uses the GKC framework primarily to organize the analysis of the concept of the DAO as a sociotechnical arrangement rather than any specific DAO. Any particular DAO is a target that is evolving more or less rapidly. In the style explored below, the GKC framework could be applied to any specific DAO or to attributes of a specific DAO or multiple specific DAOs. Examples include:

- “Pleasr,” found at <https://pleasr.org>, is a collective of artists and art collectors that invests in NFT (Non-Fungible Token) art and other digital assets.
- “ConstitutionDAO,” found at <https://www.constitutiondao.com>, was an effort to raise capital via a crowdsourcing process for a single purpose: to bid at auction for a specific copy of the United States Constitution. The fundraising succeeded; the bid ultimately failed.
- “Friends With Benefits,” found at <https://www.alchemy.com/dapps/friends-with-benefits>, is a so-called “social DAO,” in which investing in tokens grants individual members the power to meet others, especially others in their geographic location, with shared interests in Web3 development opportunities and projects. The greater the investment, the greater the powers the DAO affords for connecting.
- “Mantle,” found at <https://www.mantle.xyz>,
- “Decentraland,” found at <https://decentraland.org>, is an online virtual world governed by a DAO, in which owners of Decentraland tokens, so-called “MANA,” participate in administrative and governance decision making.
- “Uniswap,” found at <https://uniswap.org>, operates a cryptocurrency exchange on the Ethereum blockchain. It uses the “UNI” token.
- “American Cryptofed DAO,” found at <https://www.americancryptofed.org>, bills itself as “the first Wyoming Decentralized Autonomous Organization,” because its organizational standing is recognized under Wyoming state law. This DAO aims to create a cryptocurrency monetary system via tokens known as “Ducats” and “Lockes.”

- “LexDAO,” found at <https://lexdao.org>, is a collective of “legal engineering professionals” who promise to bring “the traditional legal settlement layer” to the masses, via blockchain methods.
- “Mantle,” formerly known as BitDAO and found at <https://www.mantle.xyz>, is a vehicle for investing in Web3 and de-fi (“decentralized finance”) startups. The original “BIT” tokens were swapped out for new “MNT” tokens as part of a governance vote in 2023.
- “The DAO,” which both launched and ceased operations in 2016, is usually credited with being the “original” decentralized autonomous organization, an exemplar of a new species of corporate governance, operating an investment fund but without a conventional management structure or governing board (Morrison, Mazey, and Wingreen 2020). The DAO’s “smart contract” code, which ran on the Ethereum blockchain, was hacked, and a substantial amount of its funding (3.6 million Ether, the equivalent of roughly \$70 million US) was siphoned off. In response, the Ethereum community implemented a hard fork, dividing the Ethereum blockchain between the main branch of Ethereum, on the one hand, and the original unforked blockchain, now called Ethereum Classic, on the other. The fork permitted restoration of the funds to The DAO and the original investors, but the hack caused tremendous embarrassment for Ethereum developers and exposed the idea that the blockchains are not technologically invulnerable.

We address, briefly, each of the significant clusters of GKC framing questions.

a. Relevant knowledge, information, and data resources

DAOs are concerned formally with digital representations of the products of computational processes: tokens, the products of proof of work and proof of stake processes on blockchains. These are outcomes of decisions, to which economic and possibly cultural significance is attached by virtue of their technical and social visibility and by the computational permanence of the distributed ledger that we call “the blockchain.” Tokens, as digital assets or crypto assets and sometimes denoted NFTs (“Non-Fungible Tokens”) are the first and most important layer of knowledge and information resources with which DAOs are concerned.

A token itself is not a naturally shared object, with the attributes of a public good, but the construct of a DAO operates both technologically and socially precisely

because each token in itself is useless and valueless. Whatever the purpose of a particular DAO, information *about* tokens must be shared: the investment or membership value that is associated with each token, creating its status in the DAO context visàvis both other members and non-members, and the governance powers associated with each token, which represent the powers of DAO members to engage with one another. Shared information about token ownership is the baseline attribute of a DAO that allows owners to engage in decision making within the DAO environment, to exercise membership rights and for token holders to engage in economic transactions. The shared character of tokens as knowledge resources is inherent with respect to their essential role in the functions of the entity.

Tokens may and often do represent other knowledge and information resources, including information about material assets (such as land or material artworks), information about immaterial assets (such as financial instruments), or information about immaterial intellectual property objects, such as copyrighted works, patented inventions, and trademarks. Tokens on blockchains may even refer to confidential information and trade secrets and to “things” that have an ambiguous status as matters of conventional intellectual property law, such as material subject to characterization as Traditional Knowledge, the growing body of law known as Geographical Indications, and matters of “know-how” that may play important roles in transactions concerning industrial innovation.

As DAOs consist of multiple layers of technological infrastructure and application – blockchain networks, smart contracts, and payment systems – the relevant code is, at each layer, a shared knowledge resource in itself, as is the technological and educational expertise that is contributed to building and maintaining the code. The Ethereum blockchain is built with open-source computer software, a well-established shared resource in its own right (Schweik and English 2012). Blockchain networks are frequently characterized as “trustless” systems, but it is now well-known that this framing is at best a rhetorical mis-direction. Collective trust in the developers and maintainers of the code is essential to the claim that blockchain networks have a technical integrity that justify treating applications built on them as “autonomous” relative to ordinary legal frameworks (Werbach 2018).

DAOs depend on further layers of tacit knowledge and expertise, notably trust (lending weight to the characterization of blockchains as nested, polycentric governance systems proposed in Murtazashvili et al. 2022), in the sense that DAOs

are initiated by human beings who share some degree of trust in one another as to the agreed-upon purpose(s) of the organization. Trust, like privacy, is a social phenomenon (Gambetta 1988); it should be characterized as a shared information resource. The hack of “The DAO” and the response that forked the Ethereum blockchain in order to restore investment capital to original investors suggest that DAO members are not always willing fully to “trust” the proposition that the “smart contract” code, and only the smart contract code, determines allocation of DAO resources. An appeal to extra-code values was made, and that appeal was successful.

The resources that shape DAO governance are analogous to but not necessarily or precisely the same as the resources that characterize the traditional firm and corporate governance. In a DAO, trust is an infrastructural immaterial knowledge resource that is integral to understanding governance practices in both contexts. Digital assets in the DAO setting *represent* works of intellectual property (in the case of NFTs) or financial interests, and in their representative forms (tokens) information *about* them is shared across the entity, even while ownership of a specific token is specific to a single actor. In a traditional corporate organization, money itself (in various forms), tangible assets, human capital and expertise, and intellectual property works themselves are related (possibly) shared assets, typically owned or controlled by the firm as an entity rather than by members of the firm (shareholders, managers, or employees) (Burk and McDonnell 2007). Information *about* those assets, including their origins, values, and uses and purposes, is shared within the firm, though in nuanced ways. Different managers and employees will access and use different information on a shared basis (at times) and on an exclusive basis (at other times), and sometimes in tacit forms and sometimes in explicit ones (Brown and Duguid 2000).

b. Social dilemmas

Commons governance is often stereotyped as a response to the classic “tragedy of the commons” social dilemma, where resource users rationally overconsume a shared resource. However, with knowledge and information resources, overconsumption is typically not a primary concern. When identifying other important social dilemmas in this context, we must move beyond such stereotypical thinking. As Madison et al. note (2022), the networked information economy sharpens some existing dilemmas relative to knowledge and information resources, particularly in identifying and promoting positive spillover effects of knowledge production and use; limiting harmful spillover effects relative to

adjacent interests in privacy and security; and producing education and capacity for effective participation in (or exit from) relevant governance systems. “Knowledge commons governance” as a macro category includes different possible subsidiary categories, including innovation commons (in which knowledge pools facilitate productive coordination and combination) and infrastructure commons (in which knowledge pools offer resources to a multiplicity of different uses and users).

Social dilemmas associated with DAOs are in part species of the social dilemmas associated with any organization. Because our focus is on knowledge commons dimensions of DAOs, we focus on dilemmas associated with shared knowledge and information resources. We distinguish, where possible, between dilemmas associated with forming organizations (dilemmas for which DAOs and other organizations are meant to be governance solutions) and dilemmas associated with operating organizations (dilemmas that DAOs and other organizations may create).

Because social dilemmas are defined in the first place as conflicts between individual interest and collective interest that interfere with productive collaboration or cooperation (Dawes 1980; Kollock 1998), it is appropriate though simplistic to begin by reducing all social dilemmas to problems of agency relationships (Ross 1973), meaning the risk that one party as principal, having relied on a second party as agent to act faithfully on the principal’s behalf, risks betrayal or defection by the agent. One partner may rely on a second partner to act faithfully in the joint pursuit of the partnership’s goals, but the second partner may fail, or defect. Those risks are compounded by the possibility that the principal cannot effectively monitor the agent’s performance, by the agent’s not being subject to effective accountability measures even if monitoring is present, and by the likelihood that expectations of the character of faithful performance are ambiguous or may be embodied in tacit rather than explicit understandings. It is worth noting that to a substantial extent, those elementary outlines of agency costs are matters of shared knowledge and information: the interests of principal and agent may be misaligned because they lack effective mechanisms for sharing knowledge about each other and about the conceptual and material conditions of effective cooperation.

A related set of social dilemmas arises with respect to the design and character of the organizational framework or infrastructure itself. The first order social dilemmas described in the preceding paragraph are compounded by the second

order likelihood that both principal(s) and agent(s) will address those social dilemmas by relying on intermediaries of one sort or another – the corporate form, defined by relevant law; partnerships, nonprofit associations, or cooperatives, also defined by relevant law; material forms shaping social practice, such as cities; tradition, custom, and social norms, as in universities and faith traditions; and – in the case of open source software, Wikipedia, and DAOs – combinations of contract and code. Each of those contexts both solves social dilemmas in part (principals need not rely directly on their knowledge of agents' behavior; they can rely on monitoring and enforcement powers of the intermediary) and creates new ones, again characterized significantly in terms of shared knowledge and information: how can both principals and agents be assured that the intermediary and its own agents and decision making are trustworthy, safe, fair, uncorrupted, and reliable?

Second-order social dilemmas may be compounded by third-order dilemmas, as second-order solutions (such as corporations) rely on additional layers of intermediaries, producing what one might refer to (depending on one's preference for spatial metaphors) as a pyramid of social dilemmas, or an ecology. Corporate partnerships may depend on relationships with lawyers, accountants, financiers, insurers, and so on, adding to the inventory of possible productive outcomes and to knowledge-based social dilemmas.

That broad description can be brought to ground in the following brief inventory of specific social dilemmas. None of these is wholly distinct from the others.

Identity. The organization may be defined and identified separately from the identities of its individual members, participants, or owners, and may have distinct rights, powers, and obligations as an entity.

Risk allocation / moral hazard. Having been entrusted with certain responsibilities or decision making powers in the organizational context, the agent may act according to the agent's interests rather than the principal's.

Information asymmetry. Principals in any part of an ecology of social dilemmas, whether individual or organizational, may have incomplete or inaccurate information about decision making by agents.

Residual claims/risks of loss. The costs or harms associated with the failure of a collaborative or cooperative effort may be unfairly or unclearly distributed across the population of individual members, participants, or owners.

Efficiency and effectiveness of decision making / voice. The roles and responsibilities of principals and agents as parts of decision making in the organization may be poorly defined or inappropriately biased. Individual members, participants, or owners may be excluded or believe that they have been unfairly excluded. A social dilemma may arise by virtue of having “too many cooks” in the decision making context, not only by virtue of having too few cooks, or the wrong ones.

Entrance, change, and exit. Rules or practices for including new participants or members, for permitting exit by existing participants, and for enabling existing participants to modify the character or purpose of the organization, may inappropriately or unfairly bias the organization’s operation in favor of the status quo; in favor of exclusion; in favor of the majority of participants, members, or owners; or in favor of destabilizing fluidity.

Allocating the products of spillovers, both positive and negative. The word “spillovers” is in many ways simply a synonym for the proposition that a system (including an organization) has impacts and generates benefits and costs with respect to individuals, communities, and adjacent systems that are not fully internal to its operation. The “tragedy of the commons” metaphor speaks to the possibility that those spillovers will be negative, and that the external costs of the system should be internalized by its participants. An “infrastructure” metaphor speaks to the possibility that those spillovers will be positive, so that the generative potential of the system should be enhanced, even optimized (Frischmann and Lemley 2007).

Public and private purpose. It has become essentially an article of faith during the 20th century that the purpose of for-profit organizations, such as corporations, is to return profits to shareholders (Lund and Pollman 2021). That framing may systematically disadvantage owners and others in the organization who wish to prioritize or simply to advance other social or public purposes.

Against that discussion, what, specifically, is distinctive about DAOs, both with respect to social dilemmas and with respect to how DAOs respond to social dilemmas and perhaps generate additional dilemmas?

In the first place, the design of the DAO offers a baseline institutional model as an alternative to the hierarchical solution provided by the corporation.

The corporation in a way “reifies” principals and agents, separating ownership (shareholders) from control (managers), structuring both internal decision making and external contacting around a hierarchy of managerial responsibility (Williamson 2000), and wrapping the entirety of the collaborative system in legal frameworks of corporate identity, corporate governance, securities law, and contract and commercial law. Law, as a shared knowledge resource, is a key element of the corporate solution to social dilemmas associated with cooperation.

The DAO collapses rather than reifies the distinction between principals and agents, and it largely substitutes the blockchain and smart contracts for law as shared information resources. The decentralized, consensus-based character of decision making on blockchain networks addresses governance dilemmas by associating participation in governance with token ownership, ostensibly open to anyone with access to the relevant public blockchain. In principle, this reduces if not fully eliminates the risk of defection, by channeling defection away from expression within the organization, subject to sanction via contract law, employment law, fiduciary duties and duties of care, and securities law, and toward expression by forking the code.

It is obviously true (to borrow a well-known phrase associated with Ostrom) that DAOs are no panaceas (Ostrom and Cox 2010), just as corporations are rife with poor decision making and harmful impacts. The code underlying the three key layers of a DAO – the blockchain, the smart contract, and the digital asset – is open and therefore stable so long as trust among developers persists to the degree that forks are avoided. The code is changeable and adaptable to the degree that DAOs can be repurposed in small and large ways to accommodate changes in the ambitions of their members. If the DAO is an investment vehicle, the investing ambitions of its members may change; the DAO may even fail, if investment returns don’t meet member goals.

But the technical sophistication needed to participate effectively in DAO governance is limited to a small class of experts worldwide. Because DAOs assets and members inevitably touch the ground of the non-blockchain world, additional layers of institutional trustworthiness are needed to ensure their functionality. The economic value created by DAO entities (that is, positive spillover effects) may be recognized outside of those entities only at a discount, as value encoded in tokens has to be converted to other currencies in order to be usable in other markets, or not at all. Ambitious claims that NFTs would create stable and secure markets in

digital versions of copyrighted works have largely proved untrue; the NFT market is no more stable than the auction market for material artworks – which is largely a product of elite psychology rather than fixed worth (Frye 2018). In that sense, and again focusing largely on their knowledge commons dimensions, DAOs are not as fully autonomous as initially described, and as a result they are not necessarily any more successful than corporations in solving first order social dilemmas or in avoiding second- or third-order dilemmas.

c. Social, cultural, technological, and economic context

DAOs, like blockchains, have been characterized both by proponents and by some researchers as examples of governance “by code” (Esener 2024). There is a kernel of accuracy in that description, in the sense that formally and technically, transactions and records of ownership on blockchain networks appear to be entirely “on-chain,” that is, endogenous to those networks and to related smart contract and payment layers.

In multiple respects, however, the claim is misleading. Multiple commentators have observed how DAOs and the idea of DAOs as autonomous, self-governing communities have histories and motivating ideologies, going back not only to the idealism of the mid-1990s and late-1990s internet (@keikreutler 2021; Turner 2008) but also earlier, to a range of phenomena operating both outside the market (utopianism in communal living) and in polycentric and decentralized decision making in industrial and public sectors (Seidman 1952).

The key here, as in other knowledge commons governance cases studies, is recognizing that the virtues and drawbacks of DAO governance should not be assigned fully to the operation either of human or technological agents operating within the boundaries of the entity, coordinating their actions and then causing the entity to interact with others. Here again, the “autonomous” corporation or DAO is functionally autonomous only in part. At multiple layers of practice its human operators have histories, ideologies, and preferences that cause the entity to be constructed and operated as it is. Case studies of traditional corporations usually have little trouble distinguishing between an idealized model of the firm as an imagined “nexus of contracts” and an actually functioning corporation (Stout 2017). The study of DAOs should not be seduced by the premise that DAOs are, analytically, entirely different from the latter.

d. Action arenas and rules-in-use

“Governance” is often reduced analytically to “the rules,” both formal and informal; we take a broader view of governance as practice in context.

As Sanfilippo, Frischmann, and Strandburg (Sanfilippo, Frischmann, and Strandburg 2018) observe, “*Action arenas* serve as the core units of IAD and GKC analysis, functioning as policy analysis equivalents of social action and interaction settings or Goffman’s frames. An action arena is simply a recurring type of situation in which community actors interact with one another.” Recognizing the challenges of identifying and analyzing a single “right” action arena in a polycentric social system, McGinnis introduced the concept of “adjacent action arenas” (McGinnis 2011), which has been adapted to the GKC setting by Cole and Gindis (Chapter XYZ, this volume). Investigating arena arenas of all sorts means focusing on functional attributes and implications of patterns of interaction rather than only on definitional specificity.

We therefore do not limit the focus of GKC analysis to DAOs to “the DAO” as such as “the” or the only relevant action arena. Identifying action arenas in a polycentric context means asking whether the DAO is being characterized accurately in context, so that useful levels of details are captured relative to the DAO itself as well as relative to activity taking place off the blockchain and in ways that permit the data to be compared effectively with data generated from other cases – specific DAOs, or non-DAOs, such as the traditional corporate form? Proceeding at the right levels of generality facilitates comparison across DAOs and between DAOs and other governance systems.

Questions here include both how DAO resources are created and used, and also where and how membership is determined (to the extent to which that might be treated independently of transactions); where administration takes place; where enforcement takes place and disputes are resolved; and where and how rules are formed and interpreted. This perspective aligns with Dekker and Kuchař’s (2024) framework in identifying key governance functions – resource allocation, membership, administration, enforcement, and rule-making – as structured by different actors within a system. Governance is not monolithic. Rather, governance structures vary based on who controls these functions and the degree to which these functions are integrated or stratified.

“The rules” are critical, and they are critical in part because of their definitional roles as well as their operating roles. Per Ostrom, we refer to these as “rules-in-use” to connote their significance as practices rather than only as structure or architecture. As Allen et al. (2021) observe, one of the most important contributions that Ostrom makes to the field of blockchain governance is the priority that should be given to building a “grammar” of relevant rules.

We focus on three types of rules-in-use, though in practice they reduce to a single technological construct, and we distinguish among several “action” arenas.

The three key types of rules are membership rules, decision making rules, and conflict resolution rules. In DAOs, all three are combined technically in code. In principle, anyone can become a member of a DAO by acquiring a relevant token; anyone who is a member can participate in DAO decision making; disagreements or conflicts about DAO governance are resolved on-chain, via the consensus mechanism. Unlike a classic firm, which relies on hierarchies of human responsibility, capability, and judgment, from a technical standpoint DAOs fulfill their promise of egalitarian decentralized practice. DAOs largely avoid the perils of power asymmetries and domination that are said to contaminate firms operating in market economies (DuPont 2024).

That said, there is no full avoidance of power dynamics, a fact that is exposed once we examine different action arenas as intersecting but distinct governance settings. The blockchain layer as such is a species of shared infrastructure, control of which is embedded in individual propertized objects – tokens – distinguishing it from shared physical infrastructures such as highways and bridges (Grimmelmann and Windawi 2023) and shared social infrastructures such as organizational hierarchies (Amin and Hausner 1997; Borrup 2011). In the material infrastructure setting, power dynamics are expressed as dilemmas of underproduction and possible monopoly control, leading to governance framed as government ownership, regulated industry ownership, or open access – a species of commons (Frischmann 2012). In the blockchain setting, power dynamics are expressed in terms of “standard” dilemmas of wealth accumulation rather than in terms of access to the resource (Pistor 2019).

e. Relevant legal frameworks

The typical start to a knowledge commons case study includes attention to relevant legal frameworks, as those may define relevant resources (such as patents

and copyrights) or community or collective entities (such as open source software development communities, which are defined in part by open source software licenses). With DAOs, that approach founders, as the premise of these entities is that they are self-governing, with membership, decision making, and dispute resolution processes closed off entirely from formal legal systems.

In practical terms, walling off DAOs completely from legal institutions is not feasible, even if (to some) it is desirable. Each actor with interests in DAOs at different levels – including developers, miners, users, token holders, validators, all of which may be either organizational/institutional as well as individual – has a legal, economic, and social status that exists outside of the DAO environment. Just as the classic firm faces a boundary question, so do DAOs. Just as the boundary question for the classic firm leads to important interventions from a law and regulation standpoint, DAOs are increasingly exposed to the question: should they be regulated or otherwise subject to “legal” ordering, and if so, how (Reyes and Hurt forthcoming; Reyes 2021)? Importantly, how does the response to those questions affect our characterization of DAOs as knowledge commons?

The second question has a more straightforward answer than the first. We believe that the GKC framework for knowledge commons case studies remains useful and important for studying DAOs even as various forms of legal order intrude more deeply into DAO operations and begin to shape their boundaries. Dekker and Kuchař (2021) demonstrated that knowledge commons concepts are broadly applicable to private market settings as well as to more self-evidently “communitarian” organizations. As we noted above, the question to be analyzed is not whether an organization “is” a commons or not but rather whether the knowledge commons framework is useful in understanding governance of a shared resource.

The first question – what is the likely character of “legal” regulation? – has both conceptual and technical answers.

The interesting conceptual question has to do with the fact that DAOs claim not only functional self-governing powers but also a kind of right of self-determination. In that effort, DAO organizers are aligned, at least indirectly, with numerous valuable social institutions through history, all of which have achieved dramatic degrees of governance autonomy relative to both markets and states: universities, religious organizations, philanthropies, and neighborhood and volunteer organizations. That is not to say that formal law is irrelevant to these things; they

are regulated in many different ways. Nor are they fully independent of the market. To own real or personal property, to hire employees, to publish and promote materials all require engagement with market firms and processes. What matters, instead, is the existence of the community or collective as a source of normative order. The university as an institution (not to mention individual universities) sets and enforces its own normative priorities. The virtue of self-governing communities has been recognized repeatedly, from De Tocqueville through Putnam (2000). In that respect, DAOs may tap into a robust tradition, and as knowledge commons governance research is useful to study those phenomena, it likewise remains useful to study new things such as DAOs.

Using the GKC framework means not only adhering to conceptual integrity but also getting the empirical details right, and here the technical aspects of law and DAOs will be fascinating to observe as they evolve. To a significant extent we expect to see regulators trying to “domesticate” DAOs, especially in the US and Europe, by attempting to assimilate DAO structures and capabilities to what has been tried and found effective with respect to corporations. DAOs and related artificial entities may be given recognized entity identities or personalities, as “things in themselves,” akin to but not identical to corporations or corporate-like actors, with legal rights and powers and with legal obligations (Li forthcoming).

Corporations have forms of accountability to people and entities outside the boundary of the firm, both as corporate undertakings and, under limited circumstances, in the names of their managers. Particularly in financial markets contexts, corporations have legal obligations to identify, manage, and disclose various forms of risk, to deter and refuse to participate in fraudulent practices, not to engage in money laundering, and to devise mechanisms to reasonably ensure that the entity and its people and assets are secure and stable. As interests of the state and of the broader national and global so-called community, equivalent themes are likely to be expressed *via-a-vis* DAOs, or have been expressed already (Naudts 2023). We do not think, however, that the push to wrap DAOs in certain forms of legal order compromises their essential character as decentralized decision making entities.

The possibility of wrapping DAOs in one or more legal frameworks adds an additional, important nuance to our GKC examination: classic law and legal institutions bring into focus the relative importance of human judgment and human communities of expertise in both the internal dynamics of DAOs and in external evaluation and regulation of DAOs. Blockchain networks are famously and

powerfully self-executing; decisions are made and recorded on the chain, giving rise to the belief that the “trustless” character of blockchains is part of their special power. There are no humans to corrupt, or to defect, or to make errors. By contrast, law is full of humans, often formed into expert communities: trained lawyers, judges, and (often) legislators, developing and interpreting the codes and texts of the law and using law as normative order to constrain both lay humans and also the imaginations of humans as expressed in machines. There is a sense, in short, that the very purpose of the law is called into question by the very idea of the DAO.

Notably, framing the topic in that way steps well beyond existing debates about the theory of the firm, the character of corporate governance, about the relationship between shareholders and stakeholders, between the relative importance of maximizing profits or returns and that of the normative purposes that a firm is created to serve, whether those are to deliver valuable products or services or productively employ citizens of a community. In one respect DAOs offer a somewhat conventional case study of a sociotechnical knowledge commons. In others, DAOs challenge researchers to think imaginatively about the ends of law and social science.

f. Outcomes

Assessing the outcomes of a commons governance system is notoriously difficult. Ostrom’s work was largely premised on the idea the commons management of a natural resource system could be as productive as a market-based or state-managed system, with added benefits accruing via the spillover effects of community participation in governance. In the knowledge and information context, “productivity” has no accepted definition, and it is also widely acknowledged that knowledge and information often have social virtues that far exceed their value only as industrial-style “resources,” inputs into production mechanisms. Sometimes characterized as cultural infrastructure, sometimes as economic asset, sometimes as a source of hedonic goods, sometimes as an attribute of a well-functioning civic sphere, knowledge and information often have to do with individual and collective well-being across multiple dimensions. It is unlikely that a single analytic framework can capture that range of purposes using a single evaluative rubric.

Given that difficulty, knowledge commons case study research has come to focus increasingly on the idea that successful knowledge commons governance systems

do not necessarily only produce and sustain “more” or “better” knowledge. Instead, the resolution of social dilemmas involving shared knowledge often resolves via commons governance in sustainable, resilient, and equitable communities. Focusing on the interdependence of knowledge and community enables us to suggest that the future of research on DAOs and analogous “autonomous” entities lies not in a focus on their productivity but in the ways in which the DAO structure sustains and is sustained by some wholly or partly exogenous value or sets of values. Similarly, in suggesting that focus for DAOs, we draw on a diverse array of existing knowledge commons case studies, where the knowledge implications of knowledge commons governance are functionally indistinguishable from the community implications. That diverse array includes early citizen science collectives (Madison 2014), research universities (Madison, Frischmann, and Strandburg 2009), and contemporary “smart” urbanism (Frischmann, Madison, and Sanfilippo 2023), as well as blockchain networks themselves (Bodon et al. 2022).

In short, there are multiple possible “outcomes” of knowledge commons, some more clearly described using perspectives external to the system and to commons analysis itself, and some more clearly described using commons-specific and internal perspectives.

“External” perspectives on DAOs are chronicled well by Micheler, Werbach, and Kremer in their overview of DAOs and corporate law (Micheler, Werbach, and Krenner forthcoming). Analogizing DAOs to original joint stock corporations during the Industrial Revolution, DAOs arguably offer flexible, efficient, and equitable coordination of financial and human resources, aiming, as the corporate form does in principle, at productive social and economic uses. At the same time, and again reflecting patterns of corporate practice, DAOs have experienced internal conflicts and governance failures, and their decentralized premise means that it is far from certain that DAOs represent a viable long-term complement to the corporate form.

Similarly looking at DAOs as systems that may or may not meet social needs successfully, Reyes, and Reyes and Hurt, have investigated the comparative strengths and weaknesses of DAOs relative to various business organizations, including not only corporations but also partnerships and joint ventures partnerships and corporations (C. L. Reyes and Hurt forthcoming; C. Reyes 2021). Those analyses detail comparisons with the DAO form with respect to ways in which law traditionally domesticates and disciplines organizational forms: centrally imposed, state-mandated fiduciary duties, securities law, accounting

standards, transparency regulation, compliance with security obligations and money laundering rules, and so on. The persistence and viability of any particular organization is linked closely to centralized state regulation – or to its absence. Indeed, to a significant extent investors in DAOs tend to be entities themselves that operate largely outside the purview of securities regulation, so long as they do not seek public investment (venture capital funds, for example). It is fair to consider whether DAOs are, from this perspective, a form of regulatory avoidance.

The GKC framing brings to this question an explicit focus on two dimensions of DAOs. The first is its stress on DAOs as overlapping layers of shared resources rather than as simple objects for law or other governance. The second is the GKC framework's interest in examining the details of DAO communities. DAOs, like many knowledge commons, are concerned not only with producing knowledge or information "outputs" and supplying those to the broader world beyond, but also with the producing and sustaining DAO communities themselves. The distinction between the two phenomena is not sharp but is worth considering in several respects relative to the question of assessing outcomes. How do DAOs perform not only as knowledge producers, relative to criteria used for other business organizations, but also as dynamic self-governing communities?

It is evident from the discussion earlier that the idealized aims of DAOs may not be realized in practice. DAO governance conversations taking place on Discord or Telegram channels suggest that members signal their participation and preferences not simply via their behavior in transactions recorded on the blockchain but also via private chat. That fact creates the possibility of power imbalances and an absence of transparency. As in any community governance setting, some voices may be louder or more persuasive than others, and some voices may add little value to governance processes.

Moreover, DAOs have yet to demonstrate that their self-governing socio-technical character can sustain specific DAOs over time, as members come and go and as the purposes of the DAO may evolve. GKC research increasingly draws attention to questions of voice and exit in commons governance as measures of the durability and legitimacy of a commons system (Sanfilippo, Strandburg, and Frischmann 2021). A corporate shareholder who wishes to "exit" can do so, usually, by selling their shares but without necessarily involving more than a moment's reflection about the shareholder's participation in governing the firm or jeopardizing the continued existence of the firm or its business. Even the transfer of all of the shares will not necessarily lead to the demise of the entity.

By contrast, a DAO member does not own marketable “shares” in the same respect; a wholesale liquidation of the interests of a DAO member (sometimes known as “rage-quitting”) will lead, at scale, to the end of the DAO, which will either go out of existence in its entirety or be re-constituted via forking. A sizeable amount of investment in DAOs comes from venture capital funds, whose decisions to remain or exit any investment are rarely un-considered (Alon et al. 2025). (The practice of “rage-quitting” also highlights the fact that assessing outcomes from a GKC perspective may require examining DAOs at different points in time, that is, when the DAO is in formation, when it is operating, and when it is resolving conflicts or ending.) Sub-groups within a DAO may “exit” in part by forming subDAOs, which either enhance the functionality of decentralized DAO governance or re-create a governance hierarchy that makes DAOs less “communal” or distinguishable from corporations. It is possible that durable DAOs look more like classic corporations on the inside as well as being at least partly assimilated to classic legal regulation on the outside.

5. The Corporation, the Firm, and the GKC Framework

Studying DAOs as knowledge commons teaches lessons about DAOs themselves, and it also teaches lessons about how to analyze business organizations. This section summarizes how work on DAOs builds toward broader uses of the GKC framework relative to general business corporations and corporate governance.

Broadening the scope of the research begins with a reversal. The chapter began by drawing attention to research on the character of corporations as the context for the discussion of DAOs. Focusing on distinctions between DAOs and corporations sharpens the GKC attributes of DAOs. Collapsing those distinctions, at least in part, offers different advantages. How might GKC analysis bring out different, useful perspectives on corporations and corporate governance? The core instinct animating GKC research remains intact. Social dilemmas associated with shared knowledge and information resources may be addressed by institutions that are neither creatures of the state nor entirely derived from private law. Commons institutions may comfortably co-exist with market capitalism rather than operating in opposition to it. Could a global pharmaceutical company be characterized usefully as a knowledge commons? If so, how? And how would that characterization offer an accurate understanding of the organization and performance of actors within and in partnership with that company?

Deakin (2012), with which the chapter began its review of DAOs, steers analysis of the corporation toward institutional analysis because Deakin recognizes the pragmatic limitations of the shareholder primacy model of the corporation. The model fails to recognize the practical significance of the multiple, overlapping claims of different corporate stakeholders: not only shareholders, but also managers, employees, key suppliers, customers, business partners, and possibly adjacent communities. His approach, like that of the GKC framework, is to try to describe the corporation as it actually works. Deakin uses commons concepts to assemble those stakeholders in a dynamic governance model, accepting but not demanding that corporations as they actually operate face multiple dilemmas and adopt multiple governance strategies. The corporation is an institutional solution to multiple collective action problems directed to decision-making as to resource production and distribution. In a way, Deakin's view is far from novel; Knight (1921) described business organizations as complex structural responses to the imperatives of decision-making in environments characterized by uncertainty and risk.

Even in the absence of the additional layers of analysis prompted by the GKC framework, Deakin's model suggests that the pharmaceutical company may govern some of its functions or resources as commons, that is, as shared resources governed so as to allow contribution, access, and use by multiple stakeholders. Research and development resources offer an obvious candidate. The GKC framework and its attention to knowledge and information resources add layers and nuances to that approach, both sharpening it and extending it.

In short, taking DAOs as case studies of knowledge commons suggests that the corporation itself, both as a conceptual form and as an actual entity, may be characterized as *knowledge commons*, with the implication that the social dilemmas which the corporate form addresses are principally those associated with shared knowledge and information resources. As with other knowledge commons, the corporation, , need not be viewed exclusively as a state-created subject and object. Not only may corporations in markets govern resources as commons, but also the resources that constitute the corporation in the first place may be viewed in knowledge commons terms. In both senses, governance consists of the practices and techniques by which stakeholders in the entity make decisions that produce and reproduce its form as well as its products or services

Scholars have often viewed the corporation as a collection of largely fixed legal rules intended to facilitate cooperative activity (Simon 1991). Because a GKC-

based starting point instead takes the corporate entity as the product of structured knowledge sharing, research should look for ways in which the corporation, generally and in any specific case, is as capable of being modified (from the outside) and learning (from the inside) by private management and collaboration as well as by change to public law that respond to new and changing social dilemmas. Governance is adaptable and changeable from top to bottom, not only with respect to specific corporate decisions.

This is ultimately what the study of DAOs teaches the study of the corporation. DAOs make explicit the knowledge commons character of the rules and practices and techniques that define them. For corporations, the socially-produced character of the rules that give a corporation its identity and capacity, that is, of law itself and of governance, is often only implicit, or even hidden. GKC-based examination of the general business corporation makes that socially-produced character explicit and can track the sources and impacts of changes, in any particular corporation, over time.

In that spirit, looking at the role of privately-produced governance within the corporation, Cole and Gindis (Chapter XYZ, this volume) identifies the knowledge commons dimensions of what they refer to as “the corporate mask”: the stable identity of the corporation as a legally-recognized entity and actor, simultaneously empowered to deal with its own employees, with customers, with securities markets and financial institutions, and with third parties. That mask is validated by public law and market recognition, but its power lies in the capacity that it delivers to corporate managers and employees, and to company suppliers and customers, in determining the actual character of the entity’s business. The IBM Corporation today is in legal respects the same entity as the company given that name in 1924 and its predecessor, the Computing-Tabulating-Recording Company, established in 1911. although it is obvious that the business of IBM today bears only the dimmest relationship to its business a century ago. The syntax of that sentence is evidence of the significance of the corporate mask and how it enables private decision making within and on behalf of the corporation.

The corporate mask thus does what masks always do. It creates an artificial identity that shields from public view whatever the wearer wishes to shield. The research question is where the mask comes from and what gives it salience and credibility. The corporate mask draws both on the mechanics of corporate law itself, with techniques for recognizing registration and share issues, and also on a diverse array of additional legal forms, including employment law and trademark

law, each of which brings a range of experts and other institutions (courts and agencies in the public sector; suppliers, customers, and clients in the private sector) into governance practices that sustain the mask on a consistent basis across markets and across time. The significance of the mask and its character as collective governance rather than static “thing” is highlighted when its presence is challenged, as in so-called “veil piercing” or “corporate disregard” litigation that seeks to hold shareholders liable for corporate obligations (Dignam and Oh 2020). Though veil piercing often reaffirms a corporate entity rather than discarding it, such consideration evinces its socially constructed features.

The instinct to study knowledge commons began with the search for more accurate descriptions of innovation processes in practice (Madison, Frischmann, and Strandburg 2010). Along these lines, Deakin and Stichenko (2025) draw together corporate law (sometimes known as company law) with related bodies of law that bear on the design and function of the corporation (property law, employment law, tax law, the law of secured credit, and insolvency law, among others) to illustrate how these constitute systems of shared knowledge that together “code” the corporation as a market instrument, operating as an agent in its own right and collaborating with other similar entities in partnerships and joint ventures. The argument goes beyond the well-known idea that law itself is a public good. The corporation is constructed via processes and products of public resources (law) and private ones (assets of the corporation). It is that blend which is treated by market actors and others as an entity with capacity and agency, that is, the entity as person. Pistor (2019) relatedly, writes of the “code” of capital, describing legal systems as providing the foundations for financialized markets, implicating governance in the politics of wealth creation and distribution as well as in the technical details that produce market actors. Deakin’s argument suggests an extension to Pistor, namely the possibility that corporation law may be described as an instance of the “code” of commons.

6. Conclusion

This chapter has applied the knowledge commons research framework to the novel form of entity known as the Decentralized Autonomous Organization, or DAO. DAOs are purpose-built computer code-based membership organizations that encode transactions electronically, as smart contracts on blockchains. The result, to DAO proponents, is a so-called “trustless” entity that offers efficient (decentralized) self-enforcing decision making akin to what (centralized) corporation promise, but without the uncertainty and risks associated with human

managers, and without relying on enforcement of obligations via public legal institutions. A GKC-based review of DAOs demonstrates that governance of DAOs and governance by DAOs is anchored not solely in “trustless” computer code but instead in complex, polycentric sociotechnical systems of shared knowledge and information. Much of this, but not all of it, is produced by DAO members themselves as self-governing communities.

Studying DAOs as knowledge commons illustrates an important broader point about corporations and market economies. The institutionalists in economics were largely successful in articulating the ways in which a capitalist economy depends on rules. Implicitly or explicitly, the state is seen as a source of those rules. DAOs call that premise into question. Though corporations depend on rules, they need not all come from the state.

The next step is to see this pattern not as purely the product of private law or purely private activity. Rather, conceptually and empirically, the DAO deals in knowledge commons, a concept that gives empirical life to self-governing communities. We provide a framework for analyzing these commons. Since the work has been using examples to illustrate ideas, what is next is to embrace the empirical research agenda, with case studies describing the variation of DAOs – how they work, why they emerged, what is unique about some, and what they share in common. This agenda seems especially critical for understanding the autonomous corporation of the 21st century.

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