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# Decentralized Organizations: The Theory of the Firm and Ostromian Perspectives

Law Working Paper N° 846/2025
May 2025

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ECGI Working Paper Series in Law

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## Abstract

This paper examines Decentralized Autonomous Organizations (DAOs) through two theoretical lenses: the theory of the firm and Elinor Ostrom's institutional analysis framework. We argue that DAOs' diverse organizational structures preclude broad generalizations about their economic and institutional nature. Some DAOs implement hierarchical arrangements characteristic of firms, others adopt different organizational models. The use of smart contracts does not definitively determine whether DAOs should be classified as contractual, firm-like, or hybrid arrangements. The paper critically examines the concepts of autonomy and decentralization in DAOs, revealing them as aspirational rather than fully realized characteristics. This analysis contributes to the legal scholarly discourse by providing a nuanced understanding of DAOs' organizational nature and challenging simplistic categorizations of these emerging entities. It also assists practitioners in analysing and developing the structure of particular DAOs.

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Keywords: Decentralised Organisations, DAO, theory of the firm, Ostrom

JEL Classifications: K2

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Decentralized Organizations: The Theory of the Firm and Ostromian Perspectives

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30 April 2025

Abstract: This chapter examines Decentralized Autonomous Organizations (DAOs) through two theoretical lenses: the theory of the firm and Elinor Ostrom's institutional analysis framework. We argue that DAOs' diverse organizational structures preclude broad generalizations about their economic and institutional nature. Some DAOs implement hierarchical arrangements characteristic of firms, others adopt different organizational models. The use of smart contracts does not definitively determine whether DAOs should be classified as contractual, firm-like, or hybrid arrangements. The chapter critically examines the concepts of autonomy and decentralization in DAOs, revealing them as aspirational rather than fully realized characteristics. This analysis contributes to the legal scholarly discourse by providing a nuanced understanding of DAOs' organizational nature and challenging simplistic categorizations of these emerging entities. It also assists practitioners in analysing and developing the structure of particular DAOs.

## 1 Introduction

In this chapter we will analyse DAOs from two perspectives, the theory of the firm and the analytical perspectives developed by Elinor Ostrom. We will conclude that no general statements as to the economic or institutional nature of DAOs can be made. Some but not all DAOs adopt firm-style hierarchical arrangements and in so far as they have done so should be characterised as firms. Either way, and in contrast to the predictions made in early academic contributions, the use of smart contracts does not determine if or to what extent DAOs are either contractual, firm-style or hybrid arrangements.

We will further demonstrate that an analysis relying on the work developed by Elinor Ostrom reveals that DAOs are organisational arrangements that combine technology with other institutional elements such as values, beliefs, and legal organisational forms.

The chapter is structured as follows. In section 2 we will discuss the theory of firm and explain that firms are characterised by a hierarchical structure through which an entrepreneur instructs owners of production factors such as workers to carry out certain actions. Section 3 will introduce Elinor Ostrom's work, which is sometimes referenced by DAOs and their participants. We will examine the principles she developed for the analysis of common pool resources and the framework she suggested for the analysis and development of institutions. In section 4 we will examine

[1] The authors are very grateful to Vanessa Villanueva Collao, David Gindis, and Kevin Werbach for their generous comments and pointers to further literature. All mistakes are ours.

DAOs and their properties. We will examine their ideological roots and define the concepts of autonomy and decentralisation. We will conclude that both concepts are primarily aspirations and have not been fully implemented in practice. Section 5 will discuss DAOs from the perspective of the theory of the firm and conclude that there is too much variety in DAO arrangement to support general conclusions about them. Whether a specific DAO qualifies as a firm depends on its structure. DAOs that have incorporated firm-style arrangements and should be characterised as firms. Section 6 will demonstrate that the analytical framework developed by Ostrom and adapted by Gindis and Micheler for the analysis of corporate law is useful for the academic analysis of DAOs. The framework can also be used by practitioners who develop a particular DAO structure.

## 2 The theory of the firm

The theory of the firm addresses the question of why firms exist, what determines their boundaries, and how they are different from markets. It derives its origin from Ronald Coase's seminal 1937 paper entitled, 'The Nature of the Firm.'[2] Coase posed the question: If markets are efficient, why do firms exist?

In a market buyers and sellers search for offers to match their preferences amongst a range of sellers and buyers, negotiate terms, and enter contracts. Markets are decentralized.[3] Participants enter individual spot transactions with each other.

Coase observed that market transactions have certain costs. These are expenses incurred in finding suitable trading partners and relevant information, resources spent on negotiating and drawing up contracts, or expenses related to ensuring that the other party adheres to the agreement.

He argued that firms exist for exchanges that are associated with high transaction cost and so are more efficiently organised through the hierarchy of the firm rather than through the open market. His work laid the foundation for understanding firms as entities that emerge to avoid the transaction costs associated with market exchanges. The theory further suggests that a firm will expand until the costs of organizing an extra transaction within the firm become equal to the costs of carrying out the same transaction in the open market.

In contrast to a market a firm establishes a hierarchy. Decisions are taken by an entrepreneur, who instructs the owner of a production factor such as a worker supplying labour to carry out certain actions. The relationship between the entrepreneur and the owner of the production factor is hierarchical in nature. The latter have agreed to be bound by the decisions of the former.

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[2] Ronald Coase, 'The Nature of the Firm' (1937) 4 *Economica* 386.
[3] Harold Demsetz, *The Economics of the Business Firm: Seven Critical Commentaries* (CUP 1995).

Oliver Williamson built on Coase's work. He argued that transactions have three key dimensions: asset specificity, uncertainty, and frequency.[4] An asset is specific to a transaction if its value outside that transaction is lower than within it. A bespoke component part that serves a particular machine is, for example, specific. A standard part that has many use cases is not. Uncertainty is about the frequency and intensity of disturbances in a particular environment. Frequency refers to the number of times parties transact with each other. These three dimensions help to determine whether a transaction is more efficiently conducted in markets or within firms through hierarchies. High asset specificity, high uncertainty, or high frequency can lead to higher transaction costs in markets, making it more efficient to carry out a particular transaction within the boundaries of the firm.[5]

Further, a distinction can be drawn between ex-ante and ex-post costs. For markets ex ante costs include, for example, searching for and negotiating with a contractual partner. For a firm ex ante costs are high. It needs to be established through a bureaucratic process, hire managers and employees, and set up and run a system of monitoring, reporting and dispute resolution.[6]

Ex-post costs in markets are the costs arising when a contract needs to be adapted to changes in circumstances of either party. This includes the cost of re-negotiating or the cost of enforcing the contract through the courts. In firms changes in circumstances are resolved by managers imposing orders from above. Consequently, firms have relatively low ex-post costs.[7] Indeed, the firm is a form of governance that is designed with a view to adapting to changes in circumstances.[8] The adaptability of the firm nevertheless comes at a price. The incentives of participants of the firm are muted in comparison to the incentives of participants in markets.[9]

Williamson added further depth to this distinction by discussing hybrid forms that operate between the market and the firm and contain limited managerial structures.[10] This happens when the parties anticipate that adaptation to changes in circumstances will be required. Hybrid forms of governance are particularly useful when the parties anticipate high levels of uncertainty.[11]

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[4] Oliver Williamson, 'The Governance of Contractual Relations' (1979) 22 *Journal of Law and Economics* 116 at 118.
[5] Oliver Williamson, 'The Modern Corporation: Origins, Evolution, Attributes', 19 (1981) *Journal of Economic Literature* 1537 at 1546.
[6] Hanna Halaburda, Natalia Levina and Semi Min, 'Digitization of Transaction Terms with TCE: Strong Smart Contracts as a new Mode of Transaction Governance' (2023) 3 <https://ssrn.com/abstract=4501318> accessed 29 April 2025.
[7] Ibid 3.
[8] Oliver Williamson 'Comparative Economic Organization: The Analysis of Discrete Structural Alternatives' (1991) 36 *Administrative Science Quarterly* 269, 274-281.
[9] Ibid 275.
[10] Oliver Williamson (n 4); Halabura et al (n 6) 6; but see Geoffrey M Hodgson, 'The Legal Nature of the Firm and the Myth of the Firm-Market Hybrid' (2002) 9 *International Journal of the Economics of Business*, 37.
[11] Halabura et al (n 6) 3 and 6.

## 3 Ostrom

Elinor Ostrom's work is sometimes referenced by those involved in DAOs.[12] Two bodies of her work are of particular interest. She developed principles for the management of common pool resources. This aspect of her work engaged with the claim that common pool resources inevitably find a tragic end because rational actors maximising their own respective utility are predicted to overuse the resource leading to its depletion. Ostrom carried out empirical work to discover that under certain conditions common pool resources are sustained over time. She expressed these conditions in the form of eight design principles.[13]

These principles are 1) The boundaries of the resource and the rights of individuals or households are clearly defined. 2) The rules for expropriating from the resources and the rules for contributing labour, materials and/or money to the resources are related to the local conditions. 3) Most individuals affected by the operational rules governing the resources can participate in modifying them. 4) Those who monitor appropriation behaviour are identical with or accountable to those who appropriate from the resource. 5) Appropriators who violate operational rules are likely to receive graduated sanctions. 6) There is rapid access to low-cost conflict resolution mechanisms. 7) The rights of appropriators (users of the resource) to devise their own institutions (rules) are not challenged by external governmental authorities. 8) Large common pool resources are organised in multiple layers of nested enterprises.[14]

Ostrom's principles for the management of common pool resources have inspired a narrative model for the governance of business firms. In 2012 Simon Deakin proposed an approach that conceptualises the corporation as a commons.[15] In this view the corporation is a shared resource the sustainability of which depends on the participation of multiple constituencies in its governance. These constituencies are shareholders, employees, core suppliers and customers. He argues that this model of the corporation as a shared resources better describes the legal structure of the firm

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[12] Eg Ilia Murtazashvili, Jennifer Brick Murtazashvili, Martin BH Weiss and Michael J Madison, 'Blockchain Networks as Knowledge Commons' (2022) 16(1) *International Journal of the Commons* 108; Kevin Carson, 'Governance, Agency and Autonomy: Anarchist Themes in the Work of Elionor Ostrom' Centre of a Stateless Society Paper No 16 (Second Half 2013) <https://c4ss.org/wp-content/uploads/2014/01/Anarchist-Themes-in-the-Work-of-Elinor-Ostrom.pdf>; David Rozas, Antonio Tenorio-Fornés, and Samaer Hassan, 'When Ostrom Meets Blockchain: Exploring the Potentials of Blockchain for Commons Governance' (2021) 11 (1) *Sage Open*, <https://doi.org/10.1177/21582440211002526>; Sinclair Davidson, 'Decentralised Autonomous Organisations as Commons' (2024) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4795629> accessed 28 April 2025.

[13] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (CUP 1990); Elinor Ostrom, *Understanding Institutional Diversity* (Princeton University Press 2005); Elinor Ostrom, 'Beyond Markets and States: Polycentric Governance of Complex Economic Systems' (2010) 100 (3) *The American Economic Review* 641.

[14] Elinor Ostrom and James Walker, 'Neither Markets nor States: Linking Transformation Processes in Collective Action Arenas' in Michael D McGinnis (ed) *Polycentric Games and Institutions* (The Michigan University Press 2000) 427 at 437-440.

[15] Simon Deakin, 'The Corporation as Commons: Rethinking Property Rights, Governance and Sustainability in the Business Enterprise' (2012) 37 *Queen's LJ* 339.

where managers make decisions in relative autonomy from the shareholders or any other constituency. He further stresses that, at a normative level, the conceptualisation of the corporations as a commons will help to sustain the corporate enterprise and deliver benefits for its stakeholders as well as for society as a whole.

Along similar lines Janine S Hiller and Scott J Shackelford observe for the United States that at a positive level benefit corporations can be understood as providing a mechanism for the management of common pool resources.[16] Like Deakin they believe that conceptualising the business enterprise as a common pool resource normatively changes the conversation. The question for corporate law is transformed from how to manage the relationships between share- and stakeholders to how to develop and sustain the resources attributed to the corporations through collaboration by and for the benefit of its participants.

In addition to researching common pool resources and the factors securing their sustainability, Ostrom developed a framework for the analysis of and development of institutions.[17] This framework is not limited to common pool resources and applies to institutions more generally. It uses action situations as its focus point. An action situation arises when participants with diverse preferences interact. Examples of such interactions are the exchange of goods or services in markets, the collective solving of problems in meetings, dominating one another or arguing.[18] This perspective encourages researchers to examine such interactions between people by identifying and analysing the effect of factors such as the biophysical and material conditions the action situation is embedded in, the attributes of the community the participants are part of (for example their shared beliefs), and the rules governing the situation.[19]

Relying on broader institutional thought, one of us (Micheler) proposed a theory explaining the company as a legal tool facilitating autonomous organizational actions.[20] In this perspective organisations or firms bring about behaviour that would not exist but for the organizational context. They are real in their consequences. The corporate form acknowledges, supports, and legitimizes these effects of organisational action by providing separate legal personality and procedural rules for organizational decision-making and action. Separate legal personality facilitates not only autonomous contractual actions by firms and organizations, it also makes it possible for the legal system to hold incorporated organizations and firms liable in tort and criminal law.[21]

Connecting this approach with the work of Oliver Williamson and Elinor Ostrom, David Gindis and Eva Micheler have recently set out a narrative model of the company.[22] This

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[16] Janine S Hiller and Scott Shackeford, 'The Firm and Common Pool Resource Theory: Understanding the Rise of Benefit Corporations' 55 (2018) *American Journal of Business Law* 5.
[17] Elinor Ostrom, *Understanding Institutional Diversity* (Princeton University Press 2005).
[18] Ibid 14.
[19] Ibid 15.
[20] Eva Micheler, *Company Law – A Real Entity Theory* (OUP 2021).
[21] Eva Micheler, 'Separate legal personality – an explanation and a defence', (2024) 24 *Journal of Corporate Law Studies* 301.
[22] David Gindis and Eva Micheler, 'Institutional theory for corporate law: an invitation' (2024) 24 *Journal of Corporate Law Studies* 401.

model builds on Ostrom's framework for the analysis and development of institutions. It characterises the firm as an organization that is governed in several nested levels. The meta-constitutional level consists of a Companies or Corporation Act enabling individuals to set up a company by registering certain documents with Companies House and taking decisions about the content of its constitution. At the constitutional level the shareholders and directors rely on the respective legislation and the corporate constitution to make decisions on how the company is managed. In large companies they set the strategies that inform the activities at the lower levels. At the policy level senior and lower ranking managers translate these policies into instructions that inform the operational level. At the operational level participants take and execute everyday decisions. Like Ostrom's work, the model does not advance a normative agenda. It is analytical in nature and aims to provide a granular tool informing the development and implementation of normative interventions. The model can assist those preferring to orient corporate law towards the normative idea of efficiency and shareholder value as well as for those preferring normative concepts such as equality or social welfare. It invites scholars and practitioners interested in corporate law to consider that there is more to organizational action than decisions taken by directors and that corporate law needs to solve more problems than the alignment of incentives. It helps, for example, to integrate insights on the effect of individual beliefs, social context and corporate culture into the normative analysis of corporate law.

# 4 DAOs

## 4.1 Introduction

DAOs can be defined as entities that use blockchain, digital assets, and related technologies to direct resources, coordinate activities, make decisions, and distribute value. Vanessa Villanueva Callao reports that some scholars adopt a wide definition that characterises blockchain organisations such as Ethereum as DAOs rather than as the systems on which DAOs run.[23] We do not follow this approach here. We conceptualise DAOs as *using* rather than operating certain blockchains.[24]

Use cases are diverse but cluster around the unifying themes of enthusiasm for and familiarity with blockchain technology, and the possibility for organizing trustless and transparent systems that operate without centralized control.

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[23] Vanessa Villanueva Callao, 'Decentralized Governance (DeGov) An Experimental Study' page 15 (draft on file with authors).

[24] See also Vanessa Villanueva Callao, ibid; David Gogel, Brynly Llyr, Bianca Kremer, Aiden Slavin, and Kevin Werbach, *Decentralized Autonomous Organization Toolkit* (January 2023) 6 <https://www3.weforum.org/docs/WEF_Decentralized_Autonomous_Organization_Toolkit_2023.pdf> accessed 29 April 2025; Aiden Slavin and Kevin Werbach, *Decentralized Autonomous Organization: Beyond the Hype* (June 2022) 5 <https://www3.weforum.org/docs/WEF_Decentralized_Autonomous_Organizations_Beyond_the_Hype_2022.pdf > accessed 29 April 2025; for a literature overview on the origin and evolution of the term see Samer Hassan and Primavera de Filippi, 'Decentralized Autonomous Organization' (2020) 10 *Internet Policy Review* 2; Law Commission, *Decentralised autonomous organisations (DAOs) A scoping paper* (July 2024) vi and paras 1.1 and 2.6 <https://lawcom.gov.uk/law-commission-publishes-scoping-paper-on-decentralised-autonomous-organisations/> accessed 29 April 2025.

Participants have a 'shared social or economic mission',[25] and use DAOs to serve a broad range of purposes. There is much diversity in the way DAOs are used. [26] Some share similarities with business corporations. Members make contributions in the form of money or other resources including labour. In return they receive specific rights such as a portion of the organization's profit or losses or the right to take part in the organization's decision-making process.[27] Others are like co-operatives or charities giving members the right to access, manage or transfer the resources or services that the DAO controls.[28]

DAOs are shaped by the social norms and values prevailing in the environment from which they originate. Vanessa Villanueva Callao and Kevin Werbach et al stress that informal relationships and social norms play an important role in establishing trust and enabling collaboration between DAO participants.[29] Craig Calcaterra similarly argues that the stability of DAOs depends less on formal rules than on shared transcendent values—informal, often ineffable principles that cannot be codified without risking exploitation. In this perspective a DAO is defined not by its technology or membership, but by the values it expresses in practice.[30] These values are reinforced through the community's distinctive language use and shaped by the norms of social media platforms, which also serve practical functions in DAO formation, fundraising, and coordination.[31] For lasting success, governance must align with values that both transcend the system and remain embedded in its protocols.[32]

Today, DAOs serve broad ideological and political preferences. It is nevertheless useful to understand their libertarian origins. These will be examined in the next subsection.

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[25] Aaron Wright, 'The Rise of Decentralized Autonomous Organizations: Opportunities and Challenges' (2021) 4 (2) *Stanford Journal of Blockchain Law & Policy* 152 at 156.
[26] Charles Kerrigan, *Crypto and digital assets law and regulation* (Sweet & Maxwell 2024) 481; Law Commission (n 24) para 1.5 and chapters 3-5.
[27] See most recently the analysis by Wulf A Kaal, 'DAO Market Meta Analysis 2024' (2024) *U of St. Thomas (Minnesota) Legal Studies Research Paper No 24-15* <https://ssrn.com/abstract=4900875> accessed 29 April 2025; Aaron Wright (n 25) 156; Laila Metjahic, Deconstructing the DAO: The Need for Legal Recognition and the Application of Securities Law to Decentralized Organizations' (2018) 39(4) *Cardozo Law Review* 1533.
[28] Morshed Mannan, 'The promise and perils of corporate governance-by-design in blockchain-based collectives: the case of dOrg' in Julian Manley, Anthony Webster and Olga Kuznetsova (eds), *Co-operation and co-operatives in 21st-century Europe* (Bristol University Press 2023) 78-99 <https://hdl.handle.net/1814/76414> accessed 29 April 2025; Aaron Wright (n 25) 156.
[29] Vanessa Villanueva Collao, 'Understanding the Role of Informal Relationships, Social Norms and Emerging Power Structures in Decentralized Governance' (draft on file with authors); Kevin Werbach, Primavera De Filippi, Joshua Tan, and Gina Pieters, 'Blockchain Governance in the Wild' (2024) (3) 1 Cryptoeconomic Systems 1.
[30] Craig Calcaterra, 'The Transcendent Values Thesis for DAOs' (11 November 2024) *Blockchain and Society Handbook* (De Gruyter, 2025) 17 < https://ssrn.com/abstract=5018721> accessed 18 May 2025.
[31] Sandra Faustino, 'How metaphors matter: an ethography of blockchain-based re-descriptions of the world' 12 (2019) *Journal of Cultural Economy* 478. Aiden Slavin and Kevin Werbach (n 24) 6; Jungsuk Han, Jongsub Lee, and Tao Li, 'A Review of DAO Governance: Recent Literature and Emerging Trends' European Corporate Governance Institute Finance Working Paper No 1044/2025 5-7 <https://ssrn.com/abstract=5074046> accessed 29 April 2025.
[32] Craig Calcaterra (n 32), 17.

After that we will analyse the concepts of 'autonomy' and 'decentralisation'. We will see that both autonomy and decentralisation are theoretical aims that have not been fully implemented in practice.

### 4.2 Ideological origins

Before we analyse the concepts of 'autonomy' and 'decentralisation' we will briefly explain some of the ideological foundations of DAOs.

One of us (Gandorfer) shows that DAOs and the blockchain technology through which they are built share ideological roots with the early internet. Both innovations are deeply entangled with three overlapping libertarian movements forming in the late 1980s and early 1990s: extropians,[33] cypherpunks,[34] and anarcho-capitalists.[35]

Extropians, now known as the U.S. version of transhumanists,[36] and closely align with anarcho-capitalists, adopt a futurist perspective, emphasizing the role of technology in transcending human and societal limitations. Like anarcho-capitalists, they criticise what they see as government overreach but apply this critique to fields such as biotech and longevity research. VitaDAO, a contemporary transhumanist DAO, exemplifies this by challenging conventional regulatory constraint on early-stage biomedical research in longevity, a domain extropians critique as constrained by inefficiency and overregulation.[37] We will see below that VitaDAO also experiments with legal concepts such as IP rights, drawing funding not only from web3 entities and prominent crypto entrepreneurs such as Balaji S. Srinivasan but also from established biotechnology companies such as Pfizer.

The cryptography- and privacy-focused cypherpunk movement seek, as John Perry Barlow proclaimed in his *Declaration of Independence of Cyberspace*, a 'new Social Contract' for the internet—a world that is 'both everywhere and nowhere, 'where identities have no bodies', yet are 'distributed across multiple state jurisdictions'.[38] The declaration was a response to the *Telecommunications Act* of 1996 and contains a

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[33] The OED defines 'extropy' as 'A theoretical tendency or force which opposes entropy; a tendency for order to increase over time, either within a particular context or universally.' The founders of the Extropy Journal, Max More and Thomas Bell, frame 'extropy' as a futurist movement, philosophy, and mode of living and thinking that defies entropy and celebrates the limitless outward expansion purportedly inherent in human nature - a sentiment they openly tie to frontierism (Daniela Gandorfer, *Matterphorics*, Duke University Press, 2025).

[34] The OED defines cypherpunks as 'A person who advocates the use of cryptographic techniques to ensure privacy and anonymity in electronic communications.'

[35] Daniela Gandorfer (n 33).

[36] The OED defines transhumanism as 'a belief that the human race can evolve beyond its current limitations, especially by the use of science and technology.'

[37] <https://vitadao.medium.com/vita-fast-revolutionizing-governance-in-longevity-research-9cf1d2fc0cd1> accessed 29 April 2025.

[38] Daniela Gandorfer, 'Down and Dirty in the Field of Play: Startup Societies, Cryptostatecraft, and Critical Complicity' (2022) 33(3), *Law and Critique* 355; John Perry Barlow, 'A Declaration of the Independence of Cyberspace' Electronic Frontier Foundation, 8 February 1996 <https://www.eff.org/cyberspace-independence> accessed 29 April 2025.

strong U.S. libertarian rejection of governments and, importantly, legal concepts, including 'property, expression, identity, movement, and context'.[39]

Anarcho-capitalists expand this vision by focusing on privatizing governance and creating competitive markets for legal and societal systems. Timothy May, a key figure in both the cypherpunk and anarcho-capitalist movements, outlined in his book entitled '*Crypto Anarchist Manifesto'* a world where 'individuals and groups [can] communicate and interact with each other in a totally anonymous manner', relying on 'public-key encryption' and 'zero-knowledge interactive proof systems'.[40] His ideas anticipated blockchain's capacity to facilitate trust, reputation, and unregulated transactions without centralized authorities.[41]

Anarcho-capitalists, with a strong libertarian stance and a decades-long tradition of advocating for competitive governance, spontaneous order, and private legal systems grounded in Austrian School Economics, have invested substantial hope and significant resources into blockchain technology as a means to realize these ideals.[42] Notable examples include DAOs designed to support startup cities or pop-up villages and 'network states'.[43] The term 'network state' refers to the idea of building a state-like structure in a digital environment through blockchain technology.[44] The concept was popularized in the former Coinbase Chief Technology Officer Balaji Srinivasan's book entitled *The Network State*.[45] It envisions corporations evolving into state-like entities that privatize governance services—such as legal systems, courts, police, and healthcare—and offer them in competitive markets driven by supply and demand. These projects are often associated with high profile individuals, who have recently gained political traction in the United States, among them Peter Thiel and Elon Musk.

Tracing the roots of blockchain and DAOs is useful for understanding the origins and implications of terms such as 'autonomy' and 'decentralisation'. However, it is equally important to avoid reducing blockchain-based governance and DAOs to purely libertarian tools. DAOs have diverse use cases outside of their original libertarian environment. They are used to organise unions, cooperatives, commons-based

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[39] John Perry Barlow, ibid. Telecommunications Act of 1996, *47 USC* § 151 et seq (1996).
[40] <https://groups.csail.mit.edu/mac/classes/6.805/articles/crypto/cypherpunks/may-crypto-manifesto.html> accessed 29 April 2025.
[41] Ibid.
[42] Daniela Gandorfer (n 33) ch 1.
[43] <https://thenetworkstate.com/> accessed 29 April 2025.
[44] Balaji Srinivasan, for example, offers the following definition, 'A network state is a social network with a moral innovation, a sense of national consciousness, a recognized founder, a capacity for collective action, an in-person level of civility, an integrated cryptocurrency, a consensual government limited by a social smart contract, an archipelago of crowdfunded physical territories, a virtual capital, and an on-chain census that proves a large enough population, income, and real-estate footprint to attain a measure of diplomatic recognition.' <https://thenetworkstate.com/the-network-state-in-one-sentence> accessed 29 April 2025. However, the term is now defined in different terms by different groups in the blockchain space (see eg <https://www.afropolitan.io/>; <https://vitalik.eth.limo/general/2022/07/13/networkstates.html>; <https://theblockchainsocialist.com/category/podcast/overthrowing-the-network-state/>, accessed 29 April 2025).
[45] <https://thenetworkstate.com> accessed 29 April 2025.

communities, and initiatives supporting vulnerable groups such as refugees or smallholder farmers. They are also set up to address governance challenges in corrupt or conflict-affected regions.[46]

Either way we can note that all DAO projects are experiments in (self-)governance that aim to challenge traditional legal frameworks and institutional arrangements, such as international organisations, states, corporations, and (regulated) markets. They are informed by the belief that blockchain technology can offer alternative forms of governance, addressing the challenges typically encountered in cooperative human endeavours. Their ideological origins matter—not because all DAOs follow them, but because they ground the very concepts of decentralization and autonomy that continue to shape DAO design and discourse.

Having set out the ideological origins, in this section we will discuss the concept of 'autonomy' in the next section.

## 4.3 Autonomy

### Introduction

The adjective 'autonomous' in 'decentralized autonomous organization' refers to two related ideas: 1) the aspiration of DAO participants to achieve independence from the law and traditional (and centralized) economic and societal structures, and 2) the characteristics of smart contracts, which are computer programmes that automatically enforce rules and decisions.[47] We will see in this section that both forms of autonomy are theoretical ideas, which have not been fully implemented in practice.

### Autonomy as an ideological idea

The first idea denotes autonomy in a broad ideological sense: autonomy from national and international legal systems, from dominant market players, or from incumbent corporate structures. This idea of autonomy is articulated by various participants in the field. Nathan Schneider, for instance, emphasizes the importance of DAOs for experimenting with self-governance and advocates for a 'renaissance of creative governance possibilities',[48] while Melanie Swan anticipates a multiplicity of personalized and privatized legal frameworks.[49] Vitalik Buterin similarly envisions DAOs as social coordination tools, emphasizing governance systems that allow value-aligned

[46] See for example Ukraine DAO <https://www.forbes.com/sites/ericmack/2022/04/07/how-the-influence-of-crypto-in-ukraines-resistance-goes-beyond-money/> or <https://www.linkedin.com/pulse/dao-nions-future-labour-unions-joe-noss/> accessed 29 April 2025.
[47] See also Law Commission (n 24) para 2.37.
[48] Nathan Schneider, 'Beyond Cryptoeconomics: Platform Cooperativism and the Future of Blockchain Governance,' *The Reboot*, 14 October 2021 <https://resources.platform.coop/resources/beyond-cryptoeconomics-platform-cooperativism-and-the-future-of-blockchain-governance/>; see also <https://www.coindesk.com/consensus-magazine/2024/03/26/weve-seen-breakdowns-of-trust-nathan-schneider-on-how-to-democratize-the-web> accessed 29 April 2025.
[49] Melanie Swan, *Blockchain: Blueprint for a New Economy* (O'Reilly Media 2015 Sebastopol, CA) 17.

communities to deliberate collectively and independently from centralised state control. Drawing from participatory and democratic traditions, these models could, he emphasizes, help DAOs navigate complex social, economic, and environmental challenges beyond market logic.[50] Ukraine DAO, for example, was set up by individuals disillusioned by traditional institutions organising humanitarian aid.[51] Another proposal, known as futarchy, envisions governance through prediction markets, where policy decisions are guided by betting on measurable outcomes rather than voting.[52]

Some DAOs are specifically set up to circumvent government regulations and laws. Darcy W.E. Allen et al. mentions the case of Shapeshift, a cryptocurrency exchange that initially operated as a centralized platform. Its libertarian founder later decentralized its governance structure, a move explicitly aimed at circumventing regulatory constraints while preserving operational autonomy.[53]

We have already mentioned VitaDAO's experimentation with legal concepts such as NFT based IP rights. They propose mechanisms for commodifying data and sharing revenue from scientific inventions that operate outside of traditional corporate structures.[54]

The proponents of VitaDAO are also concerned with the bureaucracy involved in having experiments and drugs approved by national regulators and propose an alternative form for granting approval for conducting research and licensing outcomes.[55] This echoes May's prediction that 'emerging information markets and crypto anarchy' could reshape intellectual property rights. His aforementioned manifesto highlighted already in 1988 cryptography's potential to create alternative legal concepts and polycentric legal structures: 'Just as barbed wire enabled the fencing-off of vast ranches, redefining land and property rights in the frontier West', a minor mathematical discovery—in his view, cryptography—could become the 'wire clippers' dismantling the barbed wire around intellectual property.[56]

At the same time, blockchain technology is used to create funding and governance structures for public goods (e.g. Funding the Commons)[57] and environmental

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[50] Vitalik Buterin, *DAOs are not corporations: Where decentralization in autonomous organizations matters* (2022) <https://vitalik.eth.limo/general/2022/09/20/daos.html> accessed 29 April 2025.
[51] <https://ukraine-dao.notion.site/Ukraine-DAO-3a0e63c6190b4796890dec5c72a94872> accessed 29 April 2025.
[52] Examples include: MetaDAO, co-founded by Robin Hanson, tests governance through simulated prediction markets, while Optimum develops modular tooling to let DAOs use forecast markets to condition decisions on expected outcomes. < https://metadao.fi> and https://ggresear.ch/t/futarchy-vs-grants-council-optimisms-futarchy-experiment/57 accessed 17 May 2025.
[53] Darcy WE Allen, Chris Berg, Aaron M Lane, and Jason Potts, 'DAOs are adaptive governance engines' (2024) 4 and 6-10 <https://ssrn.com/abstract=4973930> accessed 28 April 2025.
[54] Tyler Golato and Paul Kohlhaas, *VitaDAO White paper V1.0, 3* <Whitepaper V1.0 - GitHubGitHubhttps://raw.githubusercontent.com › master › Vita...> accessed 29 April 2025.
[55] <https://www.vitadao.com/blog-article/a-beginners-guide-to-vitalia> accessed 29 April 2025.
[56] Timothy C. May, *The Crypto Anarchist Manifesto* (1988) <https://nakamotoinstitute.org/library/crypto-anarchist-manifesto/> accessed 29 April 2025.
[57] <https://www.fundingthecommons.io/> accessed 29 April 2025.

regeneration (e.g. Celo and Regen),[58] providing a tool for local self-governance and enabling governance models built around values difficult to quantify in conventional market terms.

It remains to be seen to what extent DAOs will succeed in either operating outside of the law or the traditional market economy.[59]

### (Autonomous) smart contracts

The second idea of autonomy is narrower. It refers to the fact that DAOs began as an attempt to replace traditional legal arrangements with 'smart contracts'.[60] Smart contracts are computer programmes which run on certain blockchains and define and/or automatically enforce some or all of the terms of an arrangement entered into by the participants.[61] They are referred to as 'smart' because of this automation.

Because smart contracts govern 'the standards and procedures of anyone interacting with, or taking part in, a DAO' they are considered to be 'the primary glue to manage member-to-member transactions'.[62] Unlike simpler blockchains such as Bitcoin, this functionality is limited to programmable blockchains and, despite inherent risks, enables a broader range of design possibilities and facilitates DAOs. Examples of such protocols are Ethereum,[63] Polkadot,[64] Solana,[65] or Cardano.[66]

Automatic enforcement is particularly beneficial in the context of DAOs because participants often have diverse interests, voices, and preferences and may be in different geographical regions.[67] DAOs commonly enable members to act under pseudonyms, using blockchain wallet addresses instead of real-world identities.[68] In this case participants are unable to evaluate their respective individual qualifications or trustworthiness. The automatic execution of agreements through smart contracts is a tool for ensuring reliability.

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[58] <https://celo.org/> accessed 29 April 2025; <Regen Foundation: HOMERegen Foundationhttps://regen.foundation> accessed 29 April 2025.
[59] Law Commission (n 24) paras 2.76 – 2.78, chapter 6 and appendix 4; for an early contribution on the question of how to regulate financial technology see Christopher J. Brummer and Yesha Yadav, 'Fintech and the Innovation Trilemma' (2019) 107 *Georgetown Law Journal* 235.
[60] Aaron Wright (n 25) 152-153; Law Commission (n 24) paras 2.12 – 2.17.
[61] This definition is adapted from Law Commission, *Smart Legal Contracts Advice to Government*' (CP 563 Law Com 401, 2021) vii <https://s3-eu-west-2.amazonaws.com/cloud-platform-e218f50a4812967ba1215eaecede923f/uploads/sites/30/2021/11/Smart-legal-contracts-accessible.pdf> accessed 29 April 2025.
[62] Aaron Wright (n 25) 155; Oscar Gorgogno and Edoardo Martino, 'Decentralised autonomous organisations: targeting the potential beyond the hype' (2024) 16 392 at 395-398.
[63] <https://ethereum.org/en/developers/docs/smart-contracts/> accessed 29 April 2025.
[64] <https://wiki.polkadot.network/docs/build-smart-contracts> accessed 29 April 2025.
[65] <https://solana.com/docs/core/programs> accessed 29 April 2025.
[66] <https://developers.cardano.org/docs/smart-contracts/> accessed 29 April 2025.
[67] David Gogel et al (n 24) 3
[68] Aiden Slavin and Kevin Werbach (n 24) 17; David Gogel et al (n 24) 11; Law Commission (n 24) paras 2.16 and 2,18.

Because the DAO's self-executing smart contracts operate on blockchain networks, they are considered immutable, meaning their code cannot be altered unless such alterations are enabled in the design.[69] Smart contracts produce a highly predictable structure. They can, for example, be programmed such that funds can only be released following a formal vote of certain participants.[70] They are therefore more deterministic in nature than contracts or hierarchies.[71] This has the advantage of requiring lower levels of trust between participants as the programme ensures that pre-agreed terms are enforced automatically when a trigger event occurs. Primavera di Filippi and Aaron Wright stress that the rigidity of code acts like a layer of control facilitating cooperation between participants.[72]

Smart contracts, while creating high levels of certainty, also have disadvantages. Unlike legal contracts, which can be adapted by the courts to changes in circumstances, smart contracts are not necessarily modifiable in this way. They are therefore less suitable for environments that are uncertain.[73] Their rigidity can cause problems, for example, when there is a 'bug, issuer or regulatory concern'.[74] This disadvantage is addressed in practice by programming smart contracts such that they can be modified.[75] Some DAOs also provide exit options, which will be discussed below.[76]

Smart contracts are used for several functions, such as proposal management and members onboarding.[77] We will analyse two particular functions below: 1) rewarding participants for their contributions and 2) voting.

Smart contracts facilitate the determination and payment of rewards for contributions, which are made, for example, by providing funding, operational support, participating in governance, giving advice, or supporting 'community building' for example by organising events, discussions, or collaboration.[78]

The use of smart contracts for facilitating rewards comes with challenges. If DAOs are used to reward contributors for work, for example, there can be a problem with

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[69] Aaron Wright (n 25) 158.
[70] Ibid. at 162; Law Commission (n 24) para 2.62.
[71] Aaron Wright (n 25) 161.
[72] Primavera De Filippi and Aaron Wright, *Blockchain and the Law* (Harvard University Press 2018) 135; Aaron Wright (n 25) 163; see also Sinclair Davidson (n 12) 10; Oscar Gorgogno and Edoardo Martino (n 62) 426.
[73] Hanna Halaburda et al (n 6) 16.
[74] Aaron Wright (n 25) 158.
[75] Kevin Werbach et al (n 29) 1, 6.
[76] [].
[77] See also Law Commission (n 24) para 2.53 – 2.61; Shaanan Cohney, David Hoffmann, Jeremy Sklaroff, and David Wishnick, 'Coin-operated Capitalism' (2019) 119 (3) Columbia Law Review 591 analysed 50 ICOs and compared the promises made in their respective white papers with the code implemented. They found that there were significant discrepancies. This question will not be further discussed here.
[78] <https://elkpenn.com/blog/dao-community-building/>; <https://www.fundingthecommons.io/> accessed 29 April 2025.

uncertainty of compensation.[79] To address this problem, DAOs have integrated reputation-based frameworks such as Colony.[80] Members of DAOs which use the Colony framework earn 'reputation' by completing tasks, successfully managing projects, or otherwise contributing to the DAO's goals within specific domains. The level of reputation achieved informs the voting power, which in turn affects the remuneration paid. A smart contract then automates reward distribution. DAOstack facilitates proposal evaluation and resource allocation through reputation-weighted voting.[81]

The rigidity of smart contracts is further modified by functions that enable participants to exit. Moloch DAO, for example, introduced the 'rage quit' function,[82] allowing members to exit the organization and withdraw a proportionate share of the treasury if they disagree with a governance decision before it is executed. DAOs can also be restructured through a 'fork', where the underlying blockchain protocol is modified allowing part of the community to choose a different path.[83] A well-known example is the 2016 Ethereum hard fork following The DAO hack, which resulted in the creation of Ethereum Classic.[84] Other exit mechanisms include token redemption systems, enabling members to exchange tokens for treasury assets; buyback and burn programs (MakerDAO), where tokens are purchased and destroyed;[85] and exit auctions, where tokens can be sold transparently to other members or external buyers. In some DAOs, time-locked vesting schedules or delegation reassignment (a form of transferability) offer partial exit possibilities (Gitcoin DAO),[86] while full liquidation events occur when DAOs wind down, distributing remaining assets proportionally to token holders. There are also arbitration programmes and systems that DAOs can adopt to resolve conflicts. An example for this is Kleros.[87]

Another application for smart contracts is voting. For many DAOs voting decisions organised through a smart contract are automatically enforced, provided they reach the required threshold.[88] The technology facilitates participation of stakeholders located in

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[79] For an analysis of DAOs from the perspective of labour economics see Nataliya Ilyushina and Trent Macdonald, 'Decentralised autonomous organisations: A new research agenda for labour economics' (2022) 5(1) *The Journal of The British Blockchain Association* 50.

[80] <https://blog.colony.io/what-is-reputation-based-voting-governance-in-daos/#:~:text=Earning%20Reputation%3A%20Members%20earn%20reputation,the%20meritocratic%20ethos%20of%20Colony> accessed 29 April 2025.

[81] Alex Rea et al, *Colony Technical White Paper* (16 February 2018 version cb41534) <https://uploads-ssl.webflow.com/61840fafb9a4c433c1470856/639b50406de5d97564644805_whitepaper.pdf> accessed 29 April 2025.

[82] Sinclair Davidson (n 12) 14.

[83] Sinclair Davidson (n 12) 14; Kevin Werbach, The Blockchain and the New Architecture of Trust (The MIT Press 2018) 68-69; Oscar Gorgogno and Edoardo Martino (n 62) 418.

[84] <https://www.coindesk.com/consensus-magazine/2023/05/09/coindesk-turns-10-how-the-dao-hack-changed-ethereum-and-crypto> accessed 29 April 2025.

[85] <https://tradedog.io/inside-makerdaos-token-buyback-strategy/> accessed 29 April 2025.

[86] <https://gov.gitcoin.co/t/how-should-i-change-my-delegations-h2-2023/16831>: see also <https://blog.aragon.org/the-token-holders-guide-to-delegation/> accessed 29 April 2025.

[87] <https://kleros.io>; see also digital, non-territorial governance software such as <https://www.decentralizedgovernance.institute/ulex> accessed 29 April 2025.

[88] Law Commission (n 24) para 2.65.

different places and is credited with a high level of tamper-resistance.[89] This compares well to the system currently in places for voting shares.[90] Digital voting also makes it possible for different weighing mechanisms to be implemented.[91] Voting rules can be programmed to encourage voters to participate actively in the governance of a DAO.[92] The availability of a voting mechanism that is not only easily accessible but also designed to incentivise participation does, nevertheless, not entirely overcome voter apathy.[93]

Moreover, DAO voting occurs both on-chain and off-chain.[94] While on-chain voting ensures security and transparency through blockchain-based records, it can be costly due to 'gas' and transaction fees.[95] Off-chain voting on services such as Twitter (X), Discord, Telegram or Snapshot, potentially limits the transparency and accountability of DAO governance.[96]

We have seen in this subsection that both in relation to designing and paying rewards and organising voting smart contracts have been supplemented with functions modifying their rigidity. In addition, some DAOs have adopted founding documents, such as constitutions, to articulate principles and goals more explicitly.[97] All of this has to some extent undermined but not eliminated the ethos of 'code is law'.

**Summary**

We have seen in this section that DAOs aspire for autonomy in both a wider ideological and a narrower technological sense. Both goals are theoretical aims that have been implemented with some concessions. We will analyse the concept of decentralisation in the next section.

## 4.4 Decentralisation

Decentralisation in the context of DAOs refers to distributing decision-making power among participants rather than concentrating it within a central authority.

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[89] Aaron Wright (n 25) 160 and 164-165.
[90] For this see Eva Micheler and Elena Zaccaria, 'Digitising the UK Securities Market: The Case Against and a Proposal to Enfranchise Indirect Investors' [2024] *CLJ* 519; Eva Micheler'Custody Chains and Asset Values: Why Crypto-securities are Worth Contemplating' [2015] *CLJ* 533; see also Primavera De Filippi and Aaron Wright (n 72) 133-36; Michael A Schillig, ''Lex Cryptographi(c)a,' 'Cloud Crypto Land' or What? – Blockchain Technology on the Legal Hype Cycle', (2022) 86 *MLR* 31 at 45-49.
[91] For an overview of these see Jungsuk Han et al (n **Error! Bookmark not defined.**) 13-14.
[92] Aaron Wright (n 25)160 and 165.
[93] Primavera De Filippi and Aaron Wright (n 72) 139-40; Aaron Wright (n 25) 165.
[94] On off-chain voting and other off-chain governance practices see Kevin Werbach et al (n 29) 1.
[95] Gas fees are transaction costs on the Ethereum blockchain, paid in Ether (ETH) or gwei, compensating validators for securing the network. They fluctuate with supply, demand, and network congestion (https://www.coinbase.com/learn/crypto-basics/what-are-gas-fees#:~:text=Gas%20fees%20are%20transaction%20costs,during%20periods%20of%20network%20congestion.).
[96] David Gogel et al (n 24) 12 and 15; Sinclair Davidson (n 12) 5.
[97] David Gogel et al (n 24) 14; Aiden Slavin and Kevin Werbach (n 24) 13.

Decentralised means that decisions are made by all participants without power being allocated in the form of a hierarchy.[98]

Decentralisation is connected to but also independent of autonomy. It is possible to imagine a system that is 'autonomous' while being centralised. We can imagine a libertarian elite setting up a regime that is intended to be outside of the state but nevertheless dominated by its founders. The Soviet Union was an example of an economy that did not operate through a traditional market but was centralised.
In the context of DAOs, however, an aspiration for decentralisation is a characteristic ingredient. The connection between autonomy and decentralisation can be traced to the ideological roots of DAOs.[99] Cypherpunks, for example, critique centralised state power and believe that decentralisation is the way to achieve a better society. Anarcho-capitalists favour an unregulated free market economy and believe that decentralisation is a mechanism to create it. Both groups would like to 'exit' or withdraw from specific legal jurisdictions through decentralisation. Some speak of *crypto-secession*.[100]

Along similar lines the proponents of Ukraine DAO have, as we mentioned above, used decentralised blockchain-based crowdfunding to coordinate global humanitarian aid because they have no trust in existing institutional arrangements.[101]

Decentralisation can also be a way of avoiding regulation, which connects to particular lead actors. If an activity is organised in a decentralised manner these cannot be identified and, prima facie, the activity consequently falls outside of the letter of the law. We have already mentioned that Shapeshift adopted a decentralised model of decision-making to circumvent SEC regulations.[102]

Technologically decentralisation is implemented through smart contracts which organise functions that would normally be performed by a central decision maker such as the allocation and payment of rewards or the organisation of voting.

Because, at least at the most general level, DAOs consist of people 'loosely working together with a shared purpose' regardless of their physical location,[103] they are sometimes adopted by digital nomads seeking fluid, borderless economic and social structures.[104] An example for this is Decentraland, a virtual world governed by its

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[98] For a comprehensive analysis of the concept see Thibault Schrepel, *Blockchain + Antitrust* (EE Elgar 2021) 51 – 66.
[99] See also Law Commission (n 24) paras 2.34 and 2.37 – 2.40.
[100] Trent J. MacDonald, *The Political Economy of Non-Territorial Exit: Cryptosecession* (Cheltenham, UK: Edward Elgar Publishing, 2019).
[101] https://ukraine-dao.notion.site/Ukraine-DAO-3a0e63c6190b4796890dec5c72a94872
[102] Darcy WE Allen et al (n 53).
[103] Primavera De Filippi and Aaron Wright (n 72) 138; Aaron Wright (n 25) 152-153.
[104] On digital nomads see 52 Digital Nomad Statistics 2024 - The Nomad Almanac (available from https://thenomadalmanac.com/digital-nomad-statistics/, last visited 14 August 2024); some countries are offering tax advantages and special visas to attract digital nomads (Emma Agyemang, 'Countries wooing corporate digital nomads hope to make them stay', Financial Times 18 May 2024, available from https://on.ft.com/3KrQjqZ).

community through a DAO, demonstrating how decentralization enables users to create and manage assets without being bound by physical or legal territories.[105] Like autonomy, decentralisation is primarily a theoretical idea and unlikely to be implemented in pure form.[106] Several elements of centralisation and hierarchy have emerged in practice.

Different DAO participants can have different responsibilities where some exercise more influence than others. This introduces hierarchical elements into DAOs. For example, DAOs are normally set up by a relatively small founding team,[107] who at least initially determines and controls their design and processes.[108] From the perspective of these founders decentralization is an aim or an aspiration rather than part of the original setup with DAOs adopting 'progressive approaches' to decentralization.[109]

David Gogel et al note that disproportionate power for early contributors can be a problem.[110] This is confirmed by an empirical analysis conduced by Robin Fritsch et al.[111] They find that the governance systems of three prominent DAOs reveal 'extreme centralisation', resembling shareholder meetings where a few large investors dominate decision-making.[112] These are sometimes referred to as 'whales'.[113] However, the authors also observe that these large delegates rarely exercised their full voting power, often aligning their decisions with those of smaller token holders, thus mitigating potential governance imbalances in practice.[114] Wulf A Kaal recently analysed 50 DAOs and also found that many of these have centralised features.[115]

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[105] https://decentraland.org/whitepaper.pdf.
[106] Angela Walch, 'Deconstructing "Decentralization": Exploring the Core Claim of Crypto Systems' in Chris Brummer et al (eds) *Cryptoassets: Legal, Regulatory, and Monetary Perspectives* (OUP 2019) 39; see also David Rozas et al (n 12) 2; see also Sinclair Davidson (n 12) 10-12.
[107] Sinclair Davidson (n 12) 6, citing C Santana and L Albareda, 'Blockchain and the Emergence of Decentralized Autonomous Organizations (DAOs): An Integrative Model and Research Agenda', 182 (2022) Technological Forecasting and Social Change 121806, 5.
[108] Michael A Schillig, 'Decentralized Autonomous Organizations (DAOs) under English Law', (2022) 16 *Law and Financial Markets Review* 68 at 70-71.
[109] Kevin Werbach et al (n 29) 26 – 28; David Gogel et al (n 24) 11, 13, and 23.
[110] David Gogel et al (n 24) 11; see also Ellie Rennie, Jason Potts, and Joshua Tan, 'The "Natural State" of Blockchains: an Etnography of Validator Governance' (2024) <https://ssrn.com/abstract=4741076> accessed 29 April 2025; Romain Rossello, 'Blockholders and strategic voting in DeFi DAOs' governance' (2024) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4706759> accessed 28 April 2025.
[111] Robin Fritsch, Marino Müller and Roger Wattenhofer, 'Analysing voting power in decentralized governance: Who controls DAOs?' (2024) 5(3) *Blockchain: Research and Applications* 100208.
[112] Ibid 3 and 6.
[113] Jungsuk Han et al (n **Error! Bookmark not defined.**).
[114] Robin Fritsch et al (n 111) 5; see also Chainalysis Team, 'Exploring DAOs: Uncovering Web3 Ownership Realities' (Blogpost 27 June 2022) (https://www.chainalysis.com/blog/web3-daos-2022/) accessed 29 April 2025 and Sangita Gazi, 'In Code We Trust: Blockchain's Decentralization Paradox' (2025) 27 Vanderbilt Journal of Entertainment & Technology Law 59; see also Vanessa Villanueva Collao, 'Understanding the Role of Informal Relationships, Social Norms and Emerging Power Structures in Decentralized Governance' (draft on file with authors), who shows that hierarchy can also arise off-chain.
[115] Wulf A Kaal (n 27).

DAOs are not formally run by boards or managers,[116] but, in some, delegates are appointed to representative councils, which, according to David Gogel et al, act as quasi-boards.[117] These councils introduce a hierarchical element into those DAOs which adopt this structure.

We have already mentioned that DAOs rely on infrastructure built on blockchain technology. This leads to the separation of specific roles with different levels of influence.[118] Developers code and deploy the smart contract on a blockchain protocol.[119] Miners or validators authorise transactions that occur between token holders.[120] Smart contracts can be programmed to reward different contributors in different ways.[121] Some DAOs have core contributors entitled to receive tokens for ongoing contributions, and token holders or investors, which are the broadest category of DAO participants and do not receive tokens on an ongoing basis.[122]

Multi signature authorisation programmes also create points of hierarchy. They may enable some but not other participants to initiate and approve certain actions.[123] They are used, for example, to authorise changes to smart contracts or to control assets held by some DAOs.[124] Such assets are referred to as 'treasury', which has been said to resemble corporate capital, and normally managed through multi signature wallets.[125] Founders sometimes retain the ability to control the funds held in these wallets.[126] But even if they do not, those whose authorisations are required to release the treasury of a DAO have the power to take decisions affecting other participants.

Hyejin Park et al use literature examining constitutional arrangements in nation states to suggest three dimensions for measuring the extent to which DAOs are decentralized.[127] They evaluate DAOs in terms of political decentralization (number of accounts actively participating in voting and number of accounts actively proposing changes), administrative decentralization (dispersion of tokens, majority requirements), and economic or financial decentralization (quorum requirements and pass rate of proposals with quorum decisions).[128] In this model a high number of actively participating accounts, which not only vote but also propose changes, widely dispersed token holders and high majority requirements, high quorum requirements

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[116] Aaron Wright (n 25) 152.
[117] David Gogel et al (n 24) 16.
[118] See also Law Commission (n 24) paras 2.22 and 2.79 – 2.80.
[119] Uniswap DAO, for example, operates on the basis of a code developed by Uniswap Labs, which is legally incorporated in Delaware as Universal Navigation Inc; see also Jungsuk Han et al (n **Error! Bookmark not defined.**) 4.
[120] Sinclair Davidson (n 12) 5.
[121] Primavera De Filippi and Aaron Wright (n 72) 137.
[122] David Gogel et al (n 24) 12; Sinclair Davidson (n 12) 5.
[123] See also Law Commission (n 24) ix.
[124] David Gogel et al (n 24) 16.
[125] David Gogel et al (n 24) 11, 12, and 13; see also Law Commission (n 24) xii.
[126] Aiden Slavin and Kevin Werbach (n 24) 6, 7 (Constitution DAO) and 16 (BadgerDAO); David Gogel et al (n 24) 12.
[127] Hyejin Park, Ivan Ureta, and Boyoung Kim, 'Developing Dimensions and Indicators to Measure Decentralization in Decentralized Autonomous Organizations, (2023) 13 Administrative Science 1.
[128] Ibid at 4-5.

and a large number of proposals that are adopted with these quorum requirements in place suggest very high levels of decentralization.[129] The absence of such characteristics indicates levels of centralization.

Another aspect of centralization derives from the desire to create a link between DAOs and non-crypto native organizations, such as banks and other service providers. To connect decentralized governance with real-world legal frameworks, some DAOs use 'wrappers'. These are legal entities incorporated, for example, as foundations and operate bank accounts, hold other assets, or employ staff on behalf of the DAO community.[130] Those who control these entities have powers that affect the other participants introducing elements of hierarchy.

We have seen in this subsection that, like autonomy, decentralisation is an aspirational idea. DAOs have not completely avoided hierarchies. These have emerged because there are participants that have more influence than others. They also occur when DAOs use legal entities to connect with the real world. We will come back to this point when we examine DAOs through the lens of the theory of the firm.

### 4.5 Summary

We have seen in this section that DAOs serve a diverse range of purposes. Some DAO structures explicitly aim to replace the state with a blockchain-based libertarian model of governance. Other DAOs pursue a profit motive and can be compared with corporations. Others pursue other goals. Some are built to experiment with democratized decision-making and incentive models outside of traditional corporate structures. Some of these share similarities with cooperatives or charities.

We have further argued in this section that DAOs have their roots in particular ideological ideas but are used for a much broader spectrum of projects. They are designed to achieve the theoretical idea of autonomy, which is implemented through the theoretical idea of decentralisation. In practice both concepts are aspirations of DAO proponents and participants that have been implemented to a varied degree.[131] In the following section we will examine DAOs through the lens of the theory of the firm.

## 5 Theory of the Firm and DAOs[132]

As we have seen in section 2 the theory of the firm distinguishes markets, firms, and hybrid forms and predicts that transaction costs explain which of form of economic

[129] Ibid at 3-5.
[130] Kevin Werbach et al (n 29) 17-19; David Gogel et al (n 24) 11 (NounsDAO), 16 (Optimism Foundation), and 18; Oscar Gorgogno and Edoardo Martino (n 62) 420; Law Commission (n 24) para 2.21; Christopher J. Brummer and Rodrigo Seira, Legal Wrappers and DAOs (30 May 2022) available at https://ssrn.com/abstract=4123737 or http://dx.doi.org/10.2139/ssrn.4123737.
[131] See also Law Commission (n 24) paras 2.20 -2.23 and 2.36.
[132] Chris Berg, Sinclair Davidson, and Jason Potts, Understanding the blockchain economy: An introduction to institutional cryptoeconomics (Edward Elgar Publishing 2019 Cheltenham).

organisation prevails. In section 4 we concluded that DAOs aspire to organise activity in a less hierarchical manner and that smart contracts and reputation systems are a technology through which decisions can be taken and executed without appointing a central decision maker.[133] Academic scholars have begun to analyse the effect of DAOs on economic structure.

Hanna Halaburda et al write that digital technology has led to firms increasingly making decisions to out-source activity to the market causing the balance between firms and markets shifting towards the latter.[134] They believe that smart contracts will add to this effect and shift economic structure further towards the market in the future.[135] Along similar lines Primavera De Filippi and Aaron Wright suggest that DAOs will increase the prevalence of markets. They argue that smart contracts reduce the cost of coordination. Smart contracts could, for example, be used to develop a ride sharing system that operates without a centralized operator allowing drivers to keep a larger share of their revenue.[136] Ultimately, in their view, DAOs might reduce or even eliminate the reliance on traditional business organizations.[137]

There is more than one perspective on the effect of smart contracts. Hanna Halaburda et al, for example, caution that smart contracts have ex ante costs as they need to be programmed accounting for all future states, including rare events and so require a stable environment with low levels of uncertainty.[138] In contrast Darcy W E Allen et al observe that DAOs are highly adaptable because they can be set up and adapted at low cost.[139] They provide a case study of three DAOs and show how these have experimented with governance models in response to changes in regulation and market conditions. In their view, DAOs are adaptive governance engines.[140] It is possible that the first view reflects the properties of the early and immutable versions of smart contracts. We have mentioned that more recent smart contracts have integrated mechanisms that enable their modification, responding to the problems associated with the rigidity of their earlier predecessors.

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[133] See also Sinclair Davidson, Primavera de Filippi and Jason Potts, 'Blockchains and the economic institutions of capitalism' (2018) 14 Journal of Institutional Economics 639; Jason Potts, 'Douglass North and the Crypto-Economy' (24 September 2023) available at SSRN: https://ssrn.com/abstract=4581716 or http://dx.doi.org/10.2139/ssrn.4581716; Michael A Schillig (n 90) 40-43; Oscar Gorgogno and Edoardo Martino (n 62) 410-411.

[134] Ibid 7; see also Aaron Wright (n 25) 163.

[135] Ibid 10.

[136] Primavera De Filippi and Aaron Wright (n 72) 138-9; see also Darcy W.E. Allen, Chris Berg, Brendan Markey-Towler, Mikayla Novak and Jason Potts, 'Blockchain and the evolution of institutional technologies: Implications for innovation policy' (2020) 49 *Research Policy* 103865; and Hanna Halaburda (n 6) 10-11; see also the hypothetical example of a 'pure' DAO developed in Law Commission (n 24) chapter 3.

[137] Aaron Wright (n 25) 169-170; see also Oscar Gorgogno and Edoardo Martino (n 62) 426-427.

[138] Ibid 16.

[139] See also David Gogel et al (n 24) 9 and 11.

[140] Darcy WE Allen et al (n 53) 4 and 6-10.

We could draw a comparison between DAOs and digital platforms. These have been characterised as hybrid forms sitting somewhere between the market and the firm.[141] This would be a mistake however. Arrangements are so varied that general statements of this type are best avoided. The same is true also for digital platforms. We have seen this in the *Uber* case. The digital nature of the platform notwithstanding, drivers have been characterised as employees by the UK Supreme Court.[142] This was because the platform designed the digital relationships of drivers in a hierarchical manner.

We have seen above that a gap has opened between the theoretical aims of autonomy and decentralisation and their practical implementation. Hierarchical elements have been integrated into DAOs in several ways. Different participants have different roles and powers to make decisions that bind other participants. Founders appear to retain significant influence. DAOs use legal entities to open bank accounts or otherwise contract with other businesses or individuals. These are controlled by some but not other participants. While there is agreement that DAOs have potential to create less hierarchical structures than in other organisational environments, it is nevertheless clear that some DAOs have adopted firm-style hierarchical elements. The use of smart contracts, which was originally said to place DAOs into the market structure, has not turned out to have this effect.

We believe that no general statements should be made about whether DAOs are markets, firms or hybrids. Different DAOs adopt different structures.[143] They also change over time. Characteristics that we observe now may be outdated in a few months' time. Whether a DAO is a firm this is a matter of degree rather than principle. Corporations, cooperatives, and charities also operate some of their relationships in the form of spot contracts or contracts with limited managerial adaptability. Moreover, there is a broad range of designs within traditional organisational forms. Different jurisdictions make available different legal forms and give more or less influence to their respective participants. The hypothetical example of a peer-to-peer ride sharing system aside DAOs which adopt firm-style hierarchical elements are to this extent firms.

## 6 Ostromian perspectives

We have mentioned that Simon Deakin has characterised the corporation as a form of a common pool resource. This argument can also be found in relation to DAOs. Ilia Murtazashvili et al, for example, argue that blockchain networks represent knowledge commons governance because they rely on 'collectively-managed technologies to pool

[141] See for example Laurent Baronian 'Digital Platforms and the Nature of the Firm' (2020) 54 *Journal of Economic Issues* 214.
[142] *Uber BV v Aslam* [2021] UKSC 5. Regarding digital platforms and hierarchies see also Nofar Sheffi, 'We accept: the constitution of Airbnb' (2020) 11 *Transnational Legal Theory* 484.
[143] See also Kevin Werbach et al (n 29) 1.

and manage distributed information'.[144] In their perspective blockchain technology is a form of 'community governance to produce resources that both support and reflect collective action and self-governing communities with respect to business objectives and other purposes'.[145] Along similar lines David Rozas et al describe the technology as potentially enabling the creation of an artifact that facilitates decentralised (non-hierarchical) co-operation.[146] Ilia Murtazashvili et al further point to research that has shown that there is 'tremendous diversity' in the ways in which blockchains are organised.[147]

Sinclair Davidson also characterises DAOs as knowledge commons and uses Elionor Ostrom's framework for the analysis and development of institutions to examine DAOs through the three analytical criteria referred to earlier in the paper: resource characteristics, attributes of the community, and rules in use. He further concludes that DAOs have adopted all of the eight design principles identified in Elionor Ostrom's research and predicts that DAOs have the potential to operate as an organizational form in the longer term.[148]

From the perspective of the narrative model proposed by David Gindis and Eva Micheler we can develop insight into DAOs by distinguishing different levels of governance. The meta-constitutional level is the basis on which the constitutional framework of an organization is set up. For corporations the meta-constitutional level consists of a Corporation Act, based on which individual actors register a particular company or corporation. We have mentioned above that some DAOs use legal entities to enable them to interact with the legal system. For these DAOs the legislative documents governing how these are registered and operated form the meta-constitutional level. At this level we also find the regulatory environment that motivates the organisers of some projects to attempt to avoid regulation by adopting a decentralized model.[149] In addition, the meta-constitutional level of a DAO is shaped by the blockchain protocol within which it is programmed. These protocols each have their strengths and limitations and as such enable different ways of designing smart contracts. If a DAO adopts a conflict resolution system, the properties of this technology shape the meta-constitutional level. This level is also characterised by the formal rules and informal practices prevalent on the social media platforms, such as Discord or Snapshot, used by the respective DAO participants to launch and promote a DAO project.

The constitutional level concerns the governance of a specific DAO. At this level the analysis focuses on the rules that determine how a DAO takes and implements policy and operational decisions. We determine the purpose for which a DAO has been established and the values and beliefs which participants consider themselves bound

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[144] Ilia Murtazashvili et al (n 12) 108; see also Michael J Madison and Ilia Murtazashvili, 'The Decentralized Autonomous Corporatio as Knowledge Commons' in David Gindis and Pavel Kuchar, *Governing Corporate Knowledge Commons* (CUP 2025) (forthcoming).
[145] Ilia Murtazashvili et al (n 12) 109.
[146] David Rozas et al (n 12) 2.
[147] Ilia Murtazashvili et al (n 12) 111; see also Charles Kerrigan, *Crypto and digital assets law and regulation* (Sweet & Maxwell 2024) 481 and Kevin Werbach et al (n 29) 1.
[148] Sinclair Davidson (n 12) 5.
[149] Darcy WE Allen et al (n 53) 4 and 6-10.

by. Libertarian DAO projects, for example, value individual autonomy, freedom of speech, or free market entrepreneurialism. Participants in DAOs that are set up to reject the traditional capitalist economy identify with values such as equality, social justice, inclusion, or community (bottom-up) governance.[150] The properties of the specific smart contract rewarding contributors to the DAO for their work or other contributions are also part of the constitutional level. We further examine the methods available for modifying this contract or other ways in which the DAO can be adapted to changes in circumstances. We have mentioned that some DAOs have adopted a constitutional document or a particular conflict resolution system, which would also be relevant to determine the functioning of a DAO.

The operational level concerns ways in which DAOs affect their material and social environment. At this level we determine the extent to which constitutionally adopted rules are implemented in practice and the outcomes that they produce. We establish if and how the values adopted by a specific DAO inform operational outcomes. From a technological perspective we observe how well automated functions operate and how DAO decisions that are not automated are executed. Voting that is carried out off chain, for example, will need to be implemented formally in a DAO programme. A decision to reprogramme a smart contract or the release of treasury tokens will also require specific implementation.

An analysis that distinguishes different levels of governance not only assists academic scholars. It also helps practioners to identify and frame the questions that need to be addressed when DAOs are set up and developed. Advisors and participants need to identify the metaconstitutional blockchain protocol that hosts the DAO and the legal and regulatory environment that they will be affected by. At the constitutional level, they need to determine the purpose of a particular DAO and decide the properties of the smart contract and its interactions with the external environment. DAO practitioners are further well advised to consider the likely consequences of their design on the operational level.

We have seen in this section that the research tools developed by Elinor Ostrom are useful to guide research on how DAOs function and can assist practitioners in designing and developing DAOs.

## 7 Conclusions

In this chapter we analysed DAOs from the perspective of the theory of the firm and from the perspective of the work of Elinor Ostrom. The theory of the firm characterises economic arrangements as either markets or firms. Markets consist of peer to peer spot transactions. Firms adopt hierarchical structures. Elinor Ostrom has developed

[150] For an example setting out a vision for 'community (bottom-up) governance' see Puja Ohlhaver, Eric Glen Weyl and Vitalik Buterin, 'Decentralized Society: Finding Web3's Soul' (2022) <https://ssrn.com/abstract=4105763> accessed 29 April 2025.

analytical tools for the analysis of institutions and is sometimes referenced by participants in DAOs.

We traced the libertarian ideological origins of DAOs and argued that they have evolved from these roots to support a broad range of purposes and ideological preferences. We also analysed the concepts of 'autonomy' and 'decentralisation'. We concluded that DAOs are set up to achieve autonomy from either the state or traditional corporate arrangements through decentralisation. Both concepts, however, are not fully implemented in practice.

DAOs have many structures. It is not possible to develop a general statement as to their economic nature as either a market, a firm or hybrids. Each individual DAO needs to be assessed individually to determine the extent to which hierarchies are present. Smart contracts automate the enforcement of certain elements of arrangements. Like in the case of platforms the use of this technology does not per se predicate whether an arrangement is a contract, a firm style hierarchy or something in between.

We have finally concluded that the research tools developed by Elinor Ostrom for the analysis of institutions can usefully be applied to DAOs. Some DAOs can be characterised as knowledge commons where the design principles set out by Ostrom can be identified. We have also argued that the narrative model recently advanced by David Gindis and Eva Micheler in relation to the corporation can be usefully adapted to the analysis and development of DAOs.

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