Blockchains: Fusing Extant Organizational Functionalities Under the CAP Tradeoff

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Abstract

We argue that adopting a blockchain structure – the process of *platform tokenization* – is generally applicable for digital platforms, but this technology adoption is not always beneficial. Blockchains can be seen as representing a new generation of digital platforms; they qualify as a novel organizational form that fuses the basic functionalities of extant platform categories – knowledge community, crowdsourcing, and crowdfunding – onto a focal platform (i.e., a centralized virtual organization), which corresponds to fusing the organization of essential resources for business operations. Yet, blockchains are subject to the same CAP (consistency, availability, and partition tolerance) tradeoff that sets the boundary within which extant organizational forms function, except that blockchains lie at a different point in the functionality triangle. The advantages of blockchains compared to conventional digital platforms thus always entail costs, and so tokenization is not a panacea for platform upgrade, nor does it have a one-size-fits-many strategy. We explain cases where blockchains can help resolve the limitations of conventional platforms. Then, through this lens of blockchains as a platform fusion, we revisit some classic tensions in strategy and organization research. We last demonstrate applying the CAP triangle in further discussions around digital platforms.

1 Introduction

Blockchain is a novel information technology that emerged from innovations at the interface of cryptography, network sciences, and information theory (*Yaga et al.*, 2019). Unlike traditional data architectures, blockchains use a novel digital structure – the chain of (encrypted) cipher blocks (e.g., *Klinc et al.*, 2012) to record transaction, organization, and interaction data from business operations and management, and from participants' various activities. Key features of blockchains include (i) the support of smart contracts completion notably through online labor (*Christidis and Devetsikiotis*, 2016), (ii) an elaborated incentivization structure (*Han et al.*, 2022) for customer participation, and (iii) enhanced traceability and transparency of digital activities, along with the non-malleability of on-chain data (*Al-Jaroodi and Mohamed*, 2019). With a short history, blockchains have demonstrated transformative power for various businesses (*Iansiti and Lakhani*, 2017; *Catalini and Gans*, 2020; *Biais et al.*, 2023).

Companies are utilizing the technology to upgrade their *digital platform* (*Tiwana et. al*, 2010; *Zhu and*

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Iansiti, 2012; *Ceccagnoli et al.*, 2014; *Zhu and Furr*, 2016; *Constantinides et al.*, 2018; *De Reuver et al.*, 2018) – regarded as the core organizational form in the current Web 2.0 (*Murugesan*, 2007) – to a new virtual architecture in the coming Web 3.0, which distinguishes itself from Web 2.0 notably at substantially powering the linkage of data (*Hendler*, 2009), as is achieved on blockchains. A conventional digital platform (i.e., a Web 2.0 platform; hereinafter) can transition to adopting a blockchain structure with ease, and an entrant platform can conceive a blockchain design from its inception.

In these contexts, the implementation of blockchain elements in digital platforms' business operations concerns the process referred to as *platform tokenization* (*Chod et al.*, 2022), where small pieces of digital information, i.e., tokens, are used in various on-chain activities to support the chain (Appendix A).[1] Analogous to an offline business going online (made possible by Web 1.0 (e.g., *Abbate*, 2000)), or an online portal supporting user participation and interaction (made possible by Web 2.0 (e.g., *Constantinides and Fountain*, 2008)), platform tokenization promises a new technology revolution (under the Web 3.0 landscape) that is widely applicable to various types of digital platforms. Indeed, given the many advantages of blockchains and along the stride to the new Web era, enterprises worldwide accelerate in embracing this groundbreaking innovation, with major corporations playing leading roles in exploration.[2]

To adopt blockchains, digital platforms need to plan for their tokenization move, a process that considers multiple layers of decision-making (Appendix B). While the adoption question has not been fully answered, many companies have already started launching tokenization on their digital platforms, under the assumption that blockchains have distinct advantages over conventional platforms. This has led to the rapid emergence of blockchain applications and a fervent market response. For example, among the benefits provided by blockchains, "smart contracts" (*Wang and Xu*, 2022), as the name implies, are believed to outperform traditional contracts; incentivized participation (*Iyengar et al.*, 2023) can lead to a larger customer base compared to under-incentivized participation; enhanced traceability of operations can offer greater service transparency (*Chod et al.*, 2020), thus higher service efficiency, and non-malleable data records ensure the authenticity of transactions (*Hendershott et al.*, 2021).

Tokenization: the Default Move?

Given the advantages of blockchains, many people see tokenization as a default generation-upgrade (e.g., Web 3.0 on top of Web 2.0) for digital platforms (*Hendler*, 2009; *Al-Jaroodi and Mohamed*, 2019), and expect blockchains to be implemented on a wide range of platforms. Between two platforms with similar functionalities (*Agrawal et al.*, 2021), the one with a blockchain design is often preferred to a conventional one. The assumption is that blockchains can help resolve problems with conventional designs on current platforms, including at crowdfunding (*Hartmann et al.*, 2019), at financial engineering (*Chen, X. et al.*, 2023), at law enforcement (*Chen, M. A. et al.*, 2023), at supply chains (*Chod et al.*, 2020), and at voting systems (*Alvi et al.*, 2020). Indeed, tokenization is an upgrade that can more easily resolve conflicts between platforms and users (*Sockin and Xiong*, 2023a), can finance a strictly larger set of ventures than equity (*Malinova and Park*, 2023), and can improve the coordination in the market space (*Bakos and Halaburda*, 2022b).

The envisioned landscape of universal adoption of blockchains on digital platforms might become a reality, but we need to be aware of the corresponding costs associated with the presumed gains. While recent work has begun to challenge the optimistic view of blockchains, (e.g., *Cheng et al.*, 2019; *Chod et al.*, 2022; *Lyandres et al.*, 2022; *Ferreira et al.*, 2023; *Franke et al.*, 2023), insufficient discussion has taken place on the tradeoffs of tokenization.

Should blockchains always be adopted (*Peck*, 2017; *Wüst and Gervais*, 2018)? There is evidence suggesting that in certain cases, non-adoption may be preferable. For example, in the Greek shipping industry, despite the benefits of automation and smart contracts, research has found that the need for enterprises to remain competitive by maintaining secrecy and flexibility renders the adoption of blockchains undesirable

[1] A *token* by nature is a short digital text (i.e., "tag"), which can serve a particular digital function. The idea of using tokens in business operations existed long before the advent of blockchains (e.g., (*Holmquist et al.*, 1999)), but blockchain allows for an unprecedented large-scale implementation and consumption of tokens in digital operations.

[2] https://www.forbes.com/sites/ninabambysheva/2023/02/07/forbes-blockchain-50-2023/.

(*Papathanasiou et al.*, 2020). Broadly, questions surrounding blockchain's adoption have long existed; the uncertainties at the Initial Coin Offering events (*Catalini and Gans*, 2018; *Gan et al.*, 2021; *Lyandres et al.*, 2022), the forking and collapse of crypto projects (*Karame*, 2016), the conglomerate effect on blockchain ecosystem governance (*Ferreira et al.*, 2023), and the risks around cryptocurrencies (*Gandal et al.*, 2021; *Sockin and Xiong*, 2023b; *Cong et al.*, 2023b) etc. have tarnished the positive image of the technology.

Our Contention: Understand the Tradeoff

In this paper, we try to answer the adoption question for blockchains. We first support the idea that blockchains can be effectively implemented on diverse types of conventional platforms. We provide one rationale for this argument from the perspective of *platform functionality fusion* (Proposition 1). We establish that blockchains qualify as a new organizational structure for digital platforms; nonetheless, rather than being regarded as a completely novel invention, this organizational form can effectively be understood as a fusion of existing organizational forms: knowledge community, crowdsourcing, and crowdfunding, onto a focal platform (i.e., a centralized virtual organization). By incorporating features of these platform categories, blockchains enhance the focal platform's functionality. Essentially, these organizational forms arrange the key resources for business operations, the fusion of which thus engenders a general applicability.

This advantage of blockchains, however, is tempered by an inherent technological tradeoff, known as the CAP (consistency, availability, and partition tolerance) tradeoff (*Brewer*, 2000; *Gilbert and Lynch*, 2002, 2012). The CAP tradeoff applies to general digital systems and here in particular we apply it to digital platforms. Within this impossible triangle, each digital platform (including conventional platforms and the blockchain) highlights certain aspects of platform functionality while compromising the others (Proposition 2). At blockchains, the triangle highlights consistency features (e.g., transparency, traceability, non-malleability), in a partition-tolerant system, while sacrificing availability features (e.g., efficiency, speed, responsiveness).

This tradeoff implies that tokenization is necessarily associated with nontrivial costs, and should not be viewed as a panacea for platform upgrade. Therefore, the adoption of a blockchain design is not always beneficial for digital platforms, due to the costs accompanying the gains in functionality (Proposition 3). Further, when a blockchain design is indeed adopted, there is no one-size-fits-many solution for the timing, scale, category, type, or style of tokenization: different tokenization outcomes are uniformly subject to the tradeoff at the CAP triangle. Digital platforms need to make suitable tokenization decisions based on their specific service requirements for consistency, availability, and partition tolerance.

Viewing blockchain as a fusion of multiple platform functionalities leads us to consider blockchain participants as simultaneously playing multiple roles in the ecosystem. Each participant represents a composite of digital user, digital investor, and digital laborer. Dissecting participant roles may contribute to our understanding of the stage-wise dynamics of blockchain's adoption (*Li and Zhang*, 2023).

Organization of the paper. The rest of this paper is organized as follows. In Section 2, we establish that blockchain is a new organizational form that fuses core functionalities of key conventional platforms. In Section 3, we compare blockchain to conventional platforms vis-à-vis the CAP tradeoff, demonstrating the benefits and costs of adopting a blockchain design. In Section 4, based on the functionality fusion perspective, we discuss platform tokenization beneath the CAP tradeoff. In Section 5, under the established view of the blockchain, we examine several classic tensions in strategy and organization studies. In Section 6, we point out this study's limitations and future directions, demonstrate applying the CAP triangle in further discussions around digital platforms, and present the research outlook.

2 Fusing Extant Platform Functionalities

The ease with which blockchains can be applied to conventional platforms in various sectors and businesses, especially those comprising large-scale or long-thread digital components, is widely supported (e.g., *Zheng et al.*, 2018). This potential for universal adoption is rooted in blockchains' technological elements: the standardization of digital data, the ubiquitous operation of online transactions, and, in particular, the flexibility of hashes (*Preneel*, 1994) in the chain structure.

The power of these technological features, however, may not materialize into a direct rationale that supports blockchains' general applicability on diverse types of digital platforms. Here, we propose that the applicability of blockchains can be supported from an organizational point of view, whereby blockchain is a novel organizational form that *fuses* the functionalities of three important conventional platform categories, around which key resources for business operations are organized.

2.1 Digital Platforms: Organizing Key Resources for Business Operations

According to *Amable* (2003), the five institutional domains in modern capitalism that determine the allocation of key resources for business operations are the organization of *capital markets*, *labor markets*, *product markets*, *education systems*, and the *social safety net*. The configuration of these dimensions creates the conditions that make business possible.

A critical influence on all five dimensions is information technology (IT). Disruptive information technologies shape organizations in divergent ways, have always prompted changes in organizational design (*Huber*, 1990), and introduce new forms of organizing through various IT affordances (*Zammuto et al.*, 2007). This occurs largely via facilitating efficient communication that, in turn, provides greater access to financing and recruiting, along with the relaxation of cultural and geological constraints (*Davis and Sinha*, 2021).

In the current platform economy (*Kenney and Zysman*, 2016), IT elements are prevalent in business operations, empowering digital platforms to play a dominant role in economic growth. Among the various types of digital platforms that organize different business resources, we argue that a few platform categories – consistently, widely regarded as typical "Web 2.0 technologies" (*Andriole*, 2010) – represent distinct organizational forms that are essential to the efficient organization of specific resources (in parentheses): knowledge community (the organization of *education systems*), crowdsourcing (the organization of *labor markets*), and crowdfunding (the organization of *capital markets*). Besides, digital platforms by nature are centralized virtual organizations, whose commercial properties decide the organization of *product markets* (*Zhu and Furr*, 2016) (Table 1).

- *Knowledge community* highlights the open design of digital platforms that promotes community-based, evolutionary knowledge creation through collaboration among talented volunteers dispersed across organizational and geographical boundaries (*Conner and Prahalad*, 1996; *Grant*, 1996; *Faraj et al.*, 2011). A key characteristic of knowledge communities is that they facilitate organized open innovation (*Chesbrough*, 2003; *Nambisan et al.*, 2018) through tracking and decentralized governance. This digital organizational form advances the organization of *education systems*.

- *Crowdsourcing* highlights the accessibility enabled through digital platforms that facilitates the profit-oriented outsourcing of tasks of intellectual value creation. It is an online distributed problem-solving and production model in which networked people collaborate to complete a task (*Vukovic*, 2009). This structure harnesses the diverse skills and experiences of the crowd as well as creates mechanisms by which talent and knowledge are matched with those who need it (*Howe*, 2008; *Ipeirotis*, 2010; *Estellés-Arolas and González-Ladrón-de-Guevara*, 2012). This digital organizational form advances the organization of *labor markets*.

- *Crowdfunding* highlights the reduction of coordination costs on digital platforms which facilitates fundraising for creativity-intense and community-based projects, for which a formal organizational structure is often unnecessary and a clear profit model is often unavailable (*Agrawal et al.*, 2014; *Mollick*, 2014). In a crowdfunding campaign, financial resources are donated (*Boudreau et al.*, 2021) in exchange for some form of future reward or rights around the project, among other (sometimes nonfinancial) motivations (*Gerber and Hui*, 2013; *Gao et al.*, 2021). This digital organizational form advances the organization of *capital markets*.

- Digital platforms by nature are *centralized virtual organizations*. Intrinsic to commercial digital platforms (e.g., e-commerce, car-sharing, stream media) is the expansion of online space for information and service (*Constantinides et al.*, 2018). The development of commercial platforms has advanced the organization of *product markets*.

On a blockchain platform, networked people share knowledge, innovation, and engineering efforts in a community approach; participants conduct digital labor, for example, to support the chain's consensus mechanism, in a crowdsourced manner; crypto projects are funded via tokens and other means in a crowdfunding environment. These activities facilitate the specific service the platform provides and contribute to platform's development. Thus, fundamentally, blockchain can be seen as fusing the functionalities of the three key organizational forms – knowledge community, crowdsourcing, crowdfunding – onto the ordinary operations of a focal platform that represents a centralized virtual organization. This fusion is attributable to the technology underlying blockchains, notably around the implementation of tokens in different on-chain operations.

Therefore, putting together the essential resources for business, blockchains can integrate education systems (via knowledge community), labor markets (via crowdsourcing), and capital markets (via crowdfunding), at the product markets that operate on conventional platforms. Currently, blockchains lack a clear organization of the social safety net, despite discussions around the purported decentralization structure (see below) in the Web 3.0 digital social space. As on conventional platforms, the organization of the social safety net relies principally on activities in the physical world (*World Bank*, 2015). This limitation aside, blockchain's integration of the three critical platform categories echoes the notion that capital, labor, and knowledge are the key components for industrial productions that contribute to economic growth (*Romer*, 1990).

The fusion of institutional domains that support business (capital, labor, product markets, and education systems) thus underlines the broad applicability of blockchains on various types of digital platforms: it is possible to implement a blockchain structure on an arbitrary conventional platform and seek platform success, because all core resources for business operations can be effectively organized on the blockchain. Conceptually, this functionality-driven universality beneath technology adoption is distinct from the process of moving offline to online (Web 1.0), where universal adoption is possible thanks to the standardization and digitization of data, and from online portals supporting user participation (Web 2.0), where universal adoption is rooted in the ubiquity of interactions in the online space.

This leads us to the following proposition:

> **Proposition 1:** From an organizational perspective, blockchain can be seen as a fusion of knowledge community, crowdsourcing, and crowdfunding, onto the focal (commercial) digital platform that represents a centralized virtual organization.

We use the word "fuse" here to describe how blockchains delicately integrate the functionalities of the three platform categories. Blockchains do not simply "glue" or "combine" platforms, and it is erroneous to argue that any conventional platform can be "encompassed" or "blended" in a blockchain design.

2.2 Blockchain: Qualifying for a New Organizational Form

The novelty of a new organizational form lies in the novelty of its solutions to the problems of organizing, compared to existing organizational forms. For example, in a seminal work, *Puranam et al.* (2014) pointed out four basic problems: task division, task allocation, reward provision, and information provision.

Echoing this perspective, we argue that blockchain – the fusion of knowledge community, crowdsourcing, and crowdfunding onto a centralized virtual organization – qualifies as a new organizational form that aggregates elements of these existing platform categories to address the basic organization problems around *task*, *information*, and *reward* (Table 1):

- For *task* in organizations, it is important to consider *task division* and *task allocation.* For task division, knowledge community operates in a decentralized manner, as there is no need for a central coordinator/planner to divide tasks into components. This planning, however, is needed for crowdsourcing, crowdfunding, and centralized virtual organization. Blockchains can divide tasks in both centralized (e.g., on permissioned chains) and decentralized (e.g., on public chains) ways. For task allocation, knowledge community and crowdfunding can fully support the self-selection of tasks. Crowdsourcing and centralized virtual organization commonly assign tasks to the workforce, although self-selection is necessary for bilateral work completion. On blockchains, task allocation is achieved through both self-selection and assignment (e.g., depending on the consensus mechanism).

- For *information* in organizations, it is important to consider *transparency*, *traceability*, and *malleability*. In knowledge communities, information is transparent, traceable, yet malleable. At crowdsourcing, information is transparent but malleable, and is not logged onto a traceable data structure. At crowdfunding, information is semi-transparent, semi-traceable, and semi-malleable: these three consistency features are desirable in financial transactions, but they may not be guaranteed, due to the technical design and management of a platform. At centralized virtual organization, data is semi-transparent, non-traceable, and malleable, given the highly centralized governance. Blockchains support consistent operations and ensure transparency, traceability, and non-malleability of data (see Section 3).

- For *reward* in organizations, it is important to consider *reward visibility* and *reward type*. The reward is visible at knowledge community and crowdsourcing, but largely non-visible at crowdfunding and centralized virtual organization. At knowledge community, the motivation to participate includes volunteering, where psychological and social rewards are enjoyed. The reward is generally fixed at crowdsourcing and centralized virtual organization. At crowdfunding, the pursuit of value promotion stands out among various incentives for participation, where people expect (inflated) future rewards. On blockchains, there are both visible (e.g., service fees) and non-visible rewards (e.g., token valuation), and the incentives for participation include volunteering, fixed rewards, and value promotion.

Generally speaking, from an organizational perspective, blockchain offers an approach to enforce agreements as well as achieve cooperation and coordination that is not possible in traditional contractual and relational governance or in other information technology solutions, as blockchains essentially change the way that collaborations are organized (*Lumineau et al.*, 2021). Our platform-fusion view of the blockchain, which then qualifies as a distinct digital platform category, aligns with this organizational observation.

In the next section, we compare blockchain to each individual platform category: knowledge community, crowdsourcing, crowdfunding, and centralized virtual organization.

Platform example Category	**Wikipedia** knowledge community	**Mechanical Turk** crowdsourcing	**Kickstarter** crowdfunding	**Ethereum** blockchain	**Taobao** centralized virtual organization
Section 2.1					
Institutional domain	education system	labor market	capital market	combined	product market
Section 2.2					
Task (task division)	decentralized	centralized	decentralized	decentralized + centralized	centralized
Task (task allocation)	self-selection	assignment	self-selection	self-selection + assignment	assignment
Information	transparent traceable malleable	transparent non-traceable malleable	semi-transparent semi-traceable semi-non-malleable	transparent traceable non-malleable	semi-transparent non-traceable malleable
Reward (reward visibility)	visible	visible	non-visible	visible + non-visible	non-visible
Reward (reward type)	motivation of volunteering	fixed	motivation of promotion	volunteering + fixed + promotion	fixed
Section 3					
Extent of centralization	decentralized (⋆)	delegating (⋆⋆)	distributed (⋆⋆⋆)	combined	centralized (⋆⋆⋆⋆)
Section 3.3-3.6					
Consistency	+	++	+++	+++	+++
Availability	+++	++	++	+	+++
Partition Tolerance	+++	+++	++	+++	+

Table 1: Comparing blockchain to existing organizational forms.

3 Comparing Blockchain to Existing Organizational Forms

We compare blockchain to each individual organizational form to analyze how platform fusion is achieved, what problems on conventional platforms blockchain can help resolve, and what new problems may arise.

Each platform category – knowledge community (e.g., Wikipedia), crowdsourcing (e.g., Mechanical Turk), crowdfunding (e.g., Kickstarter), and commercial centralized virtual organization (e.g., Taobao) – is characterized by important design features that consolidate its distinctive organizational model. Features of these organizational forms can be integrated by the blockchain to create a platform fusion. Then, with its aggregate functionality, blockchain may help mitigate various operational issues that arise when different organizational forms favor or disfavor business clients (B-ends) and customer clients (C-ends).

Moreover, the four existing organizational forms fall at different points along the spectrum of platform centralization (Table 1; the more stars, the greater the level of centralization):

(1) For centralized virtual organization, operations are fully *centralized* ($\star\star\star\star$) and the platform maintains perfect control (*Parker and Van Alstyneb*, 2018).

(2) For crowdfunding, operations are *distributed* ($\star\star\star$) but the processing is still centralized; customers can influence the completion of platform operations but only minimally.

(3) For crowdsourcing, the platform *delegates* ($\star\star$) operations to network nodes, but a central coordinator is still needed, as nodes cannot self-organize.

(4) Finally, within the knowledge community, where fully *decentralized* ($\star$) operations are the norm, network participants can effectively govern the organization without a permanent central intermediary.

From the platform-fusion viewpoint, the least extent of centralization ($\star$), as in knowledge communities, is inherited by the blockchain, which underlines its core *decentralization* characteristic (see below). In practice, however, different extents of centralization are exercised across designs and applications of the blockchain (*Xu et al.*, 2017); a complete decentralization paradigm is often not adopted (e.g., in permissioned chains).

3.1 The CAP Tradeoff

Different digital organizational forms, including conventional platforms and the blockchain, can be distinguished in terms of a fundamental tradeoff, referred to as the CAP (consistency, availability, and partition tolerance) tradeoff in computer science. The CAP theorem (*Gilbert and Lynch*, 2002, 2012), also known as Brewer's theorem (*Brewer*, 2000), states that: **no data storage system can simultaneously guarantee the CAP characteristics** (summarizing main theories below; see *Gilbert and Lynch* (2002) and *Gilbert and Lynch* (2012) for the original discussion).

Consistency: Every data query receives an error-free response.

Most web services today strive to offer error-free transactions, aiming for ACID consistency: all operations succeed or fail in their entirety (Atomic); transactions never observe or result in inconsistent data (Consistent); uncommitted transactions are isolated from each other (Isolated), and once a transaction is committed it is permanent (Durable). In consistent distributed systems, there exists an order of operations such that each operation, albeit completed remotely, looks as if it were completed in a single instant on a central node.

Availability: Every data query receives the most recent response.

The necessary condition for a system to be fully available is that every READ/WRITE request (the building block of a data query) must receive a response, i.e., any algorithm used by the service must eventually terminate – practically, before the operation timeout. When a READ request does not receive a response, the data query simply does not receive a response. When a WRITE request receives no response, the database is not updated, and the data query can receive only a stale response.

Partition tolerance: The system can continue to operate during network partition.

Partitions take place when the network is divided into multiple groups that cannot communicate with each other, i.e., messages sent from nodes in one group to nodes in other groups are lost. Thus, equivalently, any message loss in the system, due to node failure, link failure, communication collision, etc., can be conceptually viewed as a temporary network partition.

Proof of the theorem. The CAP theorem can be proved by contradiction. Consider a network N partitioned into two disjoint sub-nets N_1, N_2 (partition tolerance), with all messages between N_1 and N_2 lost. Then, suppose a simple WRITE command is submitted by N_1, and a simple READ command takes place in N_2. Both WRITE and READ access the same data ledger on N, and the system should output the recent value of WRITE upon the READ request.

Since the conceptual system can guarantee availability, a value must always be output. Now, consider two cases: WRITE s_A, and WRITE s_B, either of which can happen at N_1. However, the server N_2 is unable to provide a guaranteed consistent output for the READ command, as it cannot determine whether to output s_A or s_B due to the connection lost with N_1. Thus, the partition-tolerant system is unable to provide a response that is simultaneously available and consistent. Contradiction finishes the proof. □

Constrained by the CAP tradeoff, digital systems prioritize consistency, availability, and partition tolerance to different extents, while facing limitations in unstressed dimensions. Theoretically, any two dimensions of the three can be achieved at the same time (Figure 1):

- **Achieving Consistency and Partition Tolerance.**

  Consider a system N partitioned into disjoint sub-nets N_1, N_2. For any query associated with possible processing across the two sub-nets, instead of processing taking place in the same sub-net, the system outputs None.

  In this partition-tolerant system, consistency is ensured, but availability is not.

  Example: "404 Error" – PAGE NOT FOUND.

- **Achieving Availability and Partition Tolerance.**

  Consider a system N partitioned into disjoint sub-nets N_1, N_2. For any query on sub-net N_1 or N_2, the system outputs the recent (but not the most recent) data on that sub-net.

  In this partition-tolerant system, availability is ensured, but consistency is not.

  Example: "Total items sold" number differing at multiple distributed inventories.

- **Achieving Consistency and Availability.**

  Consider a centralized system N that is not allowed to be partitioned into sub-nets. For any query on the system, it outputs the most recent value in the data ledger.

  In this partition-intolerant system, availability and consistency can be simultaneously ensured.

  Example: "Number of people waiting" on the central display window in front of a queue.

This impossible triangle represents the more general tradeoff between *safety* and *liveness* in error-prone *distributed* systems (*Gilbert and Lynch*, 2012). Importantly, the safety-liveness tradeoff externalizes the impossibility of *consensus*, defined in terms of three requirements of collective response: agreement, validity, and termination. The CAP theorem, therefore, implies that *it is impossible to achieve complete consensus in a system subject to partitions (i.e., message loss).* As pointed out in *Gilbert and Lynch* (2002), "for every purported consensus protocol that guarantees agreement and validity, there is some execution in which there are no failures and yet the algorithm never terminates. In the case of consensus, safety and liveness are impossible if the system is even potentially slightly faulty." Notably, this concern is particularly relevant for blockchains, where various designs of *consensus mechanisms* are experimented with (*Wang et al.*, 2019; *Gans and Gandal*, 2021).

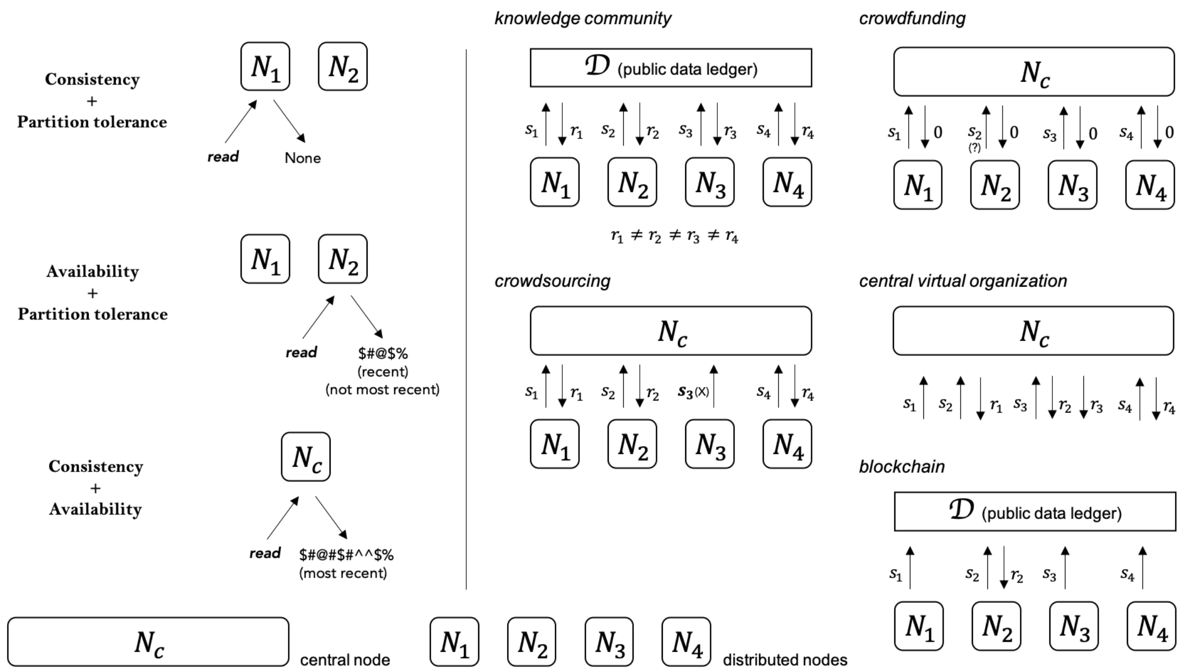

Figure 1: Illustration of different digital systems designs addressing the CAP tradeoff.

3.2 CAP Tradeoff on Digital Platforms

The CAP tradeoff applies to arbitrary digital systems that rely on data storage and data query to function and that involve geographically diverse data centers. We argue that, in particular, this functionality triangle serves as a good basis for analyzing and comparing digital platforms.

During digital platforms' operations, the organizing of task, information, and reward (Section 2.2, Table 1) relies fundamentally on data storage facilities (the hardware and the network) and data query actions (i.e., complex functionalities building on READ/WRITE): centralized or decentralized task division depends on the platform's data storage model, and the allocation of tasks, through self-selection or assignment, corresponds to voluntarily querying the database (e.g., WRITE) or discretionarily receiving the command (e.g., READ); the information flow on the platform, with different transparency, traceability, and malleability conditions, breaks down to participants' various queries to the central data storage as well as to each other's local data storage; the visibility of reward, either fixed or unfixed reward, either in monetary or in other terms, is determined by the authorization of different types of reward queries, which is tied to the platform's practiced extent of centralization.

Therefore, translating the original CAP theorem to the digital platform context, we propose:

> **Proposition 2:** No digital platform can simultaneously achieve the highest possible level of consistency, availability, and partition tolerance in its operations.

Practitioners building and deploying distributed services over unreliable networks have traditionally chosen to sacrifice either availability or consistency (*Gilbert and Lynch*, 2012). In our context, for conventional platforms, high availability (thus high service efficiency) is desired in most cases, so that task division and allocation on the platform are always possible (we dislike the 404 Error on news apps); information in the virtual space can flow smoothly and in real-time (we want quick response from friends in chats); and reward can be distributed without much delay (we wish to get coupons and bonus points instantaneously).

Unlike conventional platforms, blockchains generally sacrifice availability to achieve high consistency and high partition tolerance. User requests on blockchains may not receive responses (e.g., service unavailable or outcome uncertain), and when there are responses, substantial delays can occur (e.g., postponed completion of transaction). This reduced system availability may lead to decreased service efficiency, elevated resource waste, system instability, and dissatisfaction with service (resulting from congestion, delay, uncertainty, etc.) (*Xu et al.*, 2017; *Zheng et al.*, 2018). On the positive side, enhanced consistency and guaranteed partition tolerance may help resolve operational issues on conventional platforms (see below).

In this study, we consider three levels (low +, medium ++, high + + +) for each of the three system characteristics – consistency, availability, partition tolerance – and analyze different digital platforms at the CAP triangle (Table 1). Although our definitions of the three platform characteristics are not identical to the technical definitions for distributed systems in computer science, they adhere to the same theoretical principles.

3.3 Blockchain vs. Knowledge Community

Knowledge communities (e.g., Wikipedia) maintain a "self-governance" structure with highly refined policies, norms, and a technological architecture that supports the organizational ideals of consensus building and discussion (*Faraj et al.*, 2011, 2016). This structure incorporates the notion of "open source" design, which is a prominent tag for code development (e.g., the open source Transformer model (*Vaswani et al.*, 2017) underlying large language models). As knowledge communities grow, their governance becomes increasingly decentralized (*Forte et al.*, 2009). The decentralization of knowledge communities creates an information utopia, where anyone can contribute to knowledge sharing, while ideas are vetted through democratic channels in the reputation system. The lowest extent of centralization (*decentralized*, $\star$) is executed across the platform network. The majority of participants are customer clients instead of business clients; typically, the platform does not explicitly safeguard its clients by implementing strict customer protection mechanisms.

Within the CAP triangle (Figure 2), the knowledge community enjoys perfect partition tolerance (+++), as any number of people can add content at any time; the community can also function at the highest availability (+ + +), as newly added content can be broadcast in real-time. However, the consistency of information may be compromised (+), as inaccurate content cannot be identified instantaneously, and corrections may be made only after some time has elapsed.

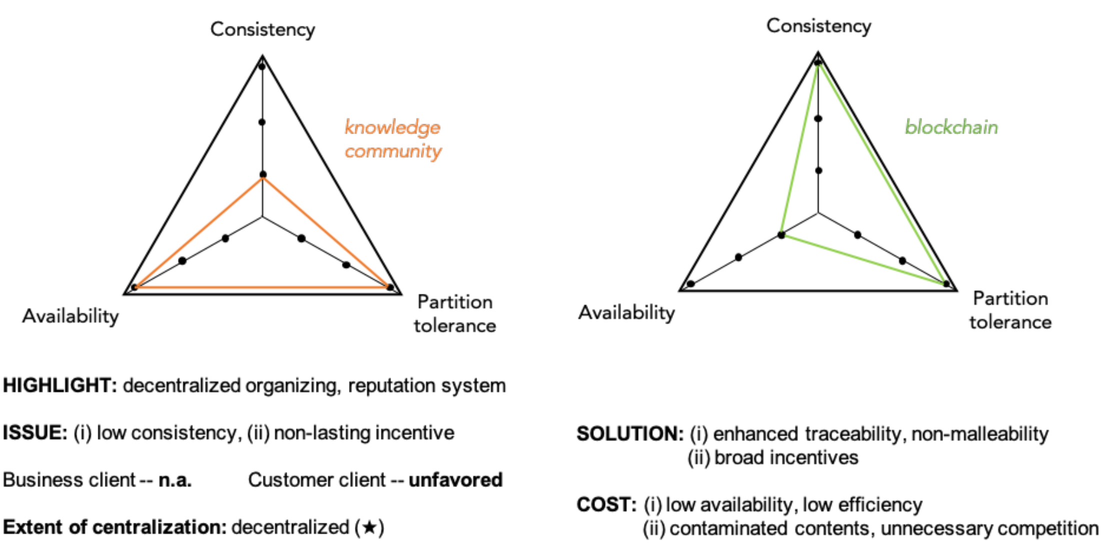

Figure 2: Comparing blockchain with knowledge community at the CAP triangle.

- **Theoretical illustration** (Figure 1). Consider a knowledge community N consisting of nodes N_1, N_2, N_3, N_4, all contributing to the public data ledger D. At distributed nodes, input s_1, s_2, s_3, s_4 are submitted (high partition tolerance), and output r_1, r_2, r_3, r_4 are returned (high availability). However, it may be that $r_1 \neq r_2 \neq r_3 \neq r_4$ (low consistency).

Besides low consistency (Issue (i)), a primary issue for knowledge community is the lack of incentives (Issue (ii)). People volunteer to contribute to platform development, often from a moral obligation for knowledge and truth, as well as to enjoy various social benefits online (*Rafaeli and Ariel*, 2008); participation may depend on members' psychological bonds to a particular online community based on need, affect, and/or obligation (*Bateman et al.*, 2011). The short-lived incentive poses a threat to the platform's survival, whose commercial expenses are currently covered mostly through donations.[3]

Blockchain can help mitigate the low consistency issue through enhanced content traceability and non-malleability, and help resolve the short-lived incentive issue through various incentivization mechanisms that bring profits to participants, via token or fiat currency. The cost of increased consistency is sacrificed availability and a resulting low efficiency in platform operations. The cost of diversifying and promoting incentives is the contamination risk from profit-driven content, low-quality content, and unnecessary competition that might harm the platform's social atmosphere (e.g., *Bazelli et al.*, 2013; *Roy*, 2020).

3.4 Blockchain vs. Crowdsourcing

Crowdsourcing (*Howe*, 2006) is a broad term with different definitions, some of which encompass the definitions of knowledge community and crowdfunding (*Estellés-Arolas and González-Ladrón-de-Guevara*, 2012), and even DAO (*Tsoukalas and Falk*, 2020) (decentralized autonomous organization; see Section 5). In this study, we focus on crowdsourcing platforms that provide workspace for online labor such as Amazon Mechanical Turk (*Ipeirotis*, 2010), where workers perform standardized tasks, as opposed to platforms that provide workspace for professionals (e.g., platform complementors (*Boudreau*, 2018)). Crowdsourcing provides easy access to freelancers, most of whom engage in unsophisticated digital work such as labeling content, contributing ideas, or participating in experiments (*Paolacci et al.*, 2010; *Huang et al.*, 2014), sometimes in the context of contests (*Jiang et al.*, 2022). For business and academics, crowdsourcing is preferred to a centralized workforce and lab experiments due to the diversity of the crowd. By delegating partial control over data generation to network nodes, while maintaining non-malleability in data processing, the platform has a low level of centralization (*delegating*, ⋆⋆).

Within the CAP triangle (Figure 3), crowdsourcing platforms enjoy high partition tolerance (+ + +), as the workforce can be arbitrarily distributed, and the outcomes are not interdependent. For example, if 3 of 10 datasets are not properly processed, the other 7 can still be finished and returned to the task launcher. Crowdsourcing maintains medium consistency (++) and availability (++). In the case of consistency, response data from diverse sources do not guarantee reliability and thus require examination. In terms of availability, for business clients, response data are not acquired immediately, and for customer clients, labor rewards are obtained after some delay, both due to the processing of verification schemes for enforcing response quality. Algorithm-based verification hosted by the platform and monetary incentives provided to laborers nonetheless prevent very low availability and very low consistency, respectively.

- **Theoretical illustration** (Figure 1). Consider a crowdsourcing system N consisting of central node N_c and work nodes N_1, N_2, N_3, N_4. Center N_c distributes work to N_1-N_4, which submit s_1, s_2, s_3, s_4 (high partition tolerance) to N_c for validation, and receive feedback r_1, r_2, r_3, r_4 (i.e., rewards). Work node submissions are not always correct or valid (medium consistency), in which case the reward is dismissed (medium availability). For example, s_3 is false, and $r_3 = None$.

One major issue for crowdsourcing platforms is the inherent disadvantage for customer clients. Customer clients have lower bargaining power (Issue (i)) in front of business clients who provide job opportunities. As such, the often fixed-reward (Issue (ii)) online labor may suffer from delayed payments and revenue uncertainties induced by quality checks. Although this can create selection pressure for business clients, as quality work outcomes will be solicited with high incentives, in the current market where work supply-demand elasticities have not been sufficiently established, the disadvantage for customer clients is evident. Many crowdfunding platforms so far have not developed adequate enforcement mechanisms to protect customer clients from their online employers.

Blockchain-based crowdsourcing (e.g., *Tsoukalas and Falk*, 2020) can help laborers through long-term incen-

[3]Wikimedia Foundation: Wikimedia Foundation Fundraising Reports.

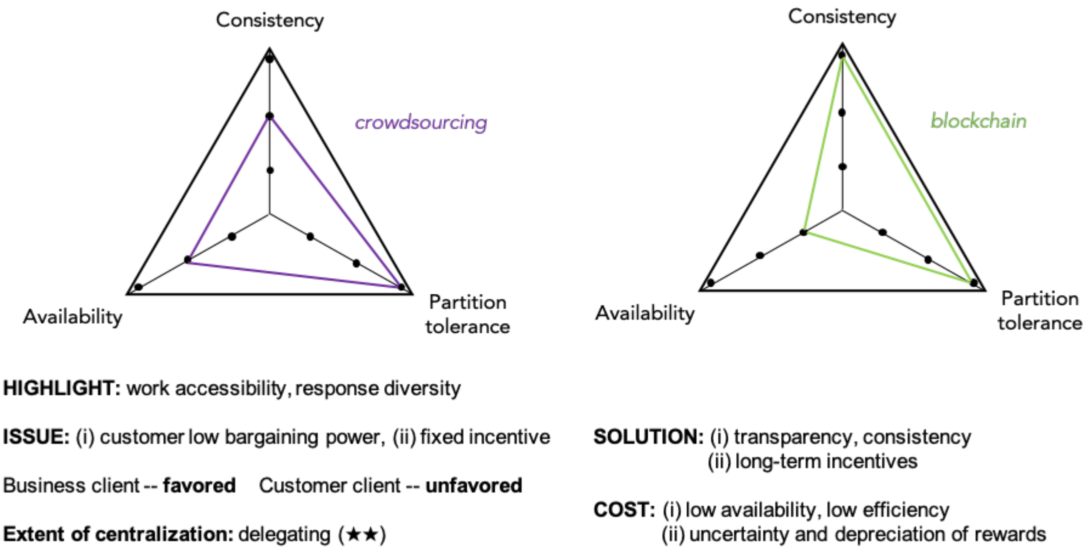

Figure 3: Comparing blockchain with crowdsourcing at the CAP triangle.

tivization via tokens, and through ensuring transparency in outcome verification, e.g., via smart contracts (*Mohanta et al.*, 2018). The quality of crowdsourced response (*Ipeirotis et al.*, 2010) may also be improved when laborers are better motivated. On the negative side, as above, higher consistency trades off availability and efficiency. Moreover, compared to fixed monetary rewards, token reward runs the risk of value depreciation; added to this risk is uncertainty around reward assignment under certain incentive mechanisms.

3.5 Blockchain vs. Crowdfunding

Crowdfunding provides a means for individual founders of prospective projects to obtain funding from the public, often in return for future products or equity (*Mollick*, 2014). In online crowdfunding, funds are raised usually from small individual contributions collected from a broad range of geographical areas (*Agrawal et al.*, 2014). This increases access to fundraising, providing enormous opportunities for small projects. For customer clients (individual funders), participation in the community is expected to yield long-term rewards, motivating clients to promote the project they support. This word-of-mouth potential is an attractive aspect of crowdfunding for small businesses when they compare different funding options. A high extent of centralization (*distributed*, $\star\star\star$) is executed on the platform.

Within the CAP triangle (Figure 4), crowdfunding systems pursue high consistency $(+++)$ during fundraising, as is required in transactions. System consistency, however, does not prevent fund loss, which cannot be predicted by the platform and is thus uncontrollable. Crowdfunding has medium partition tolerance $(++)$: funds are collected on a distributed network; however, when part of the funding network defaults, fundraising is likely to be halted. It is also medium available $(++)$, as not all funding campaigns will succeed, and not all funds will be immediately channeled.

- **Theoretical illustration** (Figure 1). Consider a crowdfunding system N consisting of central node N_c and client nodes N_1, N_2, N_3, N_4. Clients submit to center N_c the amount of investment, s_1, s_2, s_3, s_4, and receive rewards r_1, r_2, r_3, r_4 from the investment. N_c ensures that financial transactions are correct (high consistency). However, some client nodes can default (for example, $s_2 =?$), in which case the project fails to launch (medium partition tolerance). It is also possible that the project will successfully launch but then default, in which case clients may receive no output, e.g., $r_1 = r_2 = r_3 = r_4 = 0$ (medium availability).

One primary issue for crowdfunding platforms is the difficulty of establishing trust between business clients

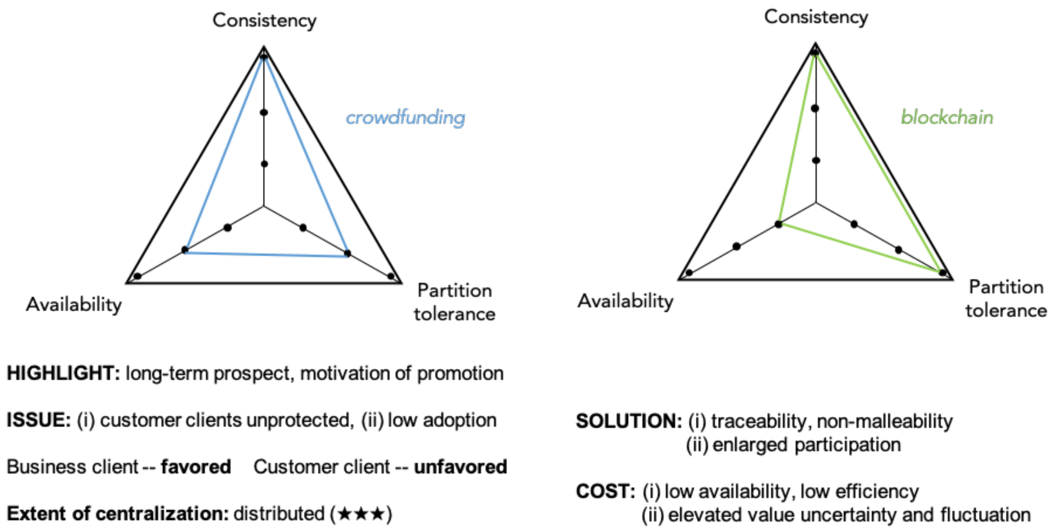

Figure 4: Comparing blockchain with crowdfunding at the CAP triangle.

(fundraisers) and customer clients (funders), as substantial uncertainties permeate the funding process, and many factors influence fundraising success (*Ahlers et al.*, 2015). In most cases, the funder side is disadvantaged (Issue (i)). Therefore, despite various funder motivations (*Boudreau et al.*, 2021) to prioritize long-term prospects, there are many deterrents to crowdfunding participation (*Gerber and Hui*, 2013). The low adoption of crowdfunding platforms (Issue (ii)) is attributable to economic constraints as well, as free participation is often not an option.

Blockchain can help establish sufficient trust between unfamiliar parties through transparent algorithmic operations. These transactions on blockchains are non-malleable, and fund losses can be fully traced, leading to better protection of customer clients. The adoption issue can also be resolved as the platform maintains functionalities other than fundraising and, therefore, participants now have alternative means to invest in a project by engaging in other on-chain activities. On the negative side, higher consistency trades off availability and efficiency; pursuing a tokenized funding option runs the risk of greater value uncertainty.

3.6 Blockchain vs. Centralized Virtual Organization

Conventional (commercial) virtual organizations (e.g., e-commerce websites) maintain full control of the platform, i.e., stay fully *centralized* (⋆⋆⋆⋆), for example, via a concentric organizing structure (*Poniatowski et al.*, 2021). Full centralization guarantees service availability and efficiency. Many conventional platforms are bi-lateral (e.g., business-to-customer, B2C (*Devaraj et al.*, 2002)), giving them sufficient bargaining power over business clients, and the ability (albeit not always the intention) to support customer clients by exerting platform power, e.g., offering low price, broad search access, good after-sale service, etc.

Within the CAP triangle (Figure 5), centralized virtual organizations are characterized by high consistency $(+++)$ and availability $(+++)$, but low partition tolerance $(+)$, as the enterprise fully controls the platform network. This organizational structure facilitates speed and efficiency in commercial operations.

- **Theoretical illustration** (Figure 1). Consider a centralized system N that is not distributed (low partition tolerance). Input and output queries are always registered in a sequence, e.g., s_1, s_2, r_1, s_3, r_2, r_3, s_4, r_4. The correct output is guaranteed (high consistency) without None (high availability).

  By contrast, consider a blockchain system N consisting of nodes N_1, N_2, N_3, N_4, all contributing to the public data ledger D. At each node, input s_1, s_2, s_3, s_4 can be submitted (high partition tolerance), and the correct output r_1, r_2, r_3, r_4 can result when possible (high consistency), but it is not guaranteed and is not without delay (low availability).

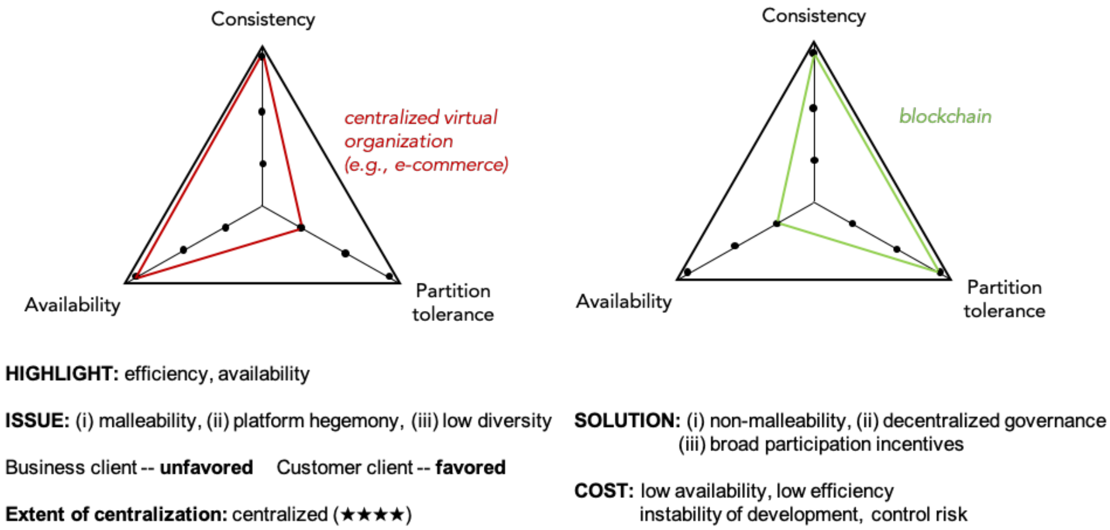

Figure 5: Comparing blockchain with centralized virtual organization at the CAP triangle.

At least three issues may arise from digital platform centralization. First, data on centralized processing channels are easily malleable (Issue (i)), due to errors or platform intentions. Second, platform hegemony (*Stein et al.*, 2023) (Issue (ii)), enabled by closed data ownership, poses an intrinsic risk for disadvantaged clients, on both the business side and the customer side. Third, full control of information generation, flow, and processing reduces information diversity (Issue (iii)), which is undesirable in many online activities.

Blockchains can help resolve these issues on conventional platforms by ensuring the non-malleability of data, adopting a decentralized organizing structure, and broadening participation incentives. Distrust of platform control promotes community autonomy and democratic operations. The downside of delegating platform management to participants via tokenization is that it increases the risk of instability in platform development, and potential control loss, due to technological (e.g., forking), organizational (e.g., community uprising), or financial (e.g., token value fluctuation) reasons. There is also the inevitable risk of deteriorated service quality (i.e., low availability and efficiency).

4 Understanding Platform Tokenization at the CAP Tradeoff

We propose that blockchain is a novel organizational form that fuses the functionalities of knowledge community, crowdsourcing, and crowdfunding, onto a focal centralized virtual organization (Section 2). This proposition serves to demystify the blockchain from an organizational point of view. Further, using the CAP tradeoff as a means for comparing blockchain to these platform categories on technological grounds (Section 3), we argue that while blockchain can help mitigate limitations of conventional platforms through the functionality aggregation, it entails nontrivial costs. Tokenization is not a "free lunch" for digital platforms.

This view of the blockchain helps diminish the hype around its value. A better understanding of the aggregate organizational form and the fusion of platform functionalities may allow firms to overcome traditional constraints in digital platform development (e.g., *Tajedin et al.*, 2019).

Specifically, this view generates the following insights around blockchain's adoption.

4.1 Decentralized Structure: It Is But an Upgrade

As mentioned earlier, it is widely believed that blockchains are in principal featured by the decentralized structure (e.g., *Hsieh and Vergne*, 2023), viewed as a crucial characteristic of tokenized platforms that can create a competitive advantage over centralized platforms (e.g., *Chen et al.*, 2021; *Gan et al.*, 2023).

Through the analysis, we contend that this common belief should be refuted. Decentralized structures on digital systems existed long before the advent of blockchains, notably in knowledge communities and even earlier, in various prototypes of person-to-person (P2P) communication (*Ford et al.*, 2005). Nonetheless, technological innovations (cryptographic inventions in particular) do allow blockchains to experiment with and deploy decentralized structures on a comprehensive level and at a greater scale.

Therefore, we argue that:

Argument: Decentralized structures are not an invention of the blockchain, and thus not a unique characteristic of the blockchain that cannot be found on other types of digital platforms. What is unique about the blockchain, however, is its ability to provide novel technological guarantees for decentralized organizing; such is an important upgrade on the decentralized structure of extant organizational forms.

4.2 Platform Tokenization: There Is No Panacea

The platform-fusion perspective of the blockchain provides a consistent rationale for why tokenization is generally applicable to various types of digital platforms. However, it is unwise to argue that tokenization should be adopted in all cases.

Through the lens of the CAP tradeoff we see that, although blockchains can indeed help resolve issues on conventional platforms, the performance gains come at a cost. In essence, tokenization is not a technology-based panacea or an add-on feature for platformization, but rather a technology implementation that reconfigures platform functionalities from a different tradeoff angle.

Further, if a blockchain structure is to be implemented, decisions regarding the timing, scale, category, type, or style of tokenization must take into account the tradeoffs under the impossible triangle. For example, for the timing of token launch, the platform needs to weigh free-riding the market fervor against the pressure of homogenization; in the choice of a public, private, or permissioned chain, the enterprise surrenders platform control to different extents, in exchange for traffic and volunteered promotion.

Therefore, we propose:

Proposition 3: Tokenization is not always beneficial for digital platforms. Further, there is no universal optimality for specific tokenization strategies.

Before adopting the blockchain, platforms need to consider the intrinsic tradeoffs; for each tokenization choice, they need to take into account the nature, scale, and intensity of their service, and the organization's compositions, boundaries, and interactions with the environment.

4.3 From Platform's Multi-functionality to Participant's Multi-role

The aggregation of knowledge community, crowdsourcing, and crowdfunding onto a single digital platform does not limit a blockchain participant to a single role, with role here referring to membership in the knowledge community (e.g., code contributor), the crowdsourcing community (e.g., online worker), or the crowdfunding community (e.g., project funder).

With the integrated functionality, blockchain has a multi-faceted utility for ordinary participants (*Li and Zhang*, 2023). It can, for instance, provide a service for transaction/interaction (e.g., using Bitcoin as a means of payment), provide a medium for digital investment (e.g., purchasing Ethereum in the crypto exchange), and provide a workspace for online labor (e.g., mining blocks on the Tether chain). This setup enables a blockchain participant to simultaneously play three roles on the platform: (service) user, (token) investor, and (crypto) laborer. The multirole of blockchain participants may help explain the stage-wise dynamics of a tokenized platform's development (*Li and Zhang*, 2023), and explain blockchain's advantage at platform adoption thanks to the accentuated platform subsidies and "piggybacking" (*Dou and Wu*, 2021).

We argue that:

Argument: Due to the fusion of platform functionalities, for ordinary participants, blockchain can simultaneously provide a service for transaction/interaction, provide a medium for digital investment, and provide a workspace for online labor. Correspondingly, on blockchains, each participant is potentially a composite of multiple roles, including digital user, digital investor, and digital laborer.

5 New Lens for Classic Tensions

Our demystification of the blockchain as a novel category of digital platform that fuses the functionalities of conventional platforms under the CAP tradeoff provides a new lens for studying several classic themes in business strategy and organization studies.

Long before the invention of blockchains and the envisioned Web 3.0 landscape, the organization and operation of *digital platforms* has been central in the Web 2.0 space. Discussions have been concerned with a platform's role as an ecosystem, platformization's generativity-induced growth, as well as key tensions regarding platform decentralization vs. control, an organization's diversification vs. uniformization, and a system's openness vs. closure. We use the lens of functionality fusion and tradeoff to anchor blockchain to conventional platforms, to shed light on these themes within general discussions on digital platforms.

5.1 Blockchains as Ecosystems

Tokenized platforms can considerably contribute to the burgeoning development of digital *ecosystems* (*Ceccagnoli et al.*, 2012; *Adner*, 2017; *Stonig et al.*, 2022) in at least two ways.

First, participants' various activities, including mining, investment, code-developing, knowledge-sharing, etc., trigger the creation of for-profit and non-profit organizations in industries such as manufacturing, finance, IT, and social media. Due to data transparency and activity complementarity on blockchains, inter-organization coordination becomes possible without full hierarchical fiat. This enables the emergence of an *off-chain* ecosystem (an ecosystem in a broad sense).

Second, a main chain can sustain an *on-chain* ecosystem (an ecosystem in a narrow sense) together with sub-chains where projects co-exist (e.g., on Ethereum) and possibly co-ordinate (e.g., on Polkadot), so that a focal value promotion of the main chain and its broad ecosystem can materialize (*Adner*, 2017). This "layer-2" system, where some computation and procedures are moved away from the main blockchain, can, for example, considerably reduce operation costs and promote the scaling of adoption (*Cong et al.*, 2023a).

Through active (on-chain) and passive (off-chain) system design, this dual-ecosystem configuration integrates the business ecosystem, the innovation ecosystem, and the platform ecosystem (*Jacobides et al.*, 2018). Through the transparent and consistent sharing of *data*, the ownership issue of this key resource for platform development is resolved, and frameworks such as the RBV (resourced-based view; e.g., (*Madhok*, 2002)) can now apply to this distinct ecosystem that highlights knowledge-based innovation (*Conner and Prahalad*, 1996). The loosely bounded organizational structure in the blockchain ecosystem (*Sosa et al.*, 2004) prompts novel product architectures (e.g., non-fungible tokens, decentralized exchanges, auctions on parachains) and complex interactions (*Rivkin and Siggelkow*, 2007).

5.2 Generativity and Growth

The integration of platform functionalities promotes *generativity* in the blockchain-based organizational model. Generativity (*Thomas and Tee*, 2022) on digital platforms, including the addition of new components to existing product categories (i.e., the product view (*Yoo et al.*, 2010)), and ensuing new interactions between these components and participants (i.e., the social interaction view (*Faraj et al.*, 2011)), expands ecosystem boundaries. This generativity can promote rapid (albeit not unbounded) *growth* in platform participation, which in turn facilitates the evolution of the platform (*Fürstenau et al.*, 2023), although the divergence of incentives may negatively affect participation (*Cennamo and Santalo*, 2019).

In the Web 2.0 platform economy, generativity-induced user growth has already been made possible on digital platforms, which open their systems to external developers and celebrate the value of platformization as a channel for growth and innovation (*Fürstenau et al.*, 2023). This generativity, however, can be significantly enhanced on blockchains due to their ability in integrating multiple platform categories. Such a qualitative innovation can bring quantitative improvements in organization growth (*Adner et al.*, 2019).

5.3 Decentralization vs. Control

Through advanced algorithm-based automation that upgrades existing decentralized structures, blockchains support the decentralized autonomous organization (DAO) paradigm (*Murray et al.*, 2021). In this paradigm,

> "routine tasks are powered by a software protocol instead of being governed by managers and employees. Task assignments and rewards are randomized by the algorithm. Information is not channeled through a hierarchy but recorded transparently and securely on an immutable public ledger. The organization decides on design and strategy changes through a democratic voting process involving a previously unseen class of stakeholders. Agreements need to be reached at the organizational level for any proposed protocol changes to be approved and activated" (*Hsieh et al.*, 2018).

Practical organizational arrangements, such as automated task design, transparent information flow, and indisputable reward completion (Section 2.2), as well as vote-based decision-making and democratic protocol change etc., can be implemented on the chain under this *decentralization* frame.

In essence, smart contracts on blockchains, which enable end-to-end automation during platform operation, realize the notion that corporations (platforms herein) are the "nexus of contracts" (*Jensen and Meckling*, 1976), or more precisely, "nexus of reciprocal arrangements" (*Eisenberg*, 1998). Decentralized exchange (DEX), where token pairs are exchanged automatically under algorithmic contracts without third-party intervention, is a prime example of this idea.

The decentralized ecosystem in practice, however, can be flawed (*Park*, 2023), notably because DAOs tend to concentrate *control*. While the concentration of governance token ownership can be limited by design or by regulation, implementation and enforcement are challenging if decentralized governance is to be maintained (*Bakos and Halaburda*, 2022a). As discussed earlier, in practice, the extent of decentralization realized on blockchains varies tremendously; without a central party holding platform control, stakeholders and participants compete for governance in a context where equilibria are either difficult to establish, or displaying centralized patterns (e.g., *Ferreira et al.*, 2023). Thus, a decentralized state may subsist only for short periods.

5.4 Openness vs. Closure

In open source communities, transparency and *openness* (i.e., "digital unfolding") are balanced with opacity and *closure* (i.e., "digital folding"), depending on the needs of the development work (*Shaikh and Vaast*, 2016). This tradeoff creates tensions that characterize the governance of technological open ecosystems (*Wareham et al.*, 2014).

On the one hand, blockchains facilitate open innovation due to their flexible organizational structure, deriving from the extensibility of the chain. On the other hand, their complete traceability outlines a clear and non-malleable boundary for platform participation, lowering the threat of expropriation (*Huang et al.*, 2013) and further encouraging innovative participants. This dual feature of openness and closure differentiates blockchain from traditional open communities, where "digital folding" is not as common as "digital unfolding." Thus, essentially, blockchain provides an environment of flexible affordances that are used to create innovations characterized by both generativity and convergence (*Yoo et al.*, 2012). This new organizational form resolves the intrinsic tension between achieving innovation and maintaining control (*Zittrain*, 2009).

Open innovation in the closed system leads to accumulation, which underlines the prototype of an advanced digital capitalism (*Schiller*, 1999; *Wajcman*, 2020). Indeed, blockchain provides the fundamental infrastructure for innovation where cumulative profits are no longer difficult to achieve. Participants can play different roles in one collaborative work, can engage in multiple lines of work on one platform, or can allocate their time on different platforms, but now with consistent record-tracking for each instance of participation.

Overall, our characterization of the blockchain as fusing conventional platform functionalities, constrained by the CAP triangle, offers new insights for classic topics related to digital platforms, highlighting the presence of *tradeoff*: each advantage that emerges from blockchain's technological affordance is balanced with costs.

In reality, the existence of functionality tradeoffs within blockchain systems has long been recognized and is described from different angles – for example, "Decentralization requires 'compromises': the Web had to throw away the ideal of total consistency of all of its interconnections, ushering in the infamous message 'Error 404: Not Found' but allowing unchecked exponential growth" (*Berners-Lee et al.*, 2001); similarly, the "sacrifice" between decentralization, security, and scalability in the widely known "blockchain trilemma" is well noted by Ethereum founder Vitalik Buterin.[4] We extend the CAP triangle from computer science to derive a formal description of the technological tradeoff, which applies to different digital platform categories and externalizes into concrete exchanges in our comparison of blockchain and conventional platforms.

Within the blockchain ecosystem, these tradeoffs are important considerations at pursuing short-term or long-term growth, at weighing decentralization over centralization, and at prioritizing openness and innovation while maintaining necessary platform boundaries. Paying attention to tradeoffs when implementing technological elements into organizational settings helps inform tokenization strategies, and beyond.

6 Concluding Remarks

Do digital platforms always benefit from tokenization? The answer is perhaps no – the tokenization campaign is not delivering a free lunch. In this study, we respond to the adoption question from two perspectives.

First, we support blockchains' strong applicability on conventional digital platforms, by offering a platform-fusion view of this new organizational form: blockchain fuses the functionalities of knowledge community, crowdsourcing, and crowdfunding, onto a focal centralized virtual organization, which corresponds to the aggregation of education systems, labor markets, and capital markets, onto product markets. As key resources for business operations are effectively organized on the blockchain, a self-sustaining ecosystem can be formulated.

Second, we reject the idea that this platform upgrade based on tokenization is always beneficial, by comparing blockchain to conventional platforms under the CAP tradeoff around platform functionalities: upon aggregating platforms' highlighted features, blockchains do provide solutions for mitigating issues with conventional designs; yet the benefits come with non-trivial costs. High consistency and full partition tolerance trade off low service availability and compromised efficiency. Balances are to be considered additionally around promoted participation, amplified value fluctuation, and ceded platform control. Decentralization, in particular, is neither an invention nor a trump card of the blockchain.

In all, for digital platforms, tokenization is palatable, but not a panacea, and not even a placebo. By establishing an organizational perspective (platform fusion) on a technological basis (the CAP triangle), we contend that this innovative move on digital platforms incorporates non-negligible tradeoffs. Further, there is no one-size-fits-many tokenization strategy for how to employ a blockchain structure. For tokenized platforms, the lines between growth and stability, decentralization and control, and openness and closure, need to be drawn with practical discretion, instead of from any technological reliance.

6.1 Limitations and Future Directions

Our discussion has many limitations and points to future research directions. Several ideas are below.

(1) Privacy is not considered in the CAP tradeoff. Different types of platforms can trade off consistency, availability, or partition tolerance, to enhance privacy-keeping. It is not straightforward whether blockchains increase or decrease participants' privacy (*Babich and Hilary*, 2020), by making every operation transparent but possibly under a pseudo name.

(2) Platform competition (e.g., *Cennamo and Santalo*, 2013; *Niculescu et al.*, 2018) is not considered in

[4] https://coinmarketcap.com/academy/glossary/blockchain-trilemma#.

the current discussion. Competition adds a layer of complexity to platform's survival strategies, to its externality-neglecting positioning in the tradeoff. To stay competitive, platforms may choose to sacrifice certain functionality factors in pursuit of others.

(3) Blockchain's novel organizational structure facilitates efficient coordination of different parties in the ecosystem. Under the platform-fusion perspective, reduction of coordination cost and enhancement of relational context (e.g., *Bakos and Halaburda*, 2022b; *Hsieh and Vergne*, 2023), are important directions for further discussion.

(4) Fusing multiple functionalities onto the focal platform and supporting multiple roles for general participants increases blockchains' potential for adoption (e.g., *AlShamsi et al.*, 2022). On the one hand, more people can access the platform, and platform can create sufficient inertia through diverse activities; on the other hand, diluting platform's core functionality can hurt platform identity, discouraging loyal participants.

(5) Platforms of different businesses prioritize consistency, availability, and partition tolerance to different extents. The functionality tradeoff also contains a time-dependent component, as platform's role and participants' expectation of that role continue to evolve (*Tiwana et. al*, 2010). Matching business contexts to configurations on the functionality triangle carries interesting dynamics.

6.2 Applying the CAP Triangle

In our comparison of blockchain to conventional platform categories, we demonstrate that the CAP triangle is a useful tool for the analysis of digital platforms. We further showcase the application of this tool in two managerial discussions.

6.2.1 Creator – Fourth Role on the Platform

Besides fusing knowledge community, crowdsourcing, and crowdfunding, blockchains can incorporate the functionality of another platform category – online creator platform – through the novel token type non-fungible token (NFT) (*Wang et al.*, 2021). This platform category goes beyond knowledge community and promotes open innovation at an advanced level in the *online maker community* (*Oehlberg et al.*, 2015). This community supports the creation of design and art, either purely digital (e.g., Pixilart) or related to physical entities (e.g., Thingiverse), as well as the creation of other intellectual property such as courses (*Komleva and Vilyavin*, 2020). Benefiting from traceability, transparency, and the long-term prospects of tokens' value, blockchains can protect property rights and establish trust in the market, thus facilitating innovative creation, encouraging incentivized promotion, and advocating new business models around the transaction of digital artifacts, e.g., "monetized graphics" (*Zeilinger*, 2018).

Within the CAP triangle (Figure 6a), an online maker community can adopt either a centralized or a decentralized organizational structure. Under the centralized option, the platform maintains medium consistency (++), as errors may be left unchecked during the creation process; medium availability (++), as creations can depend on collective response; and medium partition tolerance (++), as collaborative projects are allowed but not without constraints. Under the decentralized option, it is similar to a knowledge community, with low consistency (+), high partition tolerance (+ + +), but this time with reduced availability (++), due to larger complexity and a greater need for collaboration during the creation of artifacts, than during knowledge creation. Through tokenization, blockchains can improve online maker community platforms under either option, with the corresponding costs.

6.2.2 Stages of Web Development

The utility of the distinctions of 1.0, 2.0, 3.0, even the ambitious 4.0 era (as envisioned by the European Commission[5]), along the development of the Web, has been questioned by scholars (e.g., *Barassi and Treré*, 2012). The distinctions derive from industrial demarcations in the corporate world (*Constantinides and Fountain*, 2008) and have not yet consolidated an academic recognition (Appendix E). In casual terms, Web 1.0 corresponds to the era of "webpage", and Web 2.0 marks the era of "platform." Web 3.0, featuring

[5]https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3718.

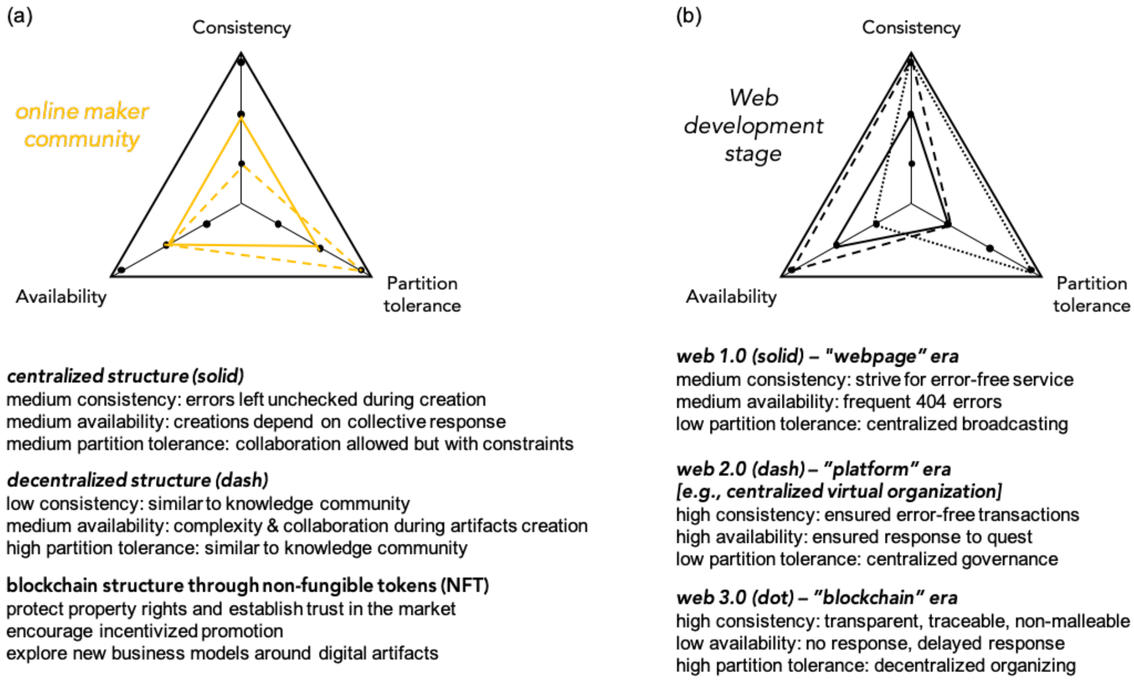

Figure 6: Application of the CAP Triangle. (a) Analyze the online maker community. (b) Compare Web development stages.

various technology advances on top of the chained data (*Hendler*, 2009), is looking for a new identity, and many agree that the ongoing is the "blockchain" era.

Within the CAP triangle (Figure 6b), we can compare the stages of Web development. In the Web 1.0 era, portals that broadcast webpages did not evolve into full-fledged platforms and web service was flawed. Medium consistency (++) and medium availability (++) were maintained amid efforts to realize error-free information flow and to reduce the frequency of 404 warnings; systems functioned on the basis of centralized broadcasting with low partition tolerance (+). In the Web 2.0 era, digital platforms are substantially developed. Advancing the portals, centralized virtual organizations – the platform category closest to Web 1.0 systems – can ensure transaction and service efficiency upon high consistency (+ + +) and high availability (+ + +), realized through the centralized governance (low partition tolerance (+)). In the Web 3.0 era, blockchains aggregate Web 2.0 platforms and become omni-functional digital spaces. Consistency (+ + +) and partition tolerance (+ + +) can be realized to the highest degree; but service and response are often not immediately available or ever available at all (+), arguably, not much different from our situation in the physical world.

6.3 Outlook: Road to Digital Living

In the coming 3.0 or 4.0 stage of the Web, we may experience the era of "metaverse" (*Mystakidis*, 2022), essentially a space for digital living (*Slater*, 2002). Despite the many tradeoffs, by enabling ordinary participants to simultaneously play three fundamental roles – user, investor, and laborer – tokenized platforms can build suitable ecosystems for digital living, where technologies steward communities in the digital habitat (*Wenger et al.*, 2009) and we enjoy "the lure of the virtual" (*Bailey et al.*, 2012).

NFT and the creator community add to this picture. On the platform, participants can create tokenized artifacts, and NFTs allow these digital artifacts to be transacted with ease. This introduces a fundamental change to life on digital platforms, as every participant now can play a fourth role: performer/creator. This new role generates a third source of earning on tokenized platforms, earning via creation/composing

(*Whitaker and Kräussl*, 2020), besides earning from investment and laboring. Although currently digital creation is popular only among the artist community on most platforms, it will not be long before we are compelled to extend our focus to this fourth, and arguably more exciting role, of ordinary digital platform participants, and embrace the novel Web stage of digital living where everyone can be a creative citizen. We are few minutes away from knocking and singing at Andy Warhol's door.[6]

References

Abbate, J. (2000), *Inventing the Internet*, MIT Press.

Adner, R. (2017), Ecosystem as structure: An actionable construct for strategy, *Journal of Management*, 43(1), 39-58.

Adner, R., Puranam, P., & Zhu, F. (2019), What is different about digital strategy? From quantitative to qualitative change, *Strategy Science*, 4(4), 253-261.

Agrawal, A., Catalini, C., & Goldfarb, A. (2014), Some simple economics of crowdfunding, *Innovation Policy and the Economy*, 14(1), 63-97.

Agrawal, A., Gans, J. S., & Stern, S. (2021), Enabling entrepreneurial choice, *Management Science*, 67(9), 5510-5524.

Ahlers, G. K., Cumming, D., Günther, C., & Schweizer, D. (2015), Signaling in equity crowdfunding, *Entrepreneurship Theory and Practice*, 39(4), 955-980.

Al-Jaroodi, J., & Mohamed, N. (2019), Blockchain in industries: A survey, *IEEE Access*, 7, 36500-36515.

AlShamsi, M., Al-Emran, M., & Shaalan, K. (2022), A systematic review on blockchain adoption, *Applied Sciences*, 12(9), 4245.

Alvi, S. T., Uddin, M. N., Islam, L., & Ahamed, S. (2020, December), From conventional voting to blockchain voting: categorization of different voting mechanisms, In *2020 2nd International Conference on Sustainable Technologies for Industry 4.0 (pp. 1-6)*, IEEE.

Amable, B. (2003), *The Diversity of Modern Capitalism*, OUP Oxford.

Andriole, S. J. (2010), Business impact of Web 2.0 technologies, *Communications of the ACM*, 53(12), 67-79.

Babich, V., & Hilary, G. (2020), OM Forum—Distributed ledgers and operations: What operations management researchers should know about blockchain technology, *Manufacturing & Service Operations Management*, 22(2), 223-240.

Bailey, D. E., Leonardi, P. M., & Barley, S. R. (2012), The lure of the virtual, *Organization Science*, 23(5), 1485-1504.

Bakos, Y., & Halaburda, H. (2022a), Will Blockchains Disintermediate Platforms? The Problem of Credible Decentralization in Daos, Available at SSRN 4221512.

Bakos, Y., & Halaburda, H. (2022b), Overcoming the coordination problem in new marketplaces via cryptographic tokens, *Information Systems Research*, 33(4), 1368-1385.

Barassi, V., & Treré, E. (2012), Does Web 3.0 come after Web 2.0? Deconstructing theoretical assumptions through practice, *New Media & Society*, 14(8), 1269-1285.

Bateman, P. J., Gray, P. H., & Butler, B. S. (2011), Research note—the impact of community commitment on participation in online communities, *Information Systems Research*, 22(4), 841-854.

Bazelli, B., Hindle, A., & Stroulia, E. (2013, September), On the personality traits of stackoverflow users, In *2013 IEEE International Conference on Software Maintenance* (pp. 460-463).

[6]In a 1968 exhibition of Andy Warhol's work at the Moderna Museet in Stockholm, Sweden, there originated the famous quote: "In the future, everyone will be world-famous for 15 minutes."

Berners-Lee, T., Hendler, J., & Lassila, O. (2001), The Semantic Web, *Scientific American*.

Biais, B., Capponi, A., Cong, L. W., Gaur, V., & Giesecke, K. (2023), Advances in blockchain and crypto economics, *Management Science*.

Boudreau, K. J. (2018), Amateurs crowds & professional entrepreneurs as platform complementors (No. w24512), *National Bureau of Economic Research*.

Boudreau, K. J., Jeppesen, L. B., Reichstein, T., & Rullani, F. (2021), Crowdfunding as donations to entrepreneurial firms, *Research Policy*, 50(7), 104264.

Brewer, E. A. (2000, July), Towards robust distributed systems, In *PODC* (Vol. 7).

Catalini, C., & Gans, J. S. (2018), Initial coin offerings and the value of crypto tokens (No. w24418), *National Bureau of Economic Research*.

Catalini, C., & Gans, J. S. (2020), Some simple economics of the blockchain, *Communications of the ACM*, 63(7), 80-90.

Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2012), Cocreation of value in a platform ecosystem! The case of enterprise software, *MIS Quarterly*, 263-290.

Ceccagnoli, M., Forman, C., Huang, P., & Wu, D. J. (2014), Digital platforms: when is participation valuable? *Communications of the ACM*, 57(2), 38-39.

Cennamo, C., & Santalo, J. (2013), Platform competition: Strategic trade-offs in platform markets, *Strategic Management Journal*, 34(11), 1331-1350.

Cennamo, C., & Santalo, J. (2019), Generativity tension and value creation in platform ecosystems, *Organization Science*, 30(3), 617-641.

Chen, M. A., Hu, S. S., Wang, J., & Wu, Q. (2023), Can Blockchain Technology Help Overcome Contractual Incompleteness? Evidence from State Laws, *Management Science*.

Chen, X., Cheng, Q., & Luo, T. (2023), The economic value of blockchain applications: Early evidence from asset-backed securities, *Management Science*.

Chen, Y., Richter, J. I., & Patel, P. C. (2021), Decentralized governance of digital platforms, *Journal of Management*, 47(5), 1305-1337.

Cheng, S. F., De Franco, G., Jiang, H., & Lin, P. (2019), Riding the blockchain mania: Public firms' speculative 8-K disclosures, *Management Science*, 65(12), 5901-5913.

Chesbrough, H. W. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Harvard Business Press.

Chod, J., Trichakis, N., Tsoukalas, G., Aspegren, H., & Weber, M. (2020), On the financing benefits of supply chain transparency and blockchain adoption, *Management Science*, 66(10), 4378-4396.

Chod, J., Trichakis, N., & Yang, S. A. (2022), Platform tokenization: Financing, governance, and moral hazard, *Management Science*, 68(9), 6411-6433.

Christidis, K., & Devetsikiotis, M. (2016), Blockchains and smart contracts for the internet of things, *IEEE Access*, 4, 2292-2303.

Cong, L. W., Hui, X., Tucker, C., & Zhou, L. (2023), Scaling Smart Contracts via Layer-2 Technologies: Some Empirical Evidence, *Management Science*.

Cong, L. W., Li, X., Tang, K., & Yang, Y. (2023), Crypto wash trading, *Management Science*.

Conner, K. R., & Prahalad, C. K. (1996), A resource-based theory of the firm: Knowledge versus opportunism, *Organization Science*, 7(5), 477-501.

Constantinides, E., & Fountain, S. J. (2008), Web 2.0: Conceptual foundations and marketing issues, *Journal of Direct, Data and Digital Marketing Practice*, 9, 231-244.

Constantinides, P., Henfridsson, O., & Parker, G. (2018), Introduction—Platforms and Infrastructures in the Digital Age, *Information Systems Research*, 29(2), 381-400.

Davis, G. F., & Sinha, A. (2021), Varieties of Uberization: How technology and institutions change the organization(s) of late capitalism, *Organization Theory*, 2(1), 2631787721995198.

De Reuver, M., Sørensen, C., & Basole, R. C. (2018), The digital platform: a research agenda, *Journal of Information Technology*, 33(2), 124-135.

Devaraj, S., Fan, M., & Kohli, R. (2002), Antecedents of B2C channel satisfaction and preference: validating e-commerce metrics, *Information Systems Research*, 13(3), 316-333.

Dou, Y., & Wu, D. J. (2021), Platform competition under network effects: Piggybacking and optimal subsidization, *Information Systems Research*, 32(3), 820-835.

Eisenberg, M. A. (1998), The Conception that the Corporation is a Nexus of Contracts, and the Dual Nature of the Firm, *Journal of Corporation Law*, 24, 819.

Estellés-Arolas, E., & González-Ladrón-de-Guevara, F. (2012), Towards an integrated crowdsourcing definition, *Journal of Information Science*, 38(2), 189-200.

Faraj, S., Jarvenpaa, S. L., & Majchrzak, A. (2011), Knowledge collaboration in online communities, *Organization Science*, 22(5), 1224-1239.

Faraj, S., von Krogh, G., Monteiro, E., & Lakhani, K. R. (2016), Special section introduction—Online community as space for knowledge flows, *Information Systems Research*, 27(4), 668-684.

Ferreira, D., Li, J., & Nikolowa, R. (2023), Corporate capture of blockchain governance, *The Review of Financial Studies*, 36(4), 1364-1407.

Ford, B., Srisuresh, P., & Kegel, D. (2005, April), Peer-to-Peer Communication Across Network Address Translators, In *USENIX Annual Technical Conference*, General Track (pp. 179-192).

Forte, A., Larco, V., & Bruckman, A. (2009), Decentralization in Wikipedia governance, *Journal of Management Information Systems*, 26(1), 49-72.

Franke, B., Fritz, Q. G., & Stenzel, A. (2023), The (limited) power of blockchain networks for information provision, *Management Science*.

Fürstenau, D., Baiyere, A., Schewina, K., Schulte-Althoff, M., & Rothe, H. (2023), Extended Generativity Theory on Digital Platforms, *Information Systems Research*.

Gan, J., Tsoukalas, G., & Netessine, S. (2021), Initial coin offerings, speculation, and asset tokenization, *Management Science*, 67(2), 914-931.

Gan, J., Tsoukalas, G., & Netessine, S. (2023), Decentralized platforms: Governance, tokenomics, and ICO design, *Management Science*.

Gandal, N., Hamrick, J. T., Moore, T., & Vasek, M. (2021), The rise and fall of cryptocurrency coins and tokens, *Decisions in Economics and Finance*, 44(2), 981-1014.

Gans, J. S., & Gandal, N. (2021), Consensus mechanisms for the blockchain, *The Palgrave Handbook of Technological Finance*, 269-286.

Gao, Q., Lin, M., & Wu, D. J. (2021), Education crowdfunding and student performance: An empirical study, *Information Systems Research*, 32(1), 53-71.

Gerber, E. M., & Hui, J. (2013), Crowdfunding: Motivations and deterrents for participation, *ACM Transactions on Computer-Human Interaction*, 20(6), 1-32.

Gilbert, S., & Lynch, N. (2002), Brewer's conjecture and the feasibility of consistent, available, partition-tolerant web services, *ACM Sigact News*, 33(2), 51-59.

Gilbert, S., & Lynch, N. (2012), Perspectives on the CAP Theorem, *Computer*, 45(2), 30-36.

Grant, R. M. (1996), Toward a knowledge-based theory of the firm, *Strategic Management Journal*, 17(S2), 109-122.

Han, R., Yan, Z., Liang, X., & Yang, L. T. (2022), How can incentive mechanisms and blockchain benefit with each other? A survey, *ACM Computing Surveys*, 55(7), 1-38.

Hartmann, F., Grottolo, G., Wang, X., & Lunesu, M. I. (2019, February), Alternative fundraising: success factors for blockchain-based vs. conventional crowdfunding, *IEEE-IWBOSE* (pp. 38-43).

Hendershott, T., Zhang, X., Zhao, J. L., & Zheng, Z. (2021), FinTech as a game changer: Overview of research frontiers, *Information Systems Research*, 32(1), 1-17.

Hendler, J. (2009), Web 3.0 Emerging, *Computer*, 42(1), 111-113.

Holmquist, L. E., Redström, J., & Ljungstrand, P. (1999), Token-based access to digital information, In *Handheld and Ubiquitous Computing: First International Symposium.*

Howe, J. (2006), The rise of crowdsourcing, *Wired Magazine*, 14(6), 1-4.

Howe, J. (2008), *Crowdsourcing: How the Power of the Crowd Is Driving the Future of Business*, Random House.

Hsieh, Y. Y., Vergne, J. P., Anderson, P., Lakhani, K., & Reitzig, M. (2018), Bitcoin and the rise of decentralized autonomous organizations, *Journal of Organization Design*, 7(1), 1-16.

Hsieh, Y. Y., & Vergne, J. P. (2023), The future of the web? The coordination and early-stage growth of decentralized platforms, *Strategic Management Journal*, 44(3), 829-857.

Huang, P., Ceccagnoli, M., Forman, C., & Wu, D. J. (2013), Appropriability mechanisms and the platform partnership decision: Evidence from enterprise software, *Management Science*, 59(1), 102-121.

Huang, Y., Vir Singh, P., & Srinivasan, K. (2014), Crowdsourcing new product ideas under consumer learning, *Management Science*, 60(9), 2138-2159.

Huber, G. P. (1990), A theory of the effects of advanced information technologies on organizational design, intelligence, and decision making, *Academy of Management Review*, 15(1), 47-71.

Iansiti, M., & Lakhani, K. R. (2017), The truth about blockchain, *Harvard Business Review*, 95(1), 118-127.

Ipeirotis, P. G. (2010), Analyzing the Amazon Mechanical Turk marketplace, *XRDS: Crossroads, The ACM Magazine for Students*, 17(2), 16-21.

Ipeirotis, P. G., Provost, F., & Wang, J. (2010, July), Quality management on Amazon Mechanical Turk, In *Proceedings of the ACM SIGKDD Workshop on Human Computation* (pp. 64-67).

Iyengar, G., Saleh, F., Sethuraman, J., & Wang, W. (2023), Economics of permissioned blockchain adoption, *Management Science*, 69(6), 3415-3436.

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018), Towards a theory of ecosystems, *Strategic Management Journal*, 39(8), 2255-2276.

Jensen, M. C., & Meckling, W. H. (1976), Theory of the firm: Managerial behavior, agency costs and ownership structure, *Journal of Financial Economics*, 3(4), 305-360.

Jiang, Z., Huang, Y., & Beil, D. R. (2022), The role of feedback in dynamic crowdsourcing contests: A structural empirical analysis, *Management Science*, 68(7), 4858-4877.

Karame, G. (2016, October), On the security and scalability of bitcoin's blockchain, In *Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security* (pp. 1861-1862).

Kenney, M., & Zysman, J. (2016), The rise of the platform economy, *Issues in Science and Technology*, 32(3).

Klinc, D., Hazay, C., Jagmohan, A., Krawczyk, H., & Rabin, T. (2012), On compression of data encrypted with block ciphers, *IEEE Transactions on Information Theory*, 58(11), 6989-7001.

Komleva, N. V., & Vilyavin, D. A. (2020), Digital platform for creating personalized adaptive online courses, *Open Education*, 24(2), 65-72.

Li, T., & Zhang, X. M. (2023), Development Trajectory of Blockchain Platforms: the Role of MultiRole, *Information Systems Research*.

Lumineau, F., Wang, W., & Schilke, O. (2021), Blockchain governance—A new way of organizing collaborations? *Organization Science*, 32(2), 500-521.

Lyandres, E., Palazzo, B., & Rabetti, D. (2022), Initial coin offering (ico) success and post-ico performance, *Management Science*, 68(12), 8658-8679.

Madhok, A. (2002), Reassessing the fundamentals and beyond: Ronald Coase, the transaction cost and resource-based theories of the firm and the institutional structure of production, *Strategic Management Journal*, 23(6), 535-550.

Malinova, K., & Park, A. (2023), Tokenomics: when tokens beat equity, *Management Science*.

Mohanta, B. K., Panda, S. S., & Jena, D. (2018, July), An overview of smart contract and use cases in blockchain technology, In *2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT) (pp. 1-4)*. IEEE.

Mollick, E. (2014), The dynamics of crowdfunding: An exploratory study, *Journal of Business Venturing*, 29(1), 1-16.

Murray, A., Kuban, S., Josefy, M., & Anderson, J. (2021), Contracting in the smart era: The implications of blockchain and decentralized autonomous organizations for contracting and corporate governance, *Academy of Management Perspectives*, 35(4), 622-641.

Murugesan, S. (2007), Understanding Web 2.0, *IT Professional*, 9(4), 34-41.

Mystakidis, S. (2022), Metaverse, *Encyclopedia*, 2(1), 486-497.

Nambisan, S., Siegel, D., & Kenney, M. (2018), On open innovation, platforms, and entrepreneurship, *Strategic Entrepreneurship Journal*, 12(3), 354-368.

Niculescu, M. F., Wu, D. J., & Xu, L. (2018), Strategic intellectual property sharing: Competition on an open technology platform under network effects, *Information Systems Research*, 29(2), 498-519.

Oehlberg, L., Willett, W., & Mackay, W. E. (2015, April), Patterns of physical design remixing in online maker communities, In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 639-648).

Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010), Running experiments on Amazon Mechanical Turk, *Judgment and Decision Making*, 5(5), 411-419.

Papathanasiou, A., Cole, R., & Murray, P. (2020), The (non-) application of blockchain technology in the Greek shipping industry, *European Management Journal*, 38(6), 927-938.

Park, A. (2023), The Conceptual Flaws of Decentralized Automated Market Making, *Management Science*.

Parker, G., & Van Alstyneb, M. (2018), Innovation, Openness, and Platform Control, *Management Science*, 64(7), 3015-3032.

Peck, M. E. (2017), Blockchain world – Do you need a blockchain? This chart will tell you if the technology can solve your problem, *IEEE Spectrum*, 54(10), 38-60.

Poniatowski, M., Lüttenberg, H., Beverungen, D., & Kundisch, D. (2021), Three layers of abstraction: a conceptual framework for theorizing digital multi-sided platforms, *Information Systems and E-business Management*, 1-27.

Preneel, B. (1994), Cryptographic hash functions, *European Transactions on Telecommunications*, 5(4), 431-448.

Puranam, P., Alexy, O., & Reitzig, M. (2014), What's "new" about new forms of organizing? *Academy of Management Review*, 39(2), 162-180.

Rafaeli, S., & Ariel, Y. (2008), Online motivational factors: Incentives for participation and contribution in Wikipedia, *Psychological Aspects of Cyberspace: Theory, Research, Applications*, 2(08), 243-267.

Rivkin, J. W., & Siggelkow, N. (2007), Patterned interactions in complex systems: Implications for exploration, *Management Science*, 53(7), 1068-1085.

Romer, P. M. (1990), Endogenous technological change, *Journal of Political Economy*, 98(5, Part 2), S71-S102.

Roy, P. K. (2020), Multilayer convolutional neural network to filter low quality content from quora, *Neural Processing Letters*, 52(1), 805-821.

Schiller, D. (1999), *Digital Capitalism: Networking the Global Market System*, MIT Press.

Shaikh, M., & Vaast, E. (2016), Folding and unfolding: Balancing openness and transparency in open source communities, *Information Systems Research*, 27(4), 813-833.

Slater, D. (2002), Social relationships and identity online and offline, *Handbook of New Media: Social Shaping and Consequences of ICTs*, 533-546.

Sockin, M., & Xiong, W. (2023a), Decentralization through tokenization, *The Journal of Finance*, 78(1), 247-299.

Sockin, M., & Xiong, W. (2023b), A model of cryptocurrencies, *Management Science*.

Sosa, M. E., Eppinger, S. D., & Rowles, C. M. (2004), The misalignment of product architecture and organizational structure in complex product development, *Management Science*, 50(12), 1674-1689.

Stein, J. M., Vizgirda, V., ... & Shadbolt, N. (2023, April), "You are you and the app. There's nobody else.": Building Worker-Designed Data Institutions within Platform Hegemony, In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (pp. 1-26).

Stonig, J., Schmid, T., & Müller-Stewens, G. (2022), From product system to ecosystem: How firms adapt to provide an integrated value proposition, *Strategic Management Journal*, 43(9), 1927-1957.

Tajedin, H., Madhok, A., & Keyhani, M. (2019), A theory of digital firm-designed markets: Defying knowledge constraints with crowds and marketplaces, *Strategy Science*, 4(4), 323-342.

Thomas, L. D., & Tee, R. (2022), Generativity: A systematic review and conceptual framework, *International Journal of Management Reviews*, 24(2), 255-278.

Tiwana, A., Konsynski, B., & Bush, A. A. (2010), Research commentary—Platform evolution: Coevolution of platform architecture, governance, and environmental dynamics, *Information Systems Research*, 21(4).

Tsoukalas, G., & Falk, B. H. (2020), Token-weighted crowdsourcing, *Management Science*, 66(9), 3843-3859.

Vaswani, A., Shazeer, N., ... & Polosukhin, I. (2017), Attention is all you need, *Advances in Neural Information Processing Systems*, 30.

Vukovic, M. (2009, July), Crowdsourcing for enterprises, In *2009 Congress on Services-I* (pp. 686-692), IEEE.

Wajcman, J. (2020), *Pressed for Time: The Acceleration of Life in Digital Capitalism*, University of Chicago Press.

Wang, Q., Li, R., Wang, Q., & Chen, S. (2021), Non-fungible token (NFT): Overview, evaluation, opportunities and challenges, arXiv:2105.07447.

Wang, W., Hoang, D. T., ... & Kim, D. I. (2019), A survey on consensus mechanisms and mining strategy management in blockchain networks, *IEEE Access*, 7, 22328-22370.

Wang, X., & Xu, F. (2022), The value of smart contract in trade finance, *Manufacturing & Service Operations Management*.

Wareham, J., Fox, P. B., & Cano Giner, J. L. (2014), Technology ecosystem governance, *Organization Science*, 25(4), 1195-1215.

Wenger, E., White, N., & Smith, J. D. (2009), Digital habitats: Stewarding technology for communities, *CPsquare*.

Whitaker, A., & Kräussl, R. (2020). Fractional equity, blockchain, and the future of creative work, *Management Science*, 66(10), 4594-4611.

World Bank. (2015), The state of social safety nets 2015, The World Bank.

Wüst, K., & Gervais, A. (2018, June), Do you need a blockchain? In 2018 *Crypto Valley Conference on Blockchain Technology* (pp. 45-54). IEEE.

Xu, X., Weber, I., ... & Rimba, P. (2017, April), A taxonomy of blockchain-based systems for architecture design, In *IEEE International Conference on Software Architecture (ICSA)* (pp. 243-252).

Yaga, D., Mell, P., Roby, N., & Scarfone, K. (2019), Blockchain technology overview, arXiv:1906.11078.

Yoo, Y., Boland Jr, R. J., Lyytinen, K., & Majchrzak, A. (2012), Organizing for innovation in the digitized world, *Organization Science*, 23(5), 1398-1408.

Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010), Research commentary—the new organizing logic of digital innovation: an agenda for information systems research, *Information Systems Research*, 21(4), 724-735.

Zammuto, R. F., Griffith, T. L., Majchrzak, A., Dougherty, D. J., & Faraj, S. (2007), Information technology and the changing fabric of organization, *Organization Science*, 18(5), 749-762.

Zeilinger, M. (2018), Digital art as 'monetised graphics': Enforcing intellectual property on the blockchain, *Philosophy & Technology*, 31(1), 15-41.

Zheng, Z., Xie, S., Dai, H. N., Chen, X., & Wang, H. (2018), Blockchain challenges and opportunities: A survey, *International Journal of Web and Grid Services*, 14(4), 352-375.

Zittrain, J. (2009), Law and technology: The end of the generative internet, *Communications of the ACM*, 52(1), 18-20.

Zhu, F., & Furr, N. (2016), Products to platforms: Making the leap, *Harvard Business Review*, 94(4), 72-78.

Zhu, F., & Iansiti, M. (2012), Entry into platform-based markets, *Strategic Management Journal*, 33(1), 88-106.