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Built to last, not to scale: The long run of decentralised autonomous organisations

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ABSTRACT

The FTX scandal and crypto boom-and-bust cycles have called into question the sustainability of decentralised systems like DAOs. This article argues that inherent constraints will limit DAOs' mainstream adoption. We contend that the primacy of code in DAOs—represented by the code is law maxim—is overstated given semantic gaps in contracts. Crisis management is another serious bottleneck due to challenges of coordinating decisions without central authorities. Informal hierarchies may also emerge—in line with organisational theoretic concept of power clawing back, which would undermine decentralization objectives. Our analysis considers anonymous reputation verification, flexibility, and transparency to have more staying power and identifies scalability as the primary obstacle—stemming from high transaction costs and throughput constraints.

Introduction

The Decentralised Autonomous Organization (referred to as DAO hereinafter) represents arguably the most promising iteration of blockchain-based applications. As the recent FTX debacle and concerns regarding the solvency of Binance have surfaced, academics, policymakers, and the ordinary public are increasingly questioning the long-term viability and resilience of decentralised Web3 technologies (Wang et al, 2022; Weaver, 2021; Newitz, 2022; Marchetti, 2022). Somehow, this runs against the campaign of certain experts in the field and industry professionals—the latter of which are usually bullish. They contend that the technology underlying DAOs, which is also the foundation of Web3, is satisfactorily trustworthy (Ding et al., 2022a, 2022b). This technology is believed to have the potential to revolutionize various industries through decentralised decision making, efficiency, and transparency (Sheridan et al., 2022; Qin et al., 2022). Such touted advantages have theoretical applications in renewed organizational structures, financial transactions, supply chain management, identity verification, title registration, capital raising, governance, voting, and collaboration (Momtaz, 2022; Jemmer & Ibrus, 2023; Makridakis & Christodoulou, 2019; Augustin et al., 2023; Axelsen, Jensen, & Ross, 2022). DAOs can also replicate traditional functions of firms, such as pooling capital and making reinvestment decisions, with greater efficiency. (Murray et al., 2021). This has inspired capital flow to DAOs in pursuit of unlocking the next unicorn with potential applications in startup funding, corporate governance, platform economics, and energy sector (Boss & Sifat, 2023). Non-traditional sectors like philanthropy and collaborative fundraising are likewise keen—all due to their potential to effectively coordinate and manage assets in a value-enhancing manner (Santana & Albareda, 2022; Bellavitis et al., 2023). Furthermore, financial literature takes an interest in DAOs as a viable alternative candidate to traditional methods of raising capital. In this instance, DAOs stand as an adversary to venture capital and private equity firms as there is a potential to subvert the established paradigm of the firm (Singh & Kim, 2019). It is thus no surprise that DAOs have become a fertile topic for study across social sciences disciplines such as organizational design, corporate governance, management, social innovation, etc. In this paper, we diverge from the prevailing techno-optimistic

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consensus through an interdisciplinary analysis. We assess several—potentially underweighted—downsides of DAOs: crypto precedent fallibility, incentive manipulation risks, and ingrained technical compromises. Predicated on these, we flesh out an argument that these inherent constraints will pose scalability challenges for widespread DAO adoption. Thus, aspirational applications of DAOs as one infers from industry literature may need to be tempered.

The discourse on DAOs has undergone significant changes since 2022, which has been accompanied by a shift in policymakers' stance towards DAO oversight and regulation. Consequently, literature has yet to keep up with these modifications and their implications for these systems. Regulators are increasingly adopting more proactive attitude towards acknowledging DAOs within existing legal and tax frameworks. This is a potential game-changer because questions about the long-term viability of DAOs can now be contemplated within the context of DAOs' ability to comply with certain pre-existing formal standards. Most of the extant literature, however, concentrates on cataloguing the perceived or projected advantages and disadvantages of this organizational structure from either an architectural or coding perspective, or by corollaries against existing paradigms of organizational design. Additionally, a cluster of studies focuses on decision-making, e.g., the protection of community votes, incentivizing participation, etc. The concept of viewing DAOs as occupying their own separate, unregulated realm is also a prevalent theme. This paper defends the thesis that pervasive barriers around reconciling scalability with decentralization durability impose essential limitations on the speed and scope of DAO proliferation. By grounding analysis in context, critically weighing architecture, and tempering speculation with skepticism, we build a theory-and-evidence-based challenge to expectations of exponentially disruptive decentralised reach.

The primary objective of this paper is to answer the question, 'Are decentralised autonomous organisations (DAOs) durable over the long run?' This inquiry is motivated by increasingly frequent regulatory commitments and investments in recognising DAOs, a surplus of hype from tech-futuristic sources that often make grandiose promises while obfuscating risks, and the regulatory haste to integrate DAOs into existing frameworks (Hsieh et al., 2018). By investigating the systemic challenges facing DAOs in light of recent developments in crypto markets, we shed light on the space for their potential progression in a transformed landscape for blockchain instruments. Furthermore, we outline a roadmap for future research that moves beyond reconciling traditional organisational theory with DAO practice and works towards constructing a DAO-specific theory as we conjecture on maturation pathways for such specialised technologies.

We begin by tracing DAOs from ideological precursors to their current iterations. We collate their pros and cons from the literature, with intermittent references to the current praxis. We then conduct an original analysis – differentiating durable features from overhyped promises. We determine that the smart contract-induced immutability aspect of DAOs – typified by the 'code is law' maxim – is partially overstated due to contract semantic gaps and acute reliability challenges during crises. We link these deficits to the absence of central coordination and note the non-trivial risk of informal hierarchies emerging. Durable advantages of DAOs include anonymity, decentralised flexibility, and transparency. However, these pros face a bottleneck in scalability due to inherent throughput limits, costs, and governance complexity. We identify potentially fertile areas for future exploration, namely the excesses of speculative exuberance, regulatory uncertainty, and the lack of a governance theoretic framework to understand and explain this novel organisational template.

Traditional firms, cryptos, and DAOs

The following Sections trace the evolution of decentralisation in business and economics to the present state of affairs, culminating in DAO experimentation. Fig. 1 provides a snapshot to help the reader keep track of theoretical and industrial developments.

Theoretical genesis of the distributed organisation

The predominant focus of organisational design for resource-constrained entities has traditionally been on cost minimisation (Hax & Majluf, 1981). Therefore, resource allocation and identifying areas of

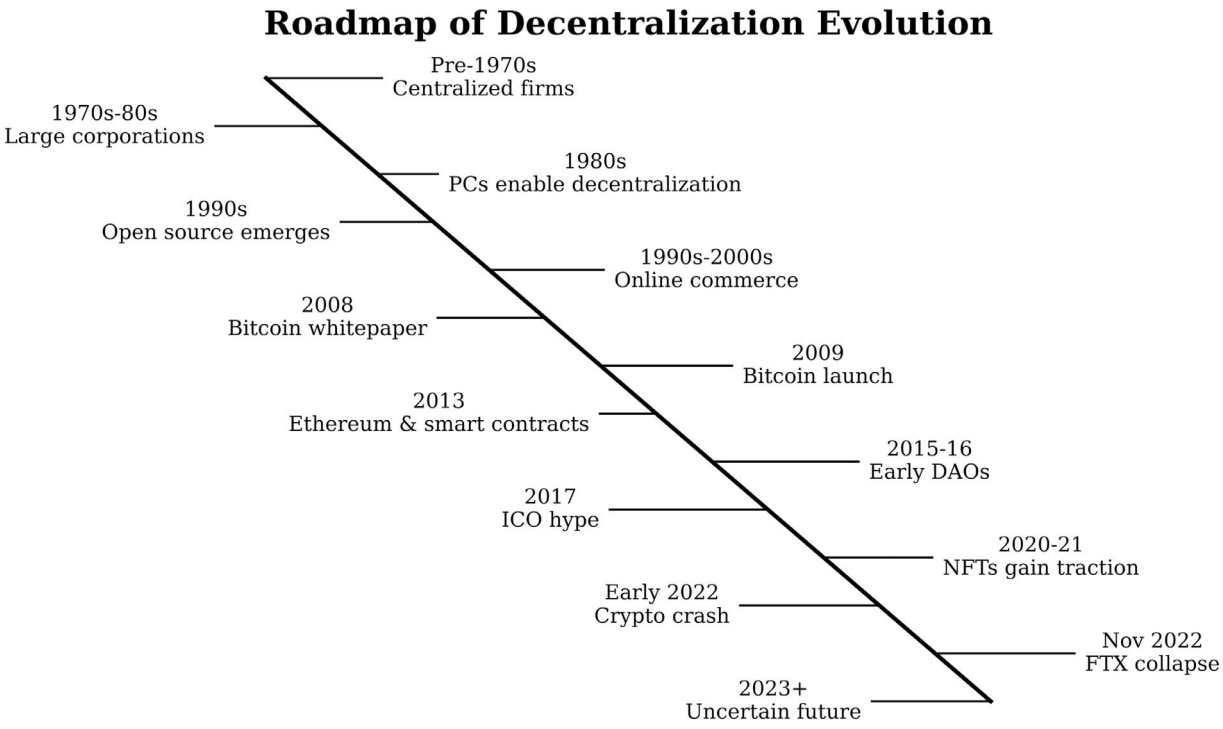

Fig. 1. Timeline of decentralisation→DAO evolution.

inefficient use were of utmost importance because they paved the way for designing streamlined processes and reducing waste. This approach has ideological roots in Coase's theory of the firm, which posits that internal production is more economical than external sourcing due to transaction costs – encompassing both direct and indirect costs such as search, contracting, monitoring, and adaptation costs. Coase's argument is that by increasing internal production, transaction costs can be economised and overall costs reduced.

In 1977, Chandler (1993) provided a revision of the transaction cost-centric perspective by demonstrating that once an enterprise surpasses a certain threshold, self-perpetuating mechanisms yield more benefits. Chandler contended that large firms necessitate centralisation and bureaucracy for the purpose of coordinating and managing tasks, as well as to gain economies of scale and overtake smaller corporations. His concept of the 'visible hand' of the firm contrasts with the 'invisible hand' of the market, which represents the decentralised forces of supply and demand. Chandler's view was endorsed by corporate leaders in the 1970s and 1980s, with the belief that behemoths such as IBM would shape the future enterprise by enabling streamlined workflows for production and services.

Nevertheless, the personal computer (PC) revolution in the 1980s and Microsoft's rise to prominence in the post-JOBS 1990s prompted a rethinking of both Coase and Chandler's perspectives, as it became technically plausible to design large organisations on a decentralised basis that integrated elements of both an open market and private firms.

Intermediate stage: 1990s and 2000s

Distributed organisations of the 1990s and 2000s served as proto-applications and theoretical precursors to modern DAOs. These early forms utilised technologies to enable decentralised decision-making and collaboration among a distributed group of individuals.

One notable example from the 1990s is the open-source software movement. Projects such as Linux, Apache, and Mozilla were developed and maintained by decentralised communities of developers who collaborated over the internet. This decentralised model of software development mirrors the way modern DAOs operate, with a community of individuals coming together to make decisions and contribute to the project.

Another example from the 2000s is the rise of online marketplaces such as eBay and Amazon. These platforms allowed individuals from around the world to buy and sell goods in a decentralised manner without the need for a central intermediary. This model of e-commerce is similar to the way modern DAOs can be used for decentralised finance (DeFi) and decentralised marketplaces, where individuals can come together and exchange value in a decentralised way.

The modern DAO

The term 'DAO' is self-explanatory. The 'decentralised' part entails the lack of a centralised power structure. In practice, this translates to the distribution of power and decision-making to the edges of the system. The 'autonomous' part refers to self-governance via smart contracts (Ding et al., 2021). This allows the founders of a DAO to vote on proposals, automate day-to-day operations, and design and execute contracts and interactions, similar to an economy. In a sense, a DAO resembles a small nation more than a traditional top-down corporation. In short, a DAO is an organisation where like-minded people congregate to pool resources towards a shared goal.

For a technology often purported to be a revolutionary disruptor, blockchain was initially treated almost as an afterthought behind the fanfare generated by its first prominent application, cryptocurrency Bitcoin, introduced in 2009. Yet, iterative developments based on blockchain have sparked varying levels of interest and hype over the technology's potential.

Blockchain is a public database relying on chains of blocks, each representing a transactional exchange within the system. Chains are secured through cryptographic hashes, and adding further blocks to the chain requires input and verification from a decentralised network of users. This is achieved through a proof-of-work consensus protocol, in which a user needs verification from other network members that they have expended a certain amount of computational effort to add to the current chain. The most immediate utility that blockchain technology presented was in the form of crypto tokens, with Bitcoin being the exemplar. Crypto tokens represented the foundational tool of blockchain and gained traction in the aftermath of the 2008 financial crisis as the harbinger of a new era of alternative financial instruments functioning outside of state-based frameworks.

The few years following Bitcoin's introduction can now be seen as almost an interregnum, with global finance reeling from the aftershocks of a loss of faith in the prevailing regime yet not matured or attuned to large-scale adoption of DeFi. One of the primary challenges to mainstream blockchain adoption was the communicative barrier in translating it to public consciousness. Blockchain was often described less in terms of its mechanics and more by its qualities of decentralisation, security, transparency, and facilitation of direct peer-to-peer exchange.

In 2013, the introduction of Ethereum as a viable open-source chain aimed to expand the boundaries of existing blockchain use cases into more traditional avenues of transactional and record-based services. Central to this thrust was the popularisation of the smart contract, an automated contractual system that foregoes third-party intermediaries to enforce terms. The entry of Ethereum sparked a new phase in blockchain adoption. However, despite investor enthusiasm and speculative hype, significant hurdles remained for further penetration, most notably the lack of compelling real-world impact, often leading to the refrain that the technology was 'a solution looking for a problem'. Nonetheless, blockchain's applicability began to steadily expand into areas such as supply chain management, healthcare, and identity solutions.

The first DAOs, emerging in 2015 and 2016, initially appeared to be a logical extension of the smart contract principle, applied to a wider pool of users coordinating based on an agreed protocol. These DAOs operated under a legally ambiguous status, and although they demonstrated significant short-term crowdfunding potential, they also exposed the risks of users being 'hostage to code', leading to a rapid flight of capital by investors.

2017 proved to be a watershed year for the world of crypto, marked by a speculative frenzy resulting in over USD 6.6 billion in sales through various initial coin offerings (ICOs), a 40-fold increase from the previous year. Despite the massive spike in token sales, public scepticism intensified with reports of scams and blatant market manipulation, driving an investor bubble that seemed primed to burst. In response to the crypto boom, several countries introduced their first legislative measures to regulate crypto, ranging from facilitative to restrictive approaches, to rein in this largely unregulated area of global finance.

The latest popular iteration of blockchain development was the rise of non-fungible tokens (NFTs), which gained prominence from 2020 to 2021. Non-fungible tokens function almost as a mutation of classic crypto by being digital assets that are non-interchangeable and designed to represent proof of ownership over a creative property without conferring copyright ownership itself. The utility for NFT purchasers often lies in licensing access to the linked file, typically a piece of digital artwork or animation that has gained traction in the exchange market or based on its projected valuation. However, the ease with which others can digitally reproduce the base file on other mediums calls the actual value of NFTs into question.

Since January 2022, there has been a sustained dip in crypto markets worldwide, with almost half of the overall value lost. This crash has raised concerns over the viability of DeFi's future, given such a loss of market faith, and whether these trends will hinder the utilitarian advances offered by the technology. An even more serious rupture in the crypto market occurred with the collapse of the FTX exchange in November 2022. The exchange experienced a collapse following reports of insolvency and leverage issues, which spurred a massive outflow of liquidity. The founder and former CEO, Sam Bankman-Fried, resigned, and FTX experienced a drop from an estimated USD 32 billion to bankruptcy within a matter of weeks, causing shockwaves in the crypto world that are still being felt (Sundar, 2023).

The seeming inevitability of the rise of blockchain adoption has engendered its own range of sceptical pushbacks. Some critiques veer along the techno-sceptic route, questioning the disparity between blockchain hype and reality. They ask whether the much-touted promise of blockchain's benefits is merely a ruse to legitimise the speculative enterprise of crypto asset investment or, worse, a cover for money laundering. Other concerns focus on the tremendous environmental costs of mainstreaming such technological infrastructure in terms of computational power and electrical usage.

Scanning over the years of blockchain formalisation to the present, it is apparent that the diversification of its applications is somewhat linked to its speculative origins. Market dynamics dictate the speed and enthusiasm of its mass adoption in various use cases. This presents a dilemma in attempting to separate the hype from the actual dividends. The evolutionary iterations of blockchain development largely hinge on market frenzies chasing unverified experiments, creating turbulence without the stability needed for more considered adoption on a larger scale. The DAO is a tangible example of a use case that warrants further exploration beyond the confines of purely market-driven manifestations.

Crypto crashes and forward paths

Since the start of 2022, the crypto market has experienced a loss of nearly $2 trillion, a precipitous decline that has affected the value of not only Bitcoin but also many other lower-profile coins. The reasons for the collapse are varied, with most analysts pointing to wider market trends as the underlying factor. Inflation spikes, stock market declines, and the looming spectre of a global recession have all coincided with the crypto bust.

This is not the first drop in the crypto market. The first notable crash occurred in late 2017 after a year-long bull run in Bitcoin and Ethereum prices. However, investor sentiment this time appears to be noticeably more pessimistic, with many questioning if crypto has entered a death spiral phase where the likelihood of a rebound in investor confidence is so low that the market will never again reach the heights it did during the frenzy of 2020–2021.

Chohan (2022) notes the difference between the recent 'crypto winter' and the one that occurred in 2017–18. The earlier crash was more due to a contraction in prices of the two largest cryptocurrencies following a burst of the hype bubble, with the retreat of these industry giants creating an overall market dip. In contrast, the latest crypto winter is marked by the bottom falling out of the entire market, affecting cryptocurrencies across the spectrum of price valuations. Notably, there has been a serious loss of faith even in stablecoins pegged to external currencies, such as Terra and Luna, which collapsed in May 2022.

Despite the downturn in the crypto market, questions remain about the prospects for the blockchain sector's forward movement. Critics of the crypto speculative bubble have been quick to embrace the crash as exposing not just the fraudulent nature of digital currencies but also the end of the overhyping of blockchain as the next evolution of internet architecture. However, within the blockchain sector, industry operators have begun to frame the recent fall of crypto as a necessary step in the technological maturation of blockchain.

Following the volatility in the crypto market in the first half of 2022, a co-founder of the blockchain media company Blockworks compared the current period with the bursting of the internet bubble in the late 90s, describing it as a cleaning of the slate of market speculative excesses to allow the technological industry to move towards sustainable, market-need-based innovation and adoption. 'That's the period we're in now. We're wiping away the greed and exuberance from the market'. (Traylor, 2022). According to these proponents, the culling of crypto portends a more egalitarian proliferation of blockchain applications away from pure capital towards more public stakeholders, allowing for a slew of new use cases to be explored in the near future.

This viewpoint seems to embrace two counterintuitive notions regarding the symbiotic relationship between crypto and the blockchain foundation on which it is based. First, while cryptocurrencies have remained a strong draw for global capital as flexible digital assets, this may not have spurred the broader industry growth of blockchain towards mass adoption. Second, despite its purported decentralised functionality, blockchain use has largely remained centralised within certain sectors aligned with global finance.

Predicting the future trajectory of blockchain is challenging, given the capricious nature of market dynamics and the potential for a resurgence of crypto in the coming years. Seligman (2022) outlines three potential paths involving United States (US) government intervention in this area. The first path involves the prohibition of crypto due to its volatility and potential for abuse. The second involves the introduction of a regulatory framework for crypto. The third path proposes the creation of competitive digital currencies to offset the unregulated spread of crypto. The inevitability of some form of government action in this area holds further possibilities for the mainstreaming of blockchain technology.

A deep dive into DAOs

This section establishes two key attributes of DAO governance frameworks that are integral to scalability and durability. The first is mitigating voting power consolidation through token delegation and identity controls to spur more participation. The second is the codification process for transparent proposal review and conflict resolution to streamline operations. Understanding the merits and demerits of DAOs is best achieved by contrasting them with the characteristics of traditional organisations.

The first two letters – D and A – are reflected in smart contracts built on the blockchain, which contain preset rules for their operation. In traditional organisations, similar rules are formulated and implemented hierarchically, starting from top executives and moving down to middle- and lower-level managers. Furthermore, a DAO can contain rules that modify themselves automatically if predetermined circumstances occur. An important feature of blockchain technology is its immutability (Hofmann et al., 2017). Ultimately, both types of organisations are managed and designed by humans. While many aspects of running a business can be automated, only some are managed by DAOs. Codifying rules has proven difficult due to the highly complex nature of human behaviour. Therefore, it is likely that the most important decisions will be made off-chain in the near future.

Voting in a DAO is done through a governance token, typically in the form of a cryptocurrency native to the DAO itself. This cryptocurrency may be accessed by working in or for the DAO or bought outright as an outsider. Governance tokens are used to cast votes on proposals or matters pertaining to running the organisation. In the existing and most popular structure, this voting power reflects the proportion of governance tokens owned by an entity (a person, another organisation, or a DAO). An upside of this system is that those

with a greater number of tokens are usually early believers in the project and often have more skin in the game. Thus, it is reasonable that they would have a bigger say in how the DAO is run. Detractors argue that one-to-one voting is preferable since anyone with deep pockets can buy a large number of tokens and take over the DAO – similar to takeover bids in traditional firms. There are other security concerns as well. Recent technical papers indicate that the best way to overcome this problem is on-chain voting. However, its implementation has not materialised yet. Thus, governance tokens remain the main technically feasible option for now.

The design of DAOs ensures immutability, safeguarding them from attacks on governance rules. This feature has attracted the attention of business, economics, and governance researchers. Some scholars voice concerns that DAOs lack the fiduciary responsibility necessary for preserving principals' interests, while others qualify this notion by saying these challenges apply primarily to large organisations. There have been calls for lawmakers, at least in the US, to impose a fiduciary duty on the creators of DAOs to ensure they comply with disclosure requirements (Minks, 2017).

In DAOs, a voting token may reward those who produce more value for the system and, therefore, have a greater influence on decision-making. By making voting tokens transferable, it is possible to appoint representatives to make decisions on behalf of valued members of the system. This system has been suggested to mitigate many risks of exploitation by platform owners. However, owners would still retain the power to submit proposals for voting, and there is a minor possibility of shutting down the system. A voting token instituted in this manner does not preclude owners from using leverage, such as buying a majority of transferable tokens, to influence outcomes against their overall business interests.

An interesting use case is the Proof of Humanity DAO, which strives for a more egalitarian mode of token governance. The voting mechanism in their system guarantees a single vote per token holder, eliminating the system bias towards larger shareholders influencing vote outcomes. Alongside this democratic vote is a nascent universal basic income scheme to distribute accrued value to all token holders (James, 2021). The evolution of this system is ongoing and depends on external fundraising support.

Mesquita and Hall (2022) demonstrate that voting models intended to increase voter participation may adversely impact voter involvement based on the structure of the proposal. 'It is less democratic to involve everyone in too many decisions', Perez (2022) states. As with political referendums, many DAOs use a referendum-based approval/disapproval voting system. This system assumes that voters are actively involved in the topic and will conduct the necessary due diligence to make an informed decision. However, due to time constraints, lack of information, or lack of interest, many voters are unable to make such commitments and are thus absent from the electoral process or merely 'phoning in' an uninformed vote. The mechanisms developed by political democracies to address these real-life constraints can be adapted to DAO systems in the future, as Mesquita and Hall (2022) propose. Alternatively, only a few critical referendum-based decisions could be considered, requiring a greater and more widespread level of voter participation, thereby justifying voters' time in weighing the merits of approval (Wiriyachaokit et al., 2022). Another method is to enhance the process by which voters can effectively delegate their decision-making powers to trusted representatives. Token holders can appoint delegates to make key decisions, akin to republicanism. Inspiration can again be drawn from the democratic processes used by modern democracies to prevent system capture in DAOs and ensure delegates remain accountable.

In lieu of a token pledge with an indefinite period of transfer, delegates should be subject to periodic elections for their positions, providing a built-in check and balance. DAOs will need to build their own ecosystems that provide a steady and digestible source of information on delegate activity for the wider voting population, similar to how online and offline news media channels provide oversight on elected representative activities. Perez (2022) further suggests that voter delegations be enhanced. Currently, ETH DAO systems have only one level of token delegation. If someone receives a token and chooses to delegate it again, their vote will not be considered representative of the original token holder. Since some DAOs still require frequent voting rounds, a more effective system would allow delegates to re-delegate to a second or third tier, representing the initial token holder. Voting can also be segmented by priority and topic to specific delegates using such systems. As democratic governance has evolved over the ages, DAOs have ample opportunity to redesign themselves based on existing political principles. In some cases, due to the technological advantages of their decentralised architecture, DAOs can outperform some of the physical limitations associated with offline voting.

With regard to voting, the design of the voting process and incentives, as well as centralisation, remain bottlenecks for DAOs – a concern addressed by some scholars. Primary among these concerns is the threat of a clique of high-net-worth individuals deciding on behalf of a large group of token holders with small capital contributions. This minimises the incentives for small contributors to do due diligence because their votes are practically countless. Precedents of pump-and-dump schemes in ICOs and cryptocurrencies have demonstrated this to be an early indicator of a desire to push up prices rather than achieve the community's goals. Thus, DAOs are not immune from accusations of rent-seeking and rent extraction. The concentration of power among wealthy individuals also runs the risk of conflicts of interest, as the same token holders may hold positions in other projects.

The capacity for DAOs to circumvent conventional banking channels and rapidly source and distribute funds based on coded mechanisms will inevitably raise questions about whether they will run afoul of financial regulations that could potentially curb or restrict their growth in the DeFi sector. A concern for financial regulators will be the issue of liability and investor protection based on these transnational funds exchanges.

Courts in the US have yet to categorically determine whether DAO-based investments qualify as genuine securities. A regulatory precedent was established in the case of 'The DAO', one of the first DAO systems to gain prominence. In 2017, the SEC released a report determining that the DAO qualified as 'investment contracts' and, therefore, DAO tokens were securities according to the Securities Act of 1933. The report stated, 'The automation of certain functions through this technology. . .does not remove conduct from the purview of the US federal securities laws'. Regulatory environments in other crypto-heavy markets have yet to decide decisively on whether a DAO's structure and rules warrant further scrutiny.

More recent actions by the Commodity Futures Trading Commission (CFTC) may have far-reaching ramifications by expanding governmental oversight to include token holder liability in DAOs. The case involved Ooki, a DAO system created to allow users to hedge on projected crypto valuations. In a September 2022 filing, the CFTC argued that Ooki amounted to a futures commission merchant (FCM) that was not officially incorporated. The DAO contended in court that its token holders should not be subject to personal liability. Although the CFTC later reached a $250,000 settlement with Ooki, the case had already sent serious reverberations across the crypto world, raising concerns about future encroachments by federal agencies (Kharif and Versprille, 2022). Interestingly, CFTC Commissioner Summer Mersinger rebuked the agency for the action, declaring it 'regulation by enforcement, plain and simple' (Frankel, 2022).

One area with possible regulatory implications is standards compliance for DAO systems. Anti-money laundering (AML) frameworks can be integrated into the coding schemes of DAOs to harmonise with regulatory bodies and gain further acceptance within business sectors. Standardised auditing of smart contracts within DAOs,

identity verification of token holders, and the prevention of token monopolisation are other areas where authorities may see an oversight role as important.

Whether DAOs themselves may be registered as legal cooperatives based on their voting and role-based membership structures remains an open question. A key structural issue is enhancing the interactive abilities of members rather than relying solely on automated processes.

The analysis thus far reveals multiple drawbacks in purely coded automation for replicating the complexities of organisational governance. This presents an opportunity to enhance interactive coordination between DAO members to address stability concerns. Additionally, the momentum of DAOs risks stalling. By addressing these gaps, gains can be made by incorporating overseer roles and dispute adjudication, which are bottlenecks in rigid smart contract protocols. Addressing these issues can help improve scalability and durability.

Separating wheat from chaff

This section aims to separate wheat from chaff against the backdrop of these major issues. It seeks to identify the salient features of DAOs that best indicate their resilience in weathering the current storms of the crypto winter, as well as their limitations in scaling further.

Code is law

We offer a key insight on code primacy: we question the assumed deterministic nature of 'code is law' based on human behavioural complexity – an angle often missing in current discourse. This has significant implications for scalability projections that rely on flawless smart contract execution. 'Code is law' has emerged as a popular idiom to denote the primacy of computer code in DAOs. In a DAO, the conduct of the organisation and its members is governed by a code. Decisions made in a DAO adhere to preset codes; resources are allocated accordingly, as are the resultant activities. The idiom captures the centrality of code to the identity, goals, and behaviour of the organisation. In this sense, code is analogous to 'law', governing the organisation's and its members' actions.

This notion has sparked controversy, as many have challenged the premise that only code dictates operations. DAO token holders' motivations, the prevailing external environment, and the implementation and enforcement of code can all exert varying degrees of influence. For instance, a member motivated by profit may prioritise actions likely to generate revenue for the organisation, often encouraging risky ventures. In contrast, members driven by ethical, social, or environmental principles may favour actions aligned with those objectives. Similarly, if a DAO operates in a highly regulated industry, it may be subject to stricter rules and constraints than a rival operating in a more relaxed industry or jurisdiction, forcing it to operate more conservatively. Furthermore, the manner in which code is implemented and enforced can also affect the behaviour of a DAO. A consistent and transparent corpus of code, with careful minimisation of opacity and guardrails against haphazard enforcement, promises to shape the organisation's behaviour predictably and desirably.

Our view is that it is wise to temper expectations from code. Code maximalists – for lack of a better term – tend to overestimate the deterministic nature of code. Its strength lies in precision and speed, but even the best code(r) is susceptible to the complexity and volatility of human nature. In other words, the code underpinning a DAO is only as strong as the values and biases of its coders and enforcers. Additionally, the term 'code is law' implies infallibility. Various scandals have demonstrated how easily malicious actors can infiltrate DAOs (Schnader, 2019). Lastly, we warn against complacency. In some instances, the 'code is law' mentality can deter questioning or challenging the rules and norms embedded in the code of a DAO.

Wellspring of ideas

Crowdsourced decision-making found in DAOs is useful for idea generation. The administration uses a democratic process that can lead to the efficient selection and funding of ideas that align with the DAO's mission. A real-world example of the potency of this crowdsourcing is the dating app Tinder. The app's methodology of matchmaking can be considered a form of crowdsourced experiment in consensus generation for courtship suitability.[1] This technique has proven successful in monetising crowdsourced decision-making. Similarly, DAOs can incentivise members to submit ideas and participate in decision-making procedures. Such open structures are known to encourage lateral thinking, unique solutions, and broader perspectives.

Semantic gap

The 'semantic gap' refers to the disconnect between the abstract ideas underlying the code of a DAO and the human actions and behaviours arising from said code (Wang et al., 2019). Code logic in the system tends to be linear, whereas human behaviour is complex and nuanced. We classify this gap according to two stages: pre-DAO and operational.

A pre-DAO semantic gap occurs at the smart contract level, where the code may be written in imprecise or vague language, leading to misunderstandings. It may even deviate from the original mission and vision of the organisation, instead reflecting the coder's own prerogatives. An operational semantic gap can occur during the active phase of a DAO. During decision-making procedures (e.g. while considering a proposal), a member's pre-existing values or biases may cloud their judgement and lead to conclusions that violate the letter and/or spirit of the code. This can be a clear issue when DAOs seek to execute instructions based on various mainstream legal contracts (Santana & Albareda, 2022).

Semantic gaps may hinder scalability through imprecise order execution and adherence to directives, causing errors, lags, and other inefficiencies. Moreover, poorly directed thoughts and orders due to semantic gaps may produce disputes within the DAO that can further impede its scalability. These can be somewhat mitigated with regular audits and monitoring of the codebase, member feedback, and performance reviews. Addressing this issue may be easier by writing smart contracts in more intuitive programming languages, making it easier for human participants to understand how they should behave. In addition, formal verification can be used to mathematically prove that smart contracts will behave as intended, providing a higher level of assurance. Besides using smart contracts, it is critical to communicate the goals and policies of a DAO clearly and concisely and to establish clear procedures for decision-making and conflict resolution. This will allow all members of the DAO to have a shared understanding of the organisation's objectives from the outset.

Crisis management

Our scepticism regarding crisis management draws upon the organisational behaviour literature, which demonstrates complications in coordination when hierarchies abstain from key decision-making during episodes of market turmoil. This viewpoint is yet unexplored in the DAO context and links crisis vulnerability to scaling obstacles. Both decentralisation and autonomy can be a double-edged sword in times of crisis. The absence of a central authority

[1] https://www.theguardian.com/commentisfree/2015/dec/29/swipe-right-to-fix-the-world-can-tinder-like-tech-match-solutions-to-problems

means that decision-making and dispute resolution in urgent situations are not easy to coordinate. Additionally, immutability has an inherent tradeoff: once deployed, smart contract-triggered actions can be impossible to roll back, debug, or fix during a crisis. Several Sybil and 51% attacks attest to this contingency.

A key issue for governance appears to be in the permissionless realm. While permissioned blockchains align well with prevalent governance models and are easier to implement due to the ease of node identification, entities in a permissionless blockchain are equally subject to accountability standards. Some have suggested that in these cases, governance should be handled by the organisation or the application to insulate entities (people, groups, etc.) from potential criminal liabilities. Exceptions to this would include force majeure events, application failures, infrastructure breakdowns, or blockchain malfunctions. Crisis management, therefore, is an important vulnerability of DAOs. Some have even suggested leaving open the possibility for ethical hacking, which underscores the gravity of this bottleneck. Since autonomy is a major selling point of DAOs, a lack of human intervention is inherent to this structure. This raises questions of legal culpability and operational responsibility in the event of a governance crisis, exacerbated further by the overlaps between the application and infrastructure layers. Together, these vulnerabilities, in the event of a crisis, could suppress the scalability prospects of DAOs.

Fund transparency

The recent crypto scandal in the second half of 2022 highlights the degree to which even established exchanges can be liable for concerns about a lack of fund transparency, leading to wild swings in market faith. However, this presents a dual challenge and opportunity for DAO systems. The challenge is the broader association of all token exchanges with the risks of money laundering and non-liable fund acquisition. The opportunity is the capability of DAOs to further differentiate themselves as open platforms with transparent registers of fund movement. However, fund transparency does not translate into transparency regarding the roles of members in the system, which is a present weakness (Liu, 2022).

Public and regulatory pressures can lead to DAOs tweaking existing or future systems to allow for further oversight and to provide a higher degree of auditability. The question of whether DAOs can be positioned as the 'safe' alternative route for DeFi capital, given their inherent advantage of being open platforms, or remain more peripheral still hangs in the air. The very openness of the DAO platform may potentially dissuade large inflows comparable to the rise of crypto markets. This analysis of fund transparency uniquely links past crypto custody scandals as a lesson for DAOs, marking them as differentiated rather than taking the indicting tone assumed in some literature. Such apprehension is predicated on an assumed weakness that could be turned into a durability strength regarding financial oversight relative to competitors.

Raising capital

DAOs have the potential to contest the current capital-raising space dominated by the VC model (Fitts, 2018; Kaal, 2023; Metjahic, 2017). The present practice is overly dependent on centralised gatekeepers – typically large VC firms and traditional underwriters. There are criticisms that the existing practice is pricey, toxic, not investor-friendly, inefficient, and sluggish, among other issues. Firms and entrepreneurs are expected to pitch their business ideas, negotiate terms, and pay exorbitant fees to stand a chance of getting funding. Legacy intermediary firms benefit from these fees in return for navigating cumbersome regulatory requirements, which reduces returns for investors. Academics have also criticised the current model for potentially throttling innovation. This has prompted some to view DAOs as a decentralised and democratic alternative to traditional venture capital.

By circumventing intermediaries, DAOs can streamline decision-making, reduce costs, and increase transparency compared to traditional procedures. This collaborative and democratic approach can also align incentives among members and the entities in which they invest. We find two promising approaches in this context: first, DAO-assisted venture capital, which blends the expertise and funding of traditional VC firms with the transparency and democratization of a DAO; second, decentralised smart contracts investment, which builds on the scalability and programmability of smart contracts on a blockchain to automate investment decision-making and execution.

To reduce rent-seeking in the regulatory compliance aspect, which is dominated by VC firms and large consultancy firms, regulatory sandboxes could be promising. If implemented, a regulatory sandbox would allow a DAO to operate with relaxed regulations to test new products and business models. This approach could reverse concerns of stifling innovation, as experimentation could occur in a controlled environment. It would also limit barriers to entry – something already somewhat low in a DAO at the initial stage.

The greatest advantage here, however, appears to be over the longer term. As DAOs mature, regulatory concerns can be incrementally addressed, potentially spurring widespread adoption and acceptance. By providing a more transparent, efficient, and democratic model for raising capital, DAOs could reshape the landscape of investment and innovation.

Shadow hierarchy and unofficial power structures

The core promise of DAOs lies in their potential to upend traditional hierarchies (Saurabh et al., 2024). However, like most decentralised organisational experiments, DAOs face an unsettling paradox: informal power structures can emerge within this supposedly flat environment. This can occur through three main conduits: capital disparities, reputation, and technical expertise asymmetry. These channels act as levers of influence and can undermine the very concept of decentralisation (Altaleb & Zoltan, 2022). This mirrors Michels' Iron Law of Oligarchy, whereby even systems founded on egalitarian ideals are prone to recentralisation. Surprisingly, the prevailing literature fixates on the technical aspects of governance. An excessive focus on formal voting mechanisms and codified incentive structures sidesteps several core questions: Why do power hierarchies reconstitute themselves in novel contexts? How are the promises of DAOs complicit in this dynamic? These remain largely unanswered.

Some clues may be gleaned from economic theories that address information asymmetry. More tech-savvy DAO members, those with higher access to data or a longer history of participation, can dominate the decision-making process. This is particularly true when governance processes are opaque. This creates a hidden feedback loop: knowledgeable members accrue more influence and amass a relative informational advantage. The transaction costs associated with participation can also create a tiered system: members unable to bear the costs (time, technical know-how, etc.) are effectively disenfranchised.

There are also sociological and psychological dimensions to DAOs' informal power dynamics. Social networks and reputations accumulated before joining the DAO can become vectors of influence even within ostensibly anonymous environments. This undermines the assumption of tabula rasa participation in DAOs. Additionally, established communication channels within a DAO can shape decision-making through information control, marginalising peripheral members. Cognitive biases like in-group favouritism and the overconfidence effect can escalate if the underlying DAO decision-making processes lack accountability or opportunities for rigorous challenge.

As research is still lacking in this nexus of DAOs and informal (shadow) hierarchies, there is ample scope to explore how DAOs might inadvertently enshrine future power structures. Token-based governance intrinsically privileges those able to acquire large holdings. Attempts to mitigate this with voting structures can paradoxically favour the status quo, making it difficult to enact changes that could disperse power more broadly. At a more fundamental level, the notion of decentralisation itself may need to be interrogated. What appears as distributed decision-making may actually conceal a new form of concentrated control in the hands of a technically savvy few. Addressing this insidious recentralisation demands a radical rethinking of DAOs.

Fair token distribution

Token distribution models in DAOs assume rational and independent actors. However, social dynamics within DAOs do not preclude collusive activities, which can undermine fairness in distributing tokens. If rewards are based on stakes, they can incentivise voting cartels and induce strategic collaboration by actors to manipulate decisions or financial outcomes. Additionally, reputation scores can propagate power hierarchies that favour early adopters.

Furthermore, an overemphasis on the perception of fairness can lead to tunnel vision, masking underlying manipulation. This can result in a demotivated group of participants. To unravel these factors further, research attention is necessary to leverage design mechanisms. Behavioural economics principles can play a crucial role in analysing how collusion occurs within DAOs and to what extent perceived fairness influences participation. Currently, real-world case studies addressing this issue are scarce.

Moreover, adaptive algorithms or simulations based on game theory could be useful in understanding the evolving frameworks in DAOs. These tools can lead to a superior understanding of patterns of fairness perception among DAO actors, providing insights into more equitable token distribution methods.

Decision bottlenecks

Decision-making bottlenecks frequently impede the scalability of DAOs. Several inherent weaknesses in this structure lead to such bottlenecks (Saurabh et al., 2024). Foremost is the illusion of structural solution maximalism. Proponents of DAOs often treat structural reforms as a panacea for decision-making inefficiencies in organisations. While multi-tiered governance and off-chain voting mechanisms offer streamlining advantages, these benefits are superficial. In fact, they can aggravate pre-existing issues. For instance, subcommittees intended to accelerate decision-making can become breeding grounds for power imbalances and information asymmetry. This can culminate in oligarchic tendencies similar to the Matthew principle.

Additionally, the theoretical elegance of predictive markets and voting based on reputation face practical issues such as manipulation, lacklustre participation, and the subjective nature of reputation itself. Another source of bottlenecks is the misalignment of incentives. The apathy and inefficiency described above result directly from rewarding participation rather than the quality of contributions. It is not unfair to accuse the current developments of encouraging a culture of vacuous voting and superficial engagement.

Moreover, uncritically embracing the wisdom of the crowd can be fallacious. Delegating decision-making to the crowd makes DAOs vulnerable to cognitive biases and social pressures. Combined with information cascades, this can exacerbate poor decisions, escalate groupthink, and suppress contrarian opinions. Overall, the decision bottlenecks invoke a well-studied efficiency—inclusivity paradox. The challenge remains how to cultivate a culture of fast and efficient decision-making without disenfranchising members and centralising power.

Reputation verification

DAOs benefit from anonymous reputation systems in several ways. First and foremost, they provide greater privacy and security for participants, as there is no need to divulge sensitive personal information to establish a reputation. This becomes particularly important if participation in the DAO is controversial or legally ambiguous, fostering a more diverse community. Moreover, anonymous reputation systems enable people from all walks of life to participate without fear of discrimination or bias, making the decision-making process inside the organisation more balanced and representative.

Additionally, anonymised reputation systems can mitigate the risk of Sybil attacks, in which an individual creates multiple identities to manipulate the DAO's decision-making process. This problem can be addressed by requiring each participant to have a unique identifier. Such systems can take several forms. Decentralised identity systems can be utilised by assigning participants unique identifiers that are stored on blockchains, which can be used to establish reputations within the organisation and tethered to actions and contributions inside the network. Alternatively, a centralised reputation system can be used, involving a third party entrusted with assigning and monitoring identifiers. However, this presents a central point of failure and may be less secure.

A hybrid approach, combining elements of centralised and decentralised systems, appears the most promising as of late 2023. It works by assigning unique identifiers through a decentralised identity system and tracking reputation via a centralised reputation system. Despite these advantages, several challenges hinder its implementation. Maintaining the anonymity of participants while allowing them to build a reputation within the organisation necessitates a balance between privacy and transparency. The reputation system must also be accurate and fair, tracking and measuring the contributions and actions of participants without compromising their anonymity. However, achieving this technical feasibility is not easy.

Discussion

The detailed discussion in this section is a culmination of a synthesis regarding multiple lingering doubts about DAOs' prospects—especially the hype-suffused scaling ambitions trumpeted by many DAO proponents vis-à-vis the grounded assessments corroborated increasingly identified by nascent literature as inherent expansion barriers (Bellavitis et al., 2023; Momtaz, 2022; Wegener et al., 2023). We directly address doubts on DAOs' purported capacity for explosive growth alongside stability by evaluating documented vulnerabilities against scenario projections in light of comparable precedents that experienced analogous hype cycles.

Scalability

In our view, the Achilles Heel of DAOs is limits to scalability. As the number of DAO participants increases, the complexity of operating and updating protocols grows, resulting in delays and other difficulties. Furthermore, as the number of transactions increase, networks may not be able to keep up with demand leading to diminished transaction completion times. It is thus essential to take scalability into account when designing or committing to DAOs to run an Organisation or a part of it.

Despite the numerous advantages that DAOs offer over traditional business structures, their scalability remains a significant issue. By scalability, we mean a DAO's ability to handle increasing numbers of users or transactions without compromising performance. Scalability is pivotal to a DAO's mission because successful membership engagement directly hinges on scalability (Singh & Kim, 2019). Several factors contribute to it: high transaction costs on blockchain networks,

constrained transaction throughput, and difficulties with governance at scale. These challenges, while marked, are likely not insurmountable. We find cause for optimism as multiple solutions are presently in the works. Solutions such as layer 2 protocols, sharding, proof of stake (PoS), increasing block size, interoperability and hybrid models can help to increase scalability; however, it is difficult to predict how long it will take to implement these solutions or whether competing structures may emerge in the meantime. For instance, since off-chain transactions lower the minimum processing transaction requirements, throughput pressure on the network is reduced. On the infrastructure side, layer 2 protocols, if implemented, serve a twin win: off-chain processing while maintaining ties to a blockchain network. The throughput capacity can be boosted further by sharding, which allows for parallel processing. Meanwhile, as a stop-gap measure, while these problems await a technical solution, firms are free to adopt hybrid models tailored to their needs. In sum, while we suggest approaching DAOs with a realistic expectation of their scalability, the technical solutions surveyed above can greatly mitigate the scalability bottlenecks.

Speculative excess

The burgeoning interest in DAOs extends beyond ideological investments like advocacy for decentralization or egalitarianism. The concurrent success of Silicon Valley, rise of the alternative investment asset class, and a low yield monetary environment have meant that speculative capital flows to DAOs in a bid to catch the *next big Amazon.* Especially for DAOs, the in-built profit distribution mechanism makes it especially appealing to early stage investors. Add to that the rising interest in decentralised finance, where DAOs are expected to play a prominent role. Unmitigated speculative fervor, however, almost always is detrimental. For instance, the token price of a DAO in which there is high speculative interest can experience heavy volatility, potentially affecting its operations (Krishnan, 2020). Like traditional financial assets, excess speculation can inflate token valuation. This can either precipitate a bubble which inevitably bursts, or, in a milder scenario, produces unrealistic expectations and sets the Organisation up for failure. From a managerial perspective, when the foremost focus is on generating returns for investors and not achieving mission objectives as per member (stakeholder) demands, the DAO's original goals suffer. Financial and accounting literature are replete with examples of managerial myopia leading to self-destructive short-termist decisions (Hirshleifer, 1993; Nyman, 2005). There are reputational risks also; e.g., if a DAO is believed to exist for the sole sake of generating quick income for its members, the market may deem it untrustworthy, making recruitment of new members.

Regulatory uncertainty

Significant amount of regulatory uncertainty plagues the regulation of DAOs. Most governments do not recognize DAOs as legal entities, and their legal standing has yet to be examined in depth. In contrast, LLCs are accepted as distinct legal entities by the jurisdiction in which they are created, and they are subject to the rules and regulations implemented by said jurisdiction governing their formation and operation. Other uncertainties stem from confusion over designating DAOs as a limited liability company, opacity over legal registration, and operational challenges surrounding decentralization, anonymity, and borderlessness. The grayness of DAOs' status leads to a lack of legal standing in the established frameworks, forcing disputes to be treated *a la* a joint venture or a partnership. This exposes the members of the DAO to the dangers of personal liabilities. Unclear definition of what a DAO is muddies the matter further, especially in jurisdictions like the US, where judges are known to apply partnership rules to all interactions between parties unified to reach a common objective—consistent with common law traditions. These ambiguities foster a mistrust in the system, denting investor confidence and creating confusion with regards to legal and compliance issues. This is heightened by the lack of a single governing body that regulates DAOs. Different countries enforce disparate regulations and legal frameworks, making it difficult to establish an integrated regulatory framework. Notably, this raises complications when dealing with matters such as investor protection, anti-money laundering and taxation. Moreover, due to the absence of regulatory clarity, it is tough for DAOs to acquire capital since investors are loathe to part with their funds without knowledge of how their investments will be managed.

Governments and stakeholders can reduce regulatory uncertainty around DAOs by clarifying and amending existing laws and regulations, such as securities laws, and engaging with stakeholders to update existing laws to better reflect the digital economy. A holistic approach to regulating DAOs is missing. It is in dire need of developing a concise and clear legal framework which achieves and inspires compliance via stakeholder engagement. It also needs specific guides on codes of conducts and best practices to inspire worthy behavior. Since the topic is technical and the ultimate goal is to drive mass participation, there is also a responsibility of public engagement. If the regulatory environment for DAOs achieves these, trust and confidence will DAO will rise. Some improvements in this regard have been observed in the US states of Vermont and Wyoming—and as of December 2022, Marshall Islands for for-profit DAOs—where legal recognition has materialized. Moreover, Switzerland, Hong Kong and Bulgaria have made significant progress in formulating a framework. Switzerland allows for the formation of non-profit DAAs, while Hong Kong provides a type of company limited by guarantee which is suitable for DAOs. Lastly, Bulgaria is suitable for the creation of traditional limited liability companies which can act as DAO developing agencies. An observation by Kaechele (2019) is pertinent here as it brings up the question of how legal frameworks developed for the internet might apply to distributed ledger technology. This author invokes the concepts of *presence* and *purposeful availment*, which have been used to establish jurisdiction in online contexts. It seems reasonable to consider that some of the same principles and frameworks might be applicable in a distributed ledger context.

Asymmetry in dynamic feedback effect

DAOs are not immune to feedback loops—positive and negative. In the same way as conventional Organisations, the motivations of token holders, the nature of the smart contracts involved, and external elements can set off feedback loops. These can be either beneficial or detrimental. Let us consider the first possibility. DAOs rely on participation and feedback from their members to function. This can include voting on proposals, contributing skills and resources, reviewing others' ideas, group decision-making, and more. Proponents contend that these attributes enable this structure to respond quickly to members' needs and preferences through code. As code is unambiguous and rules-based, upgrades and changes may be triggered automatically once everyone agrees to adopt. This agility can be construed as a built-in ability to scale up positive feedback. Member prioritization enables participative recursion—potentially engendering a virtuous cycle. As empiric works are scarce, it is unclear so far to verify whether claims of superior DAO structure lend themselves to ex post realizations as reflected through efficient outcomes. If DAOs are to get big and more common, more proof is needed on whether smart contracts can preclude undesirable choices from going against the stakeholder interests. Such verification entails longitudinal observations of decentralised governance performance and whether constitutional constraints in smart contracts have a mediating/moderating effect.

Nonetheless, the dynamic feedback effect can also create challenges for a DAO. It can struggle to juggle the interests of different

stakeholders while ensuring all voices are heard and considered. In addition, the decentralised nature of a DAO can make it difficult to coordinate and execute on decisions. The efficiency and productivity consequences for Organisations can be severe. Again, empirical evidence is nearly non-existent so our view is to err on the side of caution. Moreover, we consider it prudent to be conservative in estimating the potency of DAOs' generation and propagation of positive feedback loops.

Recent development in decentralised architecture development in recent months point towards amelioration of this problem. Bonding curves serve as algorithmic bridges between token price and supply, creating a feedback loop. This structure not only provides returns to stakeholders for their investment but also motivates users to acquire and hold tokens, thereby contributing to an upward price trajectory. Also, reputation systems can judge what members do and control their access. These systems can be designed to update in real-time as users complete tasks or interact with the DAO—engendering a feedback loop that boosts and rewards further participation. Furthermore, DAOs can have decentralised treasuries that manage funds and dispense rewards. Such systems can be programmed to automatically adjust the amount of funds allocated to certain activities contingent upon current performance and user engagement. Once again, a feedback loop ensues which animates greater involvement and rewards users for their participation. The FuegoDAO project is an example of this.

Merit based contribution

We sketch original connections between DAO automated incentivization mechanics with behavioral economic insights on stimulating scalability. We hold that such a syntehsized approach improves on the existing siloed tech-centered and governance-dependent treatment of DAOs in prevailing literature. Crucially, merit-based contribution is a concept native to DAOs. We find it arguably one of its key selling points. It stems from the idea that anyone can contribute to the Organisation and be rewarded according to the value they create. This is achieved by having a system of incentives and rewards for those who contribute to the Organisation. The rewards are often in the form of tokens or coins, and the value of these tokens or coins is determined by the value of the contributions made. The incentives for contributing to a DAO are twofold. First, the contributors are rewarded for their efforts, and second, the value of their contributions is reflected in the value of the Organisation. Bitshares, Aragon, and MakerDAO all implement this. Research is still thin on this novel concept, and it will be important to empirically verify if economic value addition indeed accrues from merit based contribution.

Governance: a unified theory

The theoretical foundations of DAOs are deeply entrenched in multiple disciplines; for instance, economics, management, and computer science. Economists are predisposed to treating a DAO as a firm, and when compared with a traditional corporate finance mindset, this tendency is prone to overstating the influence of governance mechanisms on DAOs' activities and profitability. Accordingly, most of the economics-adjacent literature surveyed by us perceived DAOs as a modernized form of governance structure. The provision for decentralised decision-making and collaboration among a collective of individuals appeared secondary. In management literature, DAOs are likened to "distributed leadership", focusing on the distributed aspect of decision-making and the role of individual leaders in formulating Organisational conduct. From a computer science perspective, DAOs are based on the concept of "smart contracts". Therefore, the emphasis lies on the reliability and efficacy of self-executing contracts with the terms of the agreement inscribed in the code. As smart contracts furnish the back-end infrastructure for decentralised decision-making and coordination, this is understandable. The downside is the secularity of this approach.

It is our opinion that a discipline-specific conceptualization of how DAOs should be operated can suffer from disciplinary tunnel vision, and the theoretical scaffolding should be re-evaluated. Therefore, we advocate for a unified framework (or theory) of governance. For example, this can be achieved by formulating a set of standard protocols and best practices for DAO governance that can be widely adopted and utilized by different Organisations. This could include things like transparent decision-making processes, explicit rules for proposal and voting, and effective mechanisms for resolving disputes. Moreover, creating a robust community of experts and stakeholders who can provide guidance and support for DAO governance can also aid in the promotion of a unified approach. Finally, since DAOs enjoy an inherent advantage in not having to adhere to the one-size-fits-all structure prominent in the traditional corporation or non-profit sectors, the structure of the DAO itself can (and should) be an ongoing project. Dynamic research and experimentation with different governance models and approaches can be explored, and future theoretical advances should take this into consideration if we are to strive for the development of a unified theory of governance through DAOs.

Governance: political implications

It is topical and timeous within the frame of this discussion to recall late 1980s' political scientists proclamation that humanity apparently convinced itself of a level of ideological maturity whereby western liberal democracy is considered the peak of societal Organisation structures. The hegemony of liberal democracy-centric assumptions and prescriptions in western academic and policy circles buttresses this view and possibly contributes to a complacent position that no further improvements are needed. Conventional politics thus often relegates ideas such as decentralization and voluntary paradigms of governance to the periphery. Over the past decade, the relative success of Blockchain-based initiatives (such as Bitcoin and other cryptocurrencies) as a monetary-cum-social experiment has started to pose a challenge to legacy perspectives on governance by illustrating viable pathways to a system powered by voluntary consensus and competition, rather than traditional power structures. The status quo typically considers democracy to be the most suitable form of governance due to its efficacy in equally distributing positions of power through popular votes. The underlying assumption is that positions of power are a prerequisite for organizing human resources efficiently. A quandary arises if individuals within the system do not conform or decline to be coerced into contributing to collective efforts that they either disagree with ideologically or perceive to be against their interests. Experiments like Bitcoin, though superficially disconnected to governance, offer inventive solutions to these age-old questions and thus are not merely monetary experiments, but ongoing case studies on decentralization, consensus-building, and the restructuring of society and governance.

The political implications of DAOs becoming mainstream could be immense. As decentralization at scale becomes a realistic possibility, how the powers-that-be will respond to an ideological challenge to the hegemony of the centralized design of states and corporations will be interesting to track. How the legacy institutions will resist or push back is an area ripe for experimentation and gathering empirical evidence on as DAOs continue to strive towards solving the scalability problem. If DAOs indeed end up gaining widespread adoption and the promises of transparency are met, we anticipate beneficial downstream effects of macro policies to micro behaviors. This will make macro policy decision-making even more crucial since now the transmission will be easier, quicker, and more precise. Extra care must then be taken to ensure the accuracy of the policy decisions. This point becomes even more salient as DAOs are more akin to direct democracy than the functional democracies around the world.

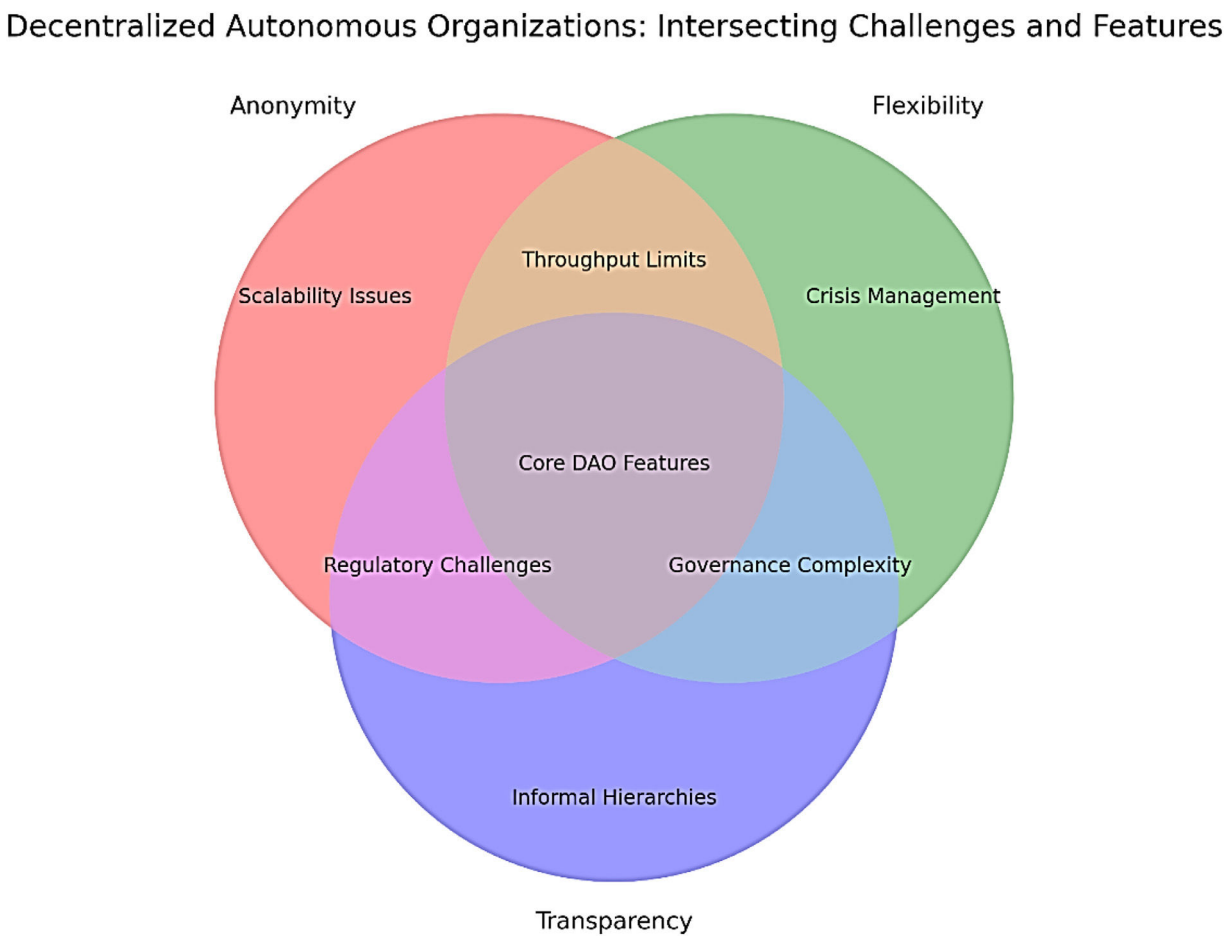

Fig. 2. Intersection of core DAO features and challenges identified.

Greater participation will likely spur more citizen engagement at an unprecedented scale. Experimental studies are the best bet in the current climate to devise models to predict the changes in human behavior in an environment of unprecedented transparency and direct democratic choice. Lastly, DAOs—in our opinion—are likely to expedite the development of novel modes of governance that are more adjustable and responsive to changing needs and circumstances.

Upshot

Our synthesis aligns with the emergent thesis that entrenched technical, behavioral, and regulatory frictions intrinsically impede the pace and breadth of mainstream DAO integration. We advise taking a cautious approach for predictions of drastic near-term changes. Instead, priorities should be placed on gradual, sustainable adoption supported by a strong foundation. Said differently, efforts should be on enabling technologies and frameworks that ease introduction over the long run. This balanced view is likely to lead to more lasting impacts versus promises of immediate, high-scale disruption. Some literature is already documenting the heterogeneous potential impact of DAOs—some across disciplines (Berthelsen & Bjelleras, 2023), some across industries (Siliämaa, 2020; Boss & Sifat, 2023). Overall, a step-by-step approach grounded in sustainability is preferable to us than lofty estimates that risk overpromising.

Conclusion

We contribute to the fields of technological innovation and various business school disciplines by engaging in a thorough examination of the current state of DAOs to tease out their durable features and sketch a map of promising areas of future research—as encapsulated in Fig. 2.

As regulators prepare legislation to tackle DAOs, disentangling the signal from noise vis-a-vis DAOs' prospects is the primary aim of this paper. Adjacent to it is informed speculation on DAOs' staying power. These concerns are particularly timeous as of 2023 as DAOs are touted to devise fresh ecosystems for governance, disrupt various layers of administration (Makridakis & Christodoulou, 2019), overthrow modern conceptualizations of firms and corporations, etc. In short, calls for reinventing the wheel have grown louder. Whether these prospects are realistic or these changes necessary is the subject of ongoing debates in multiple disciplines.

Our review of extant academic, industry, and gray papers leads to the following realizations and conclusions. Firstly, the primacy of code, emblemized by the neo-maxim "code is law," is likely an exaggeration due to—inter alia—the presence of semantic gaps within contracts. Secondly, crisis management is a serious bottleneck. Thirdly, there is a possibility of informal hierarchies forming within these Organisations. Despite these drawbacks, there are advantages to be gleaned from the utilization of DAOs, such as anonymous reputation verification, flexibility in decentralization, and transparency. Through further analysis, we have identified scalability constraints as the primary hindrance to the success of DAOs.

It is not the intention of the analysis in this paper to discredit or exalt the prospects of DAOs as they move into the regulatory space. We sought to assess, dispassionately, the staying power of DAOs in a fast-paced tech-innovation environment. Our contention, in relation to the DAO maximalists, is that the current state of DAOs falls far short of the utopian vision promoted by its proponents. DAOs are—

ultimately—susceptible to human frailty, which represents a critical bottleneck. Additionally, it is injudicious to ignore the centuries-old traditional governance structures that have been refined by law, commerce, and private and public actors. A closer examination may be warranted of DAOs' supposed aim to achieve a utopian decentralised ideal—similar to what existed before organized societies were formed.

We claim that our endeavour constitutes a timeous contribution to literature since the durability of DAOs is an underexplored topic and in light of recent developments. We speculate that DAOs are now entering a new phase of their development, one in which operators may be forced to bite the bullet and integrate themselves within existing and new regulatory frameworks. Such an integration may have been eschewed in the Wild West days of crypto in the mid-2010s yet the ramifications of the crypto crashes of 2022 has made such a move a near inevitability. Within policy circles of the EU (Shickler, 2023) and the WEF (World Economic, 2023) the broad implementation of such moves is already being discussed. There is a need then to realistically address what is likely to come once DAOs are brought inside the formal space and how they will evolve. Meanwhile, a steady growth in global appetite persists for increased automation and transparent governance. Blockchain technology in general and DAOs in particular is at the forefront of the technological innovations robust enough to fuel these changes. This makes smart contract technology an appealing choice to businesses and Organisations. While the broader Web3 movement still faces substantial challenges involving data protection, regulation, security and privacy, there is potential for extensive growth in the smart contract realm. This makes DAOs worth being bullish on, despite the aforementioned limitations on the scalability of such systems.

CRediT authorship contribution statement

Saqib Sheikh: Writing – review & editing, Writing – original draft, Conceptualization. **Imtiaz Sifat:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Formal analysis, Conceptualization.

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