Signaling Collective Action in Ecosystems

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ABSTRACT

Collective action can turn individuals into communities or ecosystems that solve complex problems together. The advent of decentralization technologies (e.g., blockchain) has enabled tools that help coordinate collective endeavors even in environments without traditional social ties. Success in such communities often hinges on securing support from key partners, collaborators, and users in a largely asocial setting. In our conceptual work, we develop a model that explains how a decentralization protocol, such as a blockchain, can implement a coordination mechanism to reach a collective action goal. We demonstrate our arguments with an illustrative case, Tracey, which facilitates sustainable tuna fishing in the Philippines with the help of a blockchain-based mobile app. We draw from signaling theory to explain how different ecosystem members can reliably demonstrate their contributions and how a resulting signaling system can mimic social relationships in an asocial context by increasing the transparency of actions, enforcing the legitimacy of collective efforts, and reinforcing a shared identity among the ecosystem members. Our conceptual model highlights the role of narratives, shared identity, and a signaling system facilitated by decentralization protocol in fostering collective action in ecosystems.

Keywords: business/innovation ecosystems, user innovation & communities, sociology

INTRODUCTION

Collective action can help solve complex problems, whether of a social, political, or environmental nature, but requires careful alignment of individual acts toward a joint goal (Ostrom, 1990). Increasingly often, such alignment efforts and resulting structures are described as "ecosystems" in the management literature (Jacobides et al., 2018; Shipilov & Gawer, 2020; Thomas & Ritala, 2022). The growing ecosystem literature explores the actions of interdependent but hierarchically independent actors who collectively fulfill an ecosystem value proposition (Adner, 2017; Jacobides et al., 2018; Shipilov & Gawer, 2020; Thomas & Ritala, 2022). The ecosystem's success relies on coordinating the roles and positions, as well as value and resource flows, among its members (Adner, 2022). Hence, collective action in ecosystems relies on joint value creation in which engaged stakeholders balance their selfish interests against the common good (Bridoux & Stoelhorst, 2022). In response, many aspiring ecosystem leaders look for a way to coordinate collective action and contributions of independent actors in a structured way. Recently, novel decentralization technologies, such as blockchain, have shown promise in this regard (Leiponen et al., 2021; Mindel et al., 2018).[1] More specifically, decentralization protocols that specify rules for operation among actors can establish an adaptive and robust coordination system for joint value creation (Dietz et al., 2003; O'Mahony & Ferraro, 2007). Hence, they offer ways to increase alignment among members in driving joint goals of collective action in ecosystems.

However, while decentralization technologies and protocols seem adept in facilitating ecosystems and addressing many problems for collective action, a vibrant community of aligned collaborators is still required. A specific challenge of the context, however, is that communities organized by decentralization protocols are largely asocial structures and often promote anonymity among their members. Thus, aspiring ecosystem leaders need to develop a compelling narrative to engage various members to foster a shared identity of the collective (Theodoraki et al., 2018; Thomas & Ritala, 2022). On one hand, past research on collective action (Aligica & Tarko, 2012; Ostrom, 1990, 2009) and shared identity formation (Berlant, 2016; Marshall et al., 2020) argue that a sense of togetherness requires social relationships and mutual understanding that may be impossible to attain without face-to-face interaction (O'Mahony & Ferraro, 2007; Ostrom, 2000).[2] Potential collaborators often search for signals of conformity among their peers (Ostrom, 2000), which might be impossible if the collaborators remain unknown. On the other hand, while decentralization protocols can, in principle, provide decentralized governance mechanisms for joint value creation, the practice is often far from egalitarian (Dierksmeier & Seele, 2018). Extant research has noted issues caused, for instance, by freeriding (Adar & Huberman, 2000) or an increased digital divide (Greco & Floridi, 2004) linked to institutional and technological complexity of the solutions. Hence, the decentralization technologies and protocols cannot address societal grand challenges or facilitate collective action without adequate legitimacy (Suddaby & Greenwood, 2005; Thomas & Ritala, 2022), a widespread collective identity (Berlant, 2016), or a relational process of "meaning making" through narratives (Garud & Giuliani, 2013; Theodoraki et al., 2018; Venkatraman et al., 2008). Therefore, we ask: *how can aspiring community leaders raise awareness and attract support in emerging ecosystems for collective action through decentralization protocols?*

Our conceptual paper contributes by explicating the role of narratives, shared identity, and a signaling system facilitated by decentralization technology to foster collective action in ecosystems. We bridge the literatures on social identity (Ashforth &

Mael, 1989), discourse and rhetoric (Suddaby & Greenwood, 2005), and social exchange (Cook et al., 2013; Ostrom, 1990) to explain their impact on the development of collectives addressing complex social, political, and environmental problems (Burke & Stets, 2009) with the help of decentralization protocols. We argue that these technologies offer significant possibilities to align collective action in communities, especially focused on digital resources (de Rosnay & Stalder, 2020), and the technologies provide concrete mechanisms to visualize the contributions and social exchanges among participants (Cook et al., 2013) via signaling (Maynard Smith & Harper, 1995; Spence, 1974, 2002). In this work, we offer a new perspective on facilitating collective action in ecosystems by utilizing signaling and narratives to foster a shared identity for the emerging community.

PERSPECTIVE: FACILITATING COLLECTIVE ACTION IN ECOSYSTEMS THROUGH DECENTRALIZATION TECHNOLOGY

This paper suggests a new perspective on facilitating collective action that converges the previously identified social requirements with the possibilities of emerging decentralization technology solutions. We present a signaling-based approach to analyze and explain how decentralization protocols support a *shared identity* and *collective action* in ecosystems. Collective action relies on social connections, trust in group members, and a shared identity to facilitate the completion of joint goals (Aligica & Tarko, 2012; Berlant, 2016; Ostrom, 2009; Skågeby, 2010). We argue that both the aspiring community leaders and, gradually, the community itself will form a narrative about the shared identity and purpose of the collective, and about "a shared set of meanings that define individuals in particular *roles* […], as members of specific *groups* in society […], and as *persons* having specific characteristics that make them unique from others" (Stets & Serpe, 2013, p. 31). Hence, the shared identity is attached to and embedded in the social structures occupied by the individual (Stryker & Burke, 2000), affecting the way the role, group, or person identities are experienced individually (Stets & Serpe, 2013). The works on identity theory analyze the sources, processes, and consequences of the identities and how the standard of "self-meanings" guides behavior in various settings (Burke & Stets, 2009; Stryker & Burke, 2000). Unlike the majority of past works on identity theory, we explore and conceptualize the development of shared identity in a context lacking typical social structures and interactions, as we turn our focus on communities facilitated by decentralization protocols.

The paper proceeds by explicating how decentralization protocols can promote collective action in ecosystems. To build and illustrate our arguments, we focus on a specific context of organizing in the digital realm: digital commons, which is "*a subset of the commons, where the resources are data, information, culture and knowledge which are created and/or maintained online*" (de Rosnay & Stalder, 2020, p. 2). Next, we summarize how the community and its commons can be coordinated for collective action through decentralization protocols, and why we think signaling provides an applicable proxy for facilitating collective action among ecosystem members. Finally, we summarize our perspective by detailing *how* decentralization protocols can form a signaling system to facilitate collective action in ecosystems.

Collective action and digital commons

Collective action and ecosystems emerge similarly to any social movement, as the shared identity is formed via interactions and negotiations among the members (Thomas & Ritala, 2022), creating a sense of togetherness and belonging (Berlant, 2016). The shared identity can be regarded as a joint understanding among the ecosystem participants regarding the central, enduring, and distinctive characteristics of the collective action goal (Thomas & Ritala, 2022) and about how the participants and the goals differ from other groups (Gulati et al., 2012; Marshall et al., 2020).

Recently, we have seen the emergence of various (online) communities that proclaim to pursue a mission for the common good and advocate social values (Dierksmeier & Seele, 2018; Kleineberg & Helbing, 2016). Many projects have attracted hobbyists and open-source activists (de Rosnay & Stalder, 2020; Stalder, 2010) but also investors who are passionate about ideological or social motives (Fisch et al., 2021) to work on digital commons. However, the digital commons—especially those facilitated by decentralization protocols—emerge and evolve in a relatively asocial setting. Relying on traditional means of creating togetherness and trust—through social interactions, communication, and personal encounters (Ostrom, 2000)—is not possible to a significant extent.

In response, many initiatives on digital commons try to establish social capital around collective goals with the help of decentralization technology and protocols (such as blockchain). These initiatives promote diversity in the system to maximize creativity and innovation and to mitigate the risk of power accumulation (Kleineberg & Helbing, 2016; Stalder, 2010). The technologies allow decentralized bookkeeping of the value created within the commons through the process of tokenization (i.e., creating and maintaining accounting units), and thereby permit direct but decentralized governance of the commons.

The decentralization technologies do not themselves ensure sustainability, and constant effort is required to govern and coordinate the commons. Such ongoing iteration reflects "commoning," which is a process, not an outcome; it is a praxis of becoming (Birkinbine, 2018). Commoning acknowledges the embedded perceptions and assumptions of the social reality and shapes the desirable outcomes and aspects of a collective effort (Birkinbine, 2018; Linebaugh, 2008). We argue that the commoning is deeply rooted in the collaboration and work conducted in the digital commons. As such, the decentralization protocols and their digitally enforced "smart contracts" specify the practices of the digital commons. The decentralization protocols provide means to transparently articulate the rules and procedures for the community, even prior to launching the community (De Filippi et al., 2020; Mindel et al., 2018).

The process of commoning is initiated, and often led, by the prospective leader of the community. Such a process view resonates with the theorizing of institutions as lived and interpreted experiences (Lowe & Feldman, 2017) in which the aspiring leaders actively seek the needed legitimacy (Suddaby & Greenwood, 2005) from their community. Hence, legitimacy impacts the perception of one's leaders (Drover et al., 2018) and shapes the emergence of an ecosystem (Thomas & Ritala, 2022). Different forms of legitimacy grow and support each other in a self-sustaining manner (Suchman, 1995). It has been argued that ecosystem legitimation relies on two complementary factors: *actions*, which align with normative expectations, and *discourses*, which build cognitive coherence in the community (Thomas & Ritala, 2022). As we will later discuss in this article, decentralization protocols affect both factors in this process.

Signaling as a proxy for being and doing good

In this paper, we draw from signaling theory for explanations of social behavior in groups. Signals are relevant for the underpinnings of collective action, as Ostrom (2000, p. 138) states: "*a core question is how potential cooperators signal one another and design institutions that reinforce rather than destroy conditional cooperation.*" Moreover, signaling is a widely studied idea in various interactions. While initially rooted in evolutionary biology and anthropology, signaling theory has broadened its influence in various fields of study.

In management, signaling theory (Spence, 1974, 2002) has become an impactful lens for explaining how organizational outsiders can evaluate the quality of an individual (e.g., applicant) or a firm (e.g., partner candidate) despite incomplete information (Bergh et al., 2014; Connelly et al., 2011). While signaling theory is inherently rooted in the issue of information asymmetry (Bergh et al., 2019; Stiglitz, 2000), e.g., employers not knowing the productivity of a worker prior to a hiring decision (Spence, 1974), classical signaling theory often assumes almost perfect distribution, observation, and interpretation of isolated signals with rational responses by the recipients (Bergh et al., 2014; Connelly et al., 2011; Drover et al., 2018). Yet, a more recent take on signaling theory has begun to challenge the idea of having uniform visibility and responses to all signals, highlighting the challenges related to high-noise signaling environments (Steigenberger & Wilhelm, 2018) and the individual differences in how the same signal can elicit different responses across receivers (Drover et al., 2018; Yang et al., 2020). Here, signaling is an inherently social process that requires coordination between senders and receivers, implying that novel signals can arise and get accepted only through a collective effort (Bliege Bird & Smith, 2005).

Signaling is a widely studied idea across disciplines, including biology (Hasson, 1997; Maynard Smith & Harper, 1995) and anthropology (Bliege Bird & Smith, 2005). It is most often associated with theories of evolutionary biology and phenomena such as mate selection. In line with signaling in management, biologists tend to consider that costly signals are more honest (Guilford & Dawkins, 1991; Maynard Smith & Harper, 1995). The high signaling cost is in the interest of high-quality individuals, as it helps to ensure that their signals stand out, such as peacocks with their extravagant, even impractical plumage (Grafen, 1990; Zahavi, 1975). The individuals may differ in their ability to bear the cost of signaling (quality) and the potential gain they are about to receive (need) (Johnstone & Grafen, 1993) and biological signals motivated by quality and need are generally considered reliable (Harper, 2006). Yet, it should be noted that signal reliability in biological signaling can also be achieved through design or convention—implying that systems need to be honest only "on average" and might not always rely on costly signals (Bliege Bird & Smith, 2005; Harper, 2006; Hasson, 1997).

Following the discourses both in management and biology, we define *signals* "*as an action or structure that increases the fitness of an individual by altering the behavior of other actors detecting it*" (Maynard Smith & Harper, 1995, p. 305). While drawing from a work on "animal signals," we consider this definition as congruent with the works in management, bearing in mind that our paper focuses on ecosystems, an analogy deeply rooted in biology (Moore, 1993). Moreover, the signaling models in management and biology have been noted to show strong parallels (Grafen, 1990), especially in the way we address signals in the creation of social knowledge and conventions (Stiglitz, 2000). In this context, "fitness" refers to the "natural selection" that determines the relative performance between alternatives and affects their growth rates, a definition borrowed from complex systems (Simon, 2002) that has been equally applied in management (Hannan & Freeman, 1977; Helfat et al., 2009) and biology (Bliege Bird & Smith, 2005; Hasson, 1997).

In particular, signaling theory provides an opportunity to integrate symbolic communication and social benefit with more materialist theories explaining fitness-enhancing individual strategic action and adaptation (Bliege Bird & Smith, 2005). A functioning signaling system can provide a measure of the intentions or the quality of an individual (Spence, 1974, 2002) but, since it may be impossible to directly measure the true "quality" of an individual (or a prospective mate) (Guilford & Dawkins, 1991; Maynard Smith & Harper, 1995; Zahavi, 1975), the signals rather represent a "proxy" that likely correlates with the desired quality or the individual's expected social behavior. While signals are visible and often intentional communication (Spence, 2002), unintentional signals (Connelly et al., 2011) or interpretations (Yang et al., 2020) also take place. Assuming that the signaling improves the fitness of an individual by altering the behavior of others, it correspondingly affects the fitness of a species (or a community) and, ultimately, increases the reliability of the signaling system over time (Hasson, 1997; Johnstone & Grafen, 1993). Thus, drawing from a long tradition in management, biology, and anthropology research, signaling theory presents a viable alternative to the more commonly known, socially-driven commoning, and facilitates similar processes in a digital, asocial environment. Next, we will summarize our perspective and explain how signaling can advance the emergent discourse on decentralization protocols and their role in coordinating digital commons.

Decentralization protocol as a signaling system for collective action

Our core argument is that decentralization protocols can be utilized as a *signaling system that increases the alignment of actions to spur collective action*. The community can facilitate a sense of togetherness and belonging in an asocial setting by relying on signals about the actions of their peers (Ostrom, 2000). Moreover, we argue that signals have a pivotal role in the emergence and evolution of digital commons through narratives and rhetoric. The importance of the resulting signaling system is a direct consequence of the need to establish trust and mutual understanding in an anonymous, asocial environment (De Filippi, 2017; Lovett & Thomas, 2021).

Instead of social relationships, interpersonal trust takes a different form in digital commons. The digital commons may rely on *confidence* in the system as a substitute (De Filippi et al., 2020; Lovett & Thomas, 2021; Morrison et al., 2020; Swan, 2015). As the technologies enforce decentralized structures, they also uphold a membrane to guide collective action based on protocol-based infrastructures, which are suggested by the leading consortium and publicized openly in the project's mission statements, technological white paper, and related documentation.[3] Confidence in the system can help the digital commons to disregard the requirement for personal relationships, face-to-face communication, and social bonding traditionally associated with a community. In our work, we argue that signals among the community members and the signaling system facilitated by the decentralization protocol are pivotal for the ecosystem's emergence.

However, the role of signals has received surprisingly little attention in explaining the development of digital commons, or collective action and ecosystems in general (for rare exceptions, see, e.g.: Mindel et al., 2018; O'Riordan et al., 2023; Thomas & Ritala, 2022). By overlooking signaling, the research has failed to recognize this common characteristic that is considered crucial for natural ecosystems, social identity, and industrial organizations. The signals may become particularly relevant for the digital commons when the actions of individuals are perceived as signals that are transmitted to other actors inside and outside of the networks. For instance, the signals can help members to reduce the noise that unnecessarily increases the searching costs for desired content or resources (Stiglitz, 2000).

Thus, we propose that: *signals come into existence through the acts of the members of the digital commons*. The signaling system is analogous to a biological ecosystem where the actions of individuals are perceived as signals transmitted to the other actors inside and outside the networks. In digital commons, signals could be, for example, actions to verify uploaded data or transactions on the blockchain, or choosing to possess a specific token (in the user's digital wallet). The key aspect is that the decentralization protocol provides a structure that makes an individual's actions open to being interpreted by other members. The signals can increase trust among members and demonstrate confidence in the value of the community. Moreover, as the different members of the community act as signalers, sending, receiving, and verifying the observed actions (Bergh et al., 2014; Connelly et al., 2011), they also perform valuable contributions toward commoning and belonging in the digital commons.

Table 1. Comparing signaling and tokenization of value approaches to decentralized protocols

"Signaling" system *(proposed perspective)*	**"Tokenization of value" approach** *(prevailing approach)*
Analogy: a *biological/natural* ecosystem Documenting *actions* Trying to mimic *social bonds* to create a sense of *belonging* Valuing *subjectivity* and *embracing* individual choices and actions *Tokens cannot* be traded and hold practically *no* exchange value Tokenization aim: Define desired or undesired *actions* Visualize member *contributions* Encourage and attract external *alignment* *Examples:* Tracey, Red String[A]	Analogy: a *financial/market* system Documenting *transactions* Relying on *system trust* for immutable *transactions* and *ownership* Prioritizing *objectivity* and *uniform* interpretation *Tokens* are primarily designed to facilitate *transactions*; often hold *exchange value* Tokenization aim: *Convert* value between contexts *Store* and exchange value *Attribute* usage or governance rights to distribute power *Examples:* SolarCoin, Single.Earth[B], Efforce[C]

[A] The Red String relies on a DLT to add transparency of the commodities, reducing the anonymity of the global supply chain. The project seeks to connect people across the globe, to root out corruption, and empower people to participate in a more ethical economy (https://www.accenture.com/us-en/services/blockchain/blockchainforgood-index) (accessed 11-30-2023).

[B] Single.Earth project aims to couple the nature with the rate of economic growth by valuing and monetizing the intrinsic value of nature. The project mints MERIT tokens for landowners who commit to preserving their lands, upholding biodiversity and carbon sequestration. The project challenges us to consider the nature, forests, and the Earth as more than just raw material. See more: Single.Earth Landowners https://www.single.earth/landowners/ (accessed 11-30-2023).

[C] Efforce provides a possibility to fund and commit to projects for improving energy efficiency. The protocol tokenizes the saved energy in kWh. Efforce's decentralized platform allows anyone to investment worldwide to energy efficiency projects, attaining profits based on realized energy savings. See more: Efforce https://efforce.io/ (accessed 11-30-2023).

As illustrated in Table 1, our approach differs from the mainstream discussion on decentralization protocols, especially the way blockchains are commonly used to account for actions and outcomes in the system. The prevalent aim of decentralization protocols has been in "tokenization of value" that is created and, in particular, making the resulting tokens valuable through exchangeability to other tokens (Fisch et al., 2021; Zook & Grote, 2020). In the more prevalent approach, the main purpose has been to provide an unambiguous account for different value elements by converting tangible resources or intangible contributions into quantifiable metrics by tokenization. It usually involves a conversion from one context to another (e.g., converting CO_2 emission savings into tradeable currency).[4] However, such an approach has been criticized: the resulting systems do not facilitate the commoning process but rather create a "market" for the commons (Ossewaarde & Reijers, 2017). The prevailing approach to decentralization protocols highlights how tokenization enables tamper-proof solutions (de Rosnay & Stalder, 2020; Dierksmeier & Seele, 2018; Ingram Bogusz & Morisse, 2018; Zavolokina et al., 2020) that greatly diminish the need for social bonds or a central authority. In contrast, the signaling system tries to mimic social bonds, strengthen relationships, and create a sense of belonging, even in a largely asocial environment. In the following, we build on the proposed signaling approach by developing a conceptual model for facilitating collective action in ecosystems.

MODEL: SIGNALING COLLECTIVE ACTION IN ECOSYSTEMS

Ecosystems require a strong shared identity and legitimacy to spur collective action. The shared identity affects new member enrolment, resolution of conflicts between the individual and the collective, and motivation to act toward system-level goals (Thomas

& Ritala, 2022). In turn, legitimacy is needed to mobilize a social movement behind a certain initiative, as it links to the congruence between the expected and observed behavior and, thus, impacts the leaders' ability to attract resources and support for their cause (Spigel & Harrison, 2018; Suchman, 1995). Thus, the legitimacy of the ecosystem and its leaders greatly influences its attractiveness among potential members.

In the following, we build on previous works on ecosystem emergence (e.g., Adner, 2017; Spigel & Harrison, 2018; Thomas & Ritala, 2022) and elaborate on how decentralization protocols can support the development of a shared identity and foster collective action among ecosystem participants, as shown in Figure 1. We illustrate how the processes of *legitimation* likely begin in the minds of the aspiring leaders of an ecosystem but gradually evolve into collective, but also divergent, endeavors among the community members. The model explains how collective action in ecosystems benefits from *narratives and rhetoric* but is also affected by the various *problems caused by the anonymity* in these systems. Simultaneously, the model benefits from the *decentralization technologies' ability* to provide transparent and verifiable means for signaling actions and member contributions to all ecosystem participants. Our model focuses on three key acts that demonstrate how signaling supports collective action in ecosystems.

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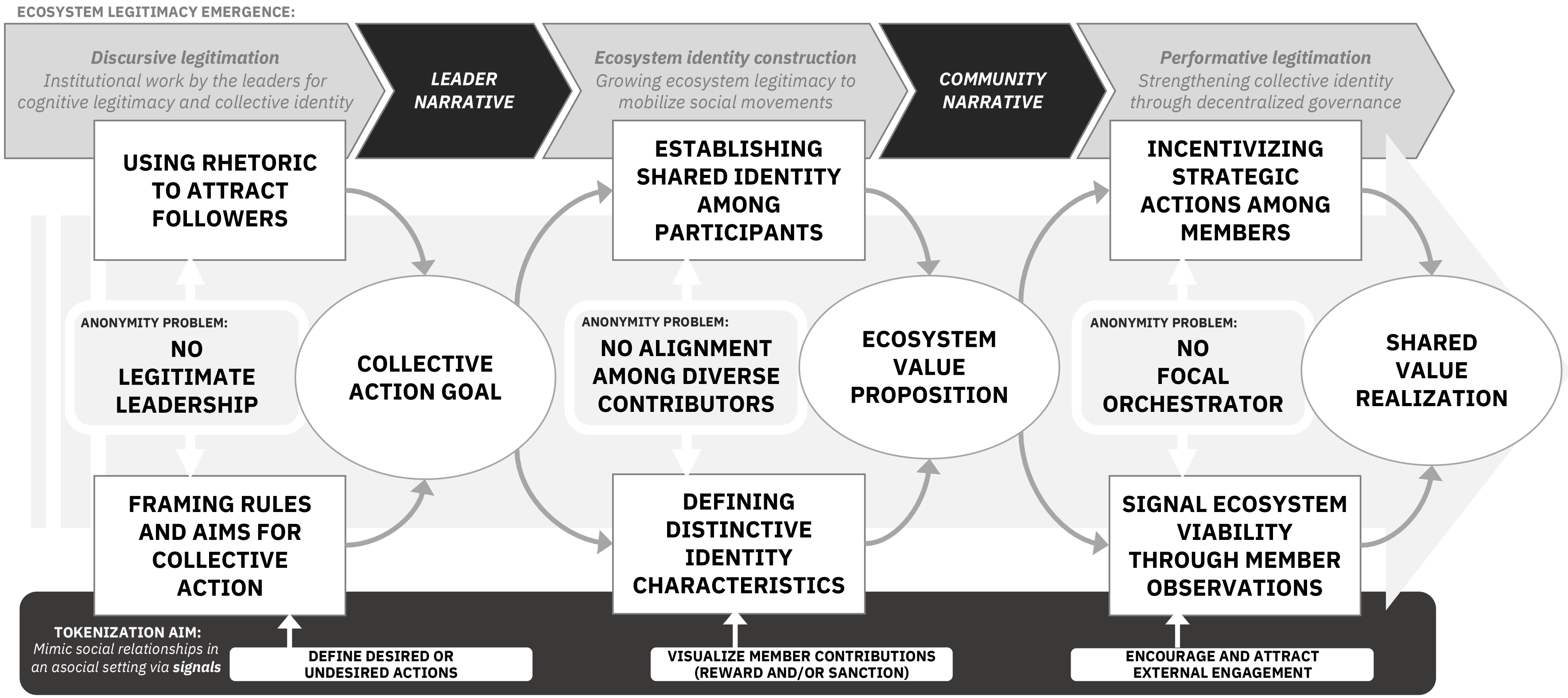
Figure 1. Model for facilitating collective action through a decentralization protocol in an emerging ecosystem



Act 1: Facilitating collective action through leader narrative

Aspiring leaders for collective action require legitimacy to attract and motivate followers. While leadership might not require or take place through formalized, hierarchical structures, it relies on individuals or groups who aspire to lead or initiate a movement (Bimber et al., 2005; Margetts et al., 2015). Thus, leaders may suggest the "overall vision" for the community, but the realization of that vision is reliant on the participation and involvement of community members (De Filippi & Lavayssière, 2020), requiring adequate legitimacy to attract followers (Thomas & Ritala, 2022).

Legitimacy may be attained in several ways, e.g., with political power or affiliated institutions (Lowe & Feldman, 2017), drawing convincing roadmaps to align stakeholders (Dattée et al., 2018), or using rhetoric to modify and displace contesting logic (Suddaby & Greenwood, 2005). However, a distinct commonality in typical methods for attaining legitimacy is the direct link to the personality and reputation of the leaders. This type of legitimation is not possible if the said community operates in an anonymous fashion or context. In our model, we refer to different challenges in this regard as **anonymity problems**. The first anonymity problem relates to not knowing who the leaders are and if they are fit for the role, thus causing an issue of **no legitimate leadership**.

To address this problem aspiring leaders can use ***rhetoric to attract followers***. The main purpose of this activity is to obtain **discursive legitimation** for the proposed ecosystem (i.e., processes to "*drive cognitive legitimacy by giving the emerging ecosystem meaning through the processes of framing, sensemaking, positioning, and recognition*;" Thomas & Ritala, 2022, p. 6). This legitimation involves institutional work by the leaders to create cognitive legitimacy and collective identity for their cause (Suddaby & Greenwood, 2005), and can happen through digital storytelling (Marshall et al., 2020) or other processes of crafting meaning for joint efforts (Garud & Giuliani, 2013). In the decentralization protocol context, the written materials, such as the project's white paper, have a crucial role in providing a concrete account of the suggested vision. In addition, the white paper explicates the **tokenization aim** of the project that connects the leaders' vision to concrete and observable signals (Bergh et al., 2014; Connelly et al., 2011) which can increase the trustworthiness of the system and mimic social relationships in this setting.

Thus, tokenization allows for defining the social norms and structures expected for collective action (Ostrom, 1990, 2000). It ***frames the rules and aims for collective action*** by concretely defining the desired or undesired actions. Tokenization allows us to trace contributions unambiguously, but more importantly, it enables a community of actors without formal hierarchical governance to agree and abide by rules of operation, which explicitly defines the actions that the community sees valuable.

When successful, this process gives rise to a community that can realize a **collective action goal**. The described system provides an outline for the operation but, concurrently, legitimizes the **leader narrative** by specifying a structure that can improve the fitness of actions among participating members. The narrative must connect to the identity of the participants and propose a compelling scenario of change (Suddaby & Greenwood, 2005). This narrative is a derivate of the leader's work to define the purpose and characteristics of the system, but now legitimizes the system through concrete benefits for the participating members. The success of the community feeds broader interest and pushes the community toward the next act.

Act 2: Developing shared identity to realize the ecosystem's value proposition

As the community grows and gets more interest from a broader audience, a second type of anonymity problem gains prominence: **no alignment among diverse contributors**.

The need for alignment is a well-known issue of ecosystem research (Adner, 2022; Dattée et al., 2018; Shipilov & Gawer, 2020; Thomas & Ritala, 2022). Often the alignment is expected to derive from skillful leadership or technological interfaces and complementarities (Adner, 2022; Jacobides et al., 2018), but the role of collective identity has also been acknowledged. Identity can take different forms (e.g., role, group, or person identities) but is generally understood in terms of membership in one category or another (Stets & Serpe, 2013). In particular, past research has highlighted the role of **ecosystem identity construction** as the defining aspect of growing the ecosystem (i.e., the "*emergence of a set of mutual understandings among ecosystem participants regarding the central, enduring, and distinctive characteristics of the ecosystem value proposition*;" Thomas & Ritala, 2022, p. 6). We concur with their view but extend their description of how ***establishing shared identity among participants*** is required to grow the ecosystem's legitimacy and mobilize social movements with the support of decentralization protocols. We use the term "shared identity" over various alternatives (e.g., collective identity, social identity, group identity) to communicate how this identity is both collectively constructed (among the members of the digital commons) and cannot be irrefutably controlled by or attributed to any single member (as the information is stored via decentralization protocol and membership in the digital commons is based on pseudonymous accounts).

We argue that the tokenization aim has a different focus for a more mature stage of the ecosystem. Once the collective action has successfully begun, tokenization is most effective in **visualizing member contributions**, as the system provides a transparent record to reward and sanction desired and undesired actions, respectively. Visualization has an important role in the further development of the collective identity, as it provides a concrete tool to evaluate the institutional congruence of the actors

(Lawrence & Suddaby, 2006; Lowe & Feldman, 2017). Each individual in the community may have their own views and motivations for joining the community (i.e., not necessarily a completely unanimous understanding), but still exhibit a high mutual understanding of the main reasons that underlie the set functions and rules behind the decentralization protocol. Moreover, the shared identity ***defines the distinctive identity characteristics*** of the group (Peteraf & Shanley, 1997), allows the members to differentiate from other groups (Marshall et al., 2020), and enables the members to consider their own identity as a part of the whole (Ashforth et al., 2023).

The successful alignment of the shared identity and its defining characteristics will lead to realizing the **ecosystem's value proposition**, as noted in the literature (Adner, 2022; Jacobides et al., 2018; Shipilov & Gawer, 2020). This success will provide additional evidence of the concrete benefits of collective action and the ecosystem for its members. It will also be observable to various external stakeholders (Dattée et al., 2018), potentially attracting further interest in the community.

However, this success is not as strongly associated with the once leaders of the ecosystem. The realization of the ecosystem's value proposition is a collective effort, and as such is portrayed as a collective success in the narratives. The ecosystem will be filled with actors who become deeply involved in the value-creation process (Adner, 2022) and who can offer their recollections of past experiences and future aspirations (Garud & Giuliani, 2013). After the community has demonstrated its ability to realize the ecosystem's value proposition, each participating member will have their own take on describing the achieved success (Callon, 1984). The narratives arise from the subjective experiences of the members who try to provide objective accounts of the ecosystem's identity (Garud & Giuliani, 2013; Venkataraman et al., 2013). We call such derivates the **community narrative** and argue that this diverse rhetoric will replace the role of leader narratives in a well-functioning ecosystem, especially with decentralized governance mechanisms.

Act 3: Legitimizing the decentralized governance for shared value realization

The multivocality of community narratives gives rise to a new type of anonymity problem, as an ecosystem operating in a decentralized manner has **no focal orchestrator**. Once proper alignment has been attained among its members and their activities, the ecosystem can fulfill its value proposition regardless of the control or guidance of its leaders, who previously had a central role in initiating the collective. This is the very premise and definition of a decentralized system: to produce a self-sustaining system that can operate without a focal orchestrator (Lovett & Thomas, 2021; Mindel et al., 2018). The idea of nurturing a self-sustaining community is also implied in the ecosystem discourse (Dattée et al., 2018; Muñoz et al., 2022; Spigel & Harrison, 2018). However, past research has given little account of how the types or balance of different roles in the ecosystem develop or shift over time. The research commonly describes that ecosystems are led by an orchestrator and supported by a group of followers: complementors, members, and other stakeholders (Adner, 2022; Jacobides et al., 2018; Shipilov & Gawer, 2020; Thomas & Ritala, 2022).

In contrast, we argue that the ecosystem orchestrator's role will, over time, diminish thanks to decentralized governance. Thus, the role of **performative legitimacy** is greatly increased at this stage (attainable through processes that "*drive normative legitimacy by proving the viability of the ecosystem through the processes of strategic action, value realization, adoption, and external intervention*;" Thomas & Ritala, 2022, p. 6). The community narrative has a crucial role in supporting the development of performative legitimacy within the ecosystem. The process is fed by the decentralization protocols that visualize the contributions of ecosystem members and demonstrate how the collective can fulfill the ecosystem's value proposition. Over time, performative legitimacy strengthens the collective identity through decentralized governance as the system transparently ***incentivizes ecosystem members to take strategic actions*** that are aligned with the collective action goal and the ecosystem's value proposition. No focal orchestrator is required. The decentralization protocol provides increased transparency of the actions within the ecosystem and helps to translate the subjective experiences of the participants into objective, observable signals within the community.

Thus, signaling is essential in how a functioning decentralized ecosystem can ***encourage and attract external engagement*** through tokenization. Since the decentralization protocol enables concrete mechanisms for visualizing member actions, it also provides means to ***signal ecosystem viability through member observations***. After the community has utilized the tokenization process to define desired or undesired actions and visualize member contributions, it can evaluate whether the system facilitates **shared value realization** as expected. The purpose of tokens in a signaling system is not to facilitate transactions or enable monetary value but to help align and motivate the ecosystem participants to conduct actions that fulfill the collective action goal. In the process, the decentralization protocol allows to record and ***visualize member contributions*** on that path. Next, before we provide an illustrative case to demonstrate the applicability of our model, we briefly summarize our research design.

RESEARCH DESIGN AND CASE DESCRIPTION

This is a conceptual paper with illustrative case evidence. This is to say that while we primarily rely on conceptual argumentation, we elaborate on the implications of our conceptual model (summarized in Figure 1) by presenting evidence from a practical use case. Tracey is a grassroots-level, blockchain-based project for organizing artisanal tuna fishing and trading in villages around the Lagonoy Gulf and Mindoro Strait in the Philippines (Marttila et al., 2019). The project joins WWF Philippines, UnionBank, and TX for a solution for documenting and verifying the catch and trade data of tuna fishing. WWF Philippines is a local branch of the World Wildlife Foundation. UnionBank is one of the universal banks in the Philippines and considered particularly open for technological innovations. TX is a consultancy partner of Streamr (which, in turn, is a distributed open-source software project). In addition, the project involves the existing communities of fishers in the area, providing a possibility to support the local fishing community and villages.[5] The case demonstrates an attempt to steer a community of actors (i.e., the fishers and other stakeholders) toward more democratic and equitable processes through the means of social justice and decentralized production and sharing of information—the aspects at the heart of digital commons (Stalder, 2010).

Our conceptualization is inspired by an ethnographic account of a project ATARCA, funded by the European Commission, focusing on using decentralization technologies to facilitate collective action.[6] We worked intensively with members from Streamr and TX, who have been the leading workers behind the Tracey project, in an academic research project during 2021-2023. Before that, we analyzed the Streamr project based on public information starting from the year 2018. During our joint project, we explored the potential of decentralization technologies in various new applications but have continuously reflected on the work conducted for the Tracey project. We have conducted ethnographic observations in the form of project meeting minutes, project-wide instant messaging service (Slack business account), recorded workshop meetings (Zoom web meetings), and used and recorded collaborative online tools (e.g., Miro boards mapping ecosystem design process, including the Tracey case). All authors of this paper have worked on the project.

The Tracey case builds on the work conducted by the WWF-Philippines' Fishery Improvement Project (FIP) (WWF Philippines, 2017). Tuna is by far the Philippines' largest seafood export commodity in terms of volume and value (Llanto et al., 2018), making the country one of the world's largest tuna producing countries. Tuna fishing provides a livelihood to thousands of small-scale fishers, many using an artisanal, handline style for their catch. Regrettably, while the area provides ideal grounds for many valuable tuna species and their stocks, many of the tuna fisheries in the area are severely overfished (WWF Philippines, 2017). The sustainability of the operation has become endangered, with alarming rates of depletion in tuna stocks being reported since 2000 (Llanto et al., 2018).

In the Tracey project, a central activity has been to create a mobile app, accessible for the fishers through their smartphones. The app is also a tool for defining the rules for consensual participation in the commons (Callon, 1984; Lovett & Thomas, 2021; Ostrom, 2000). The fishers log their catch and trade data to the system that subsequently records these data in a decentralized database (Marttila et al., 2019). As a result, the system generates a reliable and immutable database on tuna fishing. Since the fishers will input the data in the app collectively, they can pool their inputs to a so-called data union, controlling the further use of the dataset (i.e., users can submit their data inputs into a collective database, which can be opened or shared with third parties, while users get rewarded based on their share of data created).

TRACEY CASE: INITIATING A SIGNAL-BASED DECENTRALIZED MOVEMENT

The Tracey case combines physical and digital commons to address a societal, grand challenge. In terms of physical commons, the project connects to the well-known issues of managing fisheries in a more collective and sustainable way (Ostrom, 2005). Yet, a key idea in pursuing this goal is to manage the physical resources with the help of digital commons using decentralization technologies. If successful, the project can provide more timely and accurate data to guide environmental policies (Ascui et al., 2018; Gabrys, 2016) but also impact actions at the grassroots level.

In essence, we frame Tracey as a carefully thought-out signaling system, involving digital and physical commons, enabled by a decentralization protocol. The Tracey ecosystem develops around mutual benefits and complex interdependencies. Community members are guided in their efforts toward a collective action goal (Act 1), helped to define a shared identity for realizing the ecosystem value proposition (Act 2), and provided a system for collective coordination that formalizes shared value realization (Act 3). Next, we will elaborate on how the Tracey ecosystem exhibits the different acts portrayed in our conceptual model (Figure 1).

Signaling collective action in ecosystems: Incentivizing more sustainable actions among community members

The whole ecosystem is initiated by the collective action goal of more sustainable tuna fishing and fair trade with just compensation (left-most circle in Figure 1). This goal is hampered by several problems and information asymmetries, aggravated by the anonymity linked to the setting: current tuna fishing practices offer no transparency on the amount and type of catch or who has caught it, despite regulations preventing the export of the fish without reliable catch documentation. Different members, such as UnionBank or Streamr, have very different problems caused by anonymity: UnionBank is required to provide a certain proportion of their loans to small business owners, but cannot do that without an adequate credit rating, which, in turn, cannot be attained without reliable working history or collateral that many fishers do not possess. Streamr and TX could have a solution that addresses the aforementioned problems, but they are not known members of the community, and hence their proposal might not attract support.

Leader narrative to address anonymity problems (Act 1). In line with our model (Figure 1), Streamr and TX do what the aspiring leaders of a decentralized system normally do to address such issues: they formulate their proposal into a compelling narrative that can speak to the key stakeholders and write a white paper that meticulously defines how the proposed system can help their stakeholders to attain their individual goals. The decentralization protocol also formalizes and incentivizes actions that follow the rules and aims for collective action. In practice, that means that the fishers will continue to do their business as before, but utilize the app developed by Streamr and TX to log their catches, for which they receive a small compensation sponsored by the WWF Philippines. To raise awareness and attract more participants to the system, the project leaders reinforce their narrative with a broader audience using compelling storytelling, e.g., producing videos describing the benefits of the system for different stakeholders.

Shared identity about the ends and means of collective action (Act 2). Once an ecosystem attracts enough members that benefit from interdependencies and complementarities, it begins to fulfill its value proposition (Jacobides et al., 2018; Kapoor, 2018). In this case, the ecosystem's value proposition is to reward its members for participating in more sustainable fishing and trade practices (the middle circle in Figure 1). The anonymity problems linked to the commons-pool resources still remain, as there is no certainty about who has (or has not) logged their catch as intended. Therefore, it is crucial that the community works to increase awareness about the ecosystem's potential value and strengthen the legitimacy of its operation. This can happen, for instance, by reaching out to community members and external stakeholders alike, such as when promoting an opportunity for an end customer across the globe to know the origin of their dinner, and being able to tip the original producer for a job well done. These interactions become possible because the signaling system records and displays past member actions. Transparency helps in visualizing the member contributions and provides an opportunity to reward or sanction members for their demonstrated behavior (e.g., a fisher inputting false catch data can face a reputation loss or exclusion from the system and their community if getting caught for misbehaving). By promoting such actions that can reward system participants for participating in more sustainable practices, the members can gradually establish a shared identity about the benefits attainable through participation. Such collective understanding helps to define the distinctive identity characteristics that begin to differentiate participants from non-participants. In management literature, such differentiation is known as the separating equilibrium associated with signaling systems (Bergh et al., 2014; Spence, 2002). All the above reflects how, in an ecosystem, the actors operate to serve their own interests, but in a way shaped by complex interdependencies and complementarities. The crucial difference, though, is that at this stage, there will be numerous versions of the narrative describing the benefits of the system, which we refer to as the "community narrative." Since there is no hierarchical managerial control over the participants in ecosystems, neither will there be central management of the presented narrative.

Legitimizing new practices via decentralized signaling system (Act 3). The decentralization protocol is crucial in facilitating shared value realization in digital commons. Most importantly, it formally operationalizes a self-sustaining system that incentivizes collective action in ecosystems (right-most circle in Figure 1). However, such autonomy causes a drastic management problem—there is no focal actor or orchestrator running the show. In practice, this deficiency can jeopardize the veracity of data inputs, if data auditing is not properly designed as a part of the system. In the Tracey case, the plan was to involve the fish vendors to verify that the data inputs and fish to be sold match each other.[7] The data veracity has an important role in incentivizing strategic action among members by increasing transparency behind actions and in making the obtained benefits tangible. For instance, thanks to the transparent working record provided by the system, the once "unbankable" fishers could now get a loan from the UnionBank, for example, to repair a broken boat or develop their business. As the number of happy community members increases, so will the number of active advocates who can endorse the benefits of the system and want to sustain its operating standards. Such actions promoting collective governance and the transparently recorded benefits of the system can greatly encourage and attract external engagement.

All in all, based on our observations, we argue that the Tracey case illustrates how a decentralization protocol can form an actualized signaling system. The decentralization protocol's source code serves as a verification of the leading consortium's intentions (as the source code defines the functionalities, rewards, and punishments of the system). The Tracey case also cleverly benefits from the produced signal data: the information is used to subsidize participating fishers through the provision of banking services and loans. Table 2 summarizes the key characteristics of the Tracey signaling system.

Table 2. Characteristics of the Tracey signaling system

Signals	***Narratives by the leading consortium and the community*** signal the set agenda and a long-term vision for a group of like-minded people. ***Catch and trade data logged by the fishers*** signals a commitment to more sustainable fishing practices among the community members. ***Any participation*** signals a willingness to obey the commonly set rules and policies—that one is willing to partake in the common cause.
How signal trustworthiness is ensured	***The set agenda*** and ***the decentralization protocol*** (smart contract source code) will be compared. The code should reflect the leading consortium's narrative and vision. The followers in the consortium constantly evaluate whether the protocol functions match the set agenda. ***Fishers' actions*** will provide ***a blockchain-based verifiable record*** of the individuals' catch and trade data. It is almost impossible to alter or forge the data stored in the blockchain after it has been recorded. The logged data can be verified in subsequent exchanges (e.g., a vendor can verify that the fish to be sold and the catch recorded in the app match each other)
Punishment of misbehavior	***Leading consortium*** may lose the support for their cause, if they deviate from the set agenda or joint vision. Ultimately, it is possible that misaligned community members will "fork" the system (i.e., copy and rewrite the decentralization protocol and set new rules for an alternative system). ***Fishers*** can be banned from the system if they misbehave (e.g., falsify catch records), facing the risk of reputation loss.
Benefits of desirable behavior	***The community*** can reach the desired cause (more sustainable fishing) and be rewarded for actions toward this cause. ***Leading consortium*** attains support and users for their technology protocol, demonstrating its practical value. ***Fishers*** will get a verifiable working record that grants access to banking services (in addition to the long-term benefits of more sustainable fishing). At the same time, loan providers can match their internal requirements for funding unprivileged actors. ***Other stakeholders*** will get access to high-quality catch and trade data to facilitate policymaking.

Requirements for a functioning signaling system

As the choices made by single individuals become recorded in a traceable and transparent, decentralized ledger, the anonymous and asocial digital commons becomes a socially constructed reality. A key enabler here is that the technology (in Tracey, a blockchain-based protocol) enables the tokenization of signals and signaling processes for the digital commons. Thus, following the premises of signaling theory, the actions of a member of the community influence the actions of others, improving their future success by altering the behavior of other individuals (Bliege Bird & Smith, 2005; Connelly et al., 2011; Maynard Smith & Harper, 1995). However, our evidence also suggested some important boundary conditions for the signaling system facilitated by decentralization protocols.

We argue that a functioning signaling system must have a positive net effect on the intended followers over time. [8] We see this requirement as a critical boundary condition for any system looking to facilitate collective action through signals. The Tracey case can be critiqued as an ideologically motivated story that assumes what is good for the individual fishers is also good for the whole collective. In reality, the individual fishers, the collective, and the world as a whole might all have different incentives driving their actions. Hence, regardless of the system's capability, e.g., to address overfishing by providing more timely and accurate data on the catch among the said collective, it can also have a negative impact on them. For instance, if governments get alarmed by the catch data, new policies or regulations may be imposed—that would directly have a negative effect on the participating collective versus any other groups or stakeholders who do not participate and provide similarly accurate data. We therefore argue that for any signaling system to be sustainable, the short-term individual benefits of using the system must be greater than the temporally distant collective downsides. In the Tracey case, such benefits could have been the monetary subsidies for recording catch data in the app, while the downsides have been managed by other stakeholders (e.g., WWF Philippines) in advocating the veracity of catch data without regulating the overall amount. Should these short- and long-term benefits need adjustment over time, the community can take action to modify them. Thus, the system orchestration should remain in the hands of the collective to manage and, if needed, adjust the realized net effects for the ecosystem members. Our model highlights this possibility by advocating decentralized governance mechanisms (right-hand side in Figure 1).

In summary, Tracey combines physical and digital commons to address a grand challenge. Our illustrative examples shed light on how the digital commons and the decentralization protocol might not provide a substitute for interpersonal togetherness via traditional face-to-face mechanisms, but they can complement these traditional means. The system has not only provided means to engage in processes of commoning and belonging among the fishers (Berlant, 2016; Birkinbine, 2018), but has also initiated a new form of a digital commons through the expansive potential of collected data (Birkinbine, 2018; de Rosnay & Stalder, 2020). The project signals a commitment to more sustainable fishing practices among the community members (TX, 2019; WWF Philippines, 2017) and openly invites the fishers to join the system, with low barriers to entry. The boundaries of the community and the digital commons are dynamically shaped by both the producers and the users of the system (de Rosnay & Stalder, 2020). Most importantly, the project has articulated a common agenda, mutual incentives, and a long-term vision for a group of like-minded people, shaping a shared identity of aligned actors (Ingram Bogusz & Morisse, 2018; Peteraf & Shanley, 1997). Thus, the case presents a particularly interesting avenue for investigating the devices of interaction, accountability, and coordination between the involved stakeholders, helping the parties to define and articulate their identities and roles to facilitate collaboration.

IMPLICATIONS FOR POLICY AND MANAGEMENT

In this paper, we explored the potential of decentralization protocols in facilitating ecosystems for collective action. We focused on the context of digital commons and argued that the aspiring leaders of the community rely on building a narrative to secure support from prospective members of the collective (cf. Suddaby & Greenwood, 2005). Furthermore, we argued that the role of the leader's narrative diminishes over time as the community members become more active and impactful representatives of the ecosystem and its benefits. In turn, our illustrative case presented how the digital commons can aid in resolving known issues of managing common-pool (physical) resources (Ostrom, 1990) by enhancing the social aspect of the conducted exchanges (Cook et al., 2013). Overall, our findings connect to the discourse on shared identity (Ashforth & Mael, 1989), describing how it unfolds in an emerging community working toward a common goal, with notable implications for both policy and management.

In the following, we discuss the implications of our study from three perspectives, while constantly reflecting on the illustrative evidence from Tracey. First, we elaborate on the role of leader narratives in raising awareness and shaping a compelling vision to attract followers. Then, we address the potential of decentralization protocols in facilitating behavior that incentivizes ecosystem members to partake in collective action and the member's role in shaping the broader community narrative. Last, we further extend our implications by elaborating on the broader societal value of digital commons in addressing grand challenges, discussing their applicability to other contexts looking to facilitate collective action.

Materializing the collective vision through leader narratives

Careful alignment of visions, motivations, and actions is required in realizing the benefits of a decentralized system. Such needs portray the "translation" of the issue to be resolved, i.e., the leading consortium's characterization of the represented actors and their problems (Callon, 1984). The translation provided by Streamr and TX provides a compelling vision: there is little reason *not* to like the initiative behind the Tracey project, especially if one believes in the virtues of more democratic, egalitarian governance. The system provides more accurate and more reliable catch data that may facilitate environmental governance and, thus, supports data-based political ecology (Campling & Colás, 2018; Nost & Goldstein, 2021).

An efficient narrative of such translation and its benefits is valuable for the mobilization of the solution and in motivating actors to join the system.[9] The system provides a structured mechanism to ensure the sustainability of the long-term future of the fishing industry in the area, addressing the problem of diminishing tuna stocks (Llanto et al., 2018) and the looming tragedy of the commons (Hardin, 1968). The Tracey app provides the tools for ensuring the sustainable appropriation of oceanic common pool resources (Campling & Colás, 2018) and the grounds for establishing digital commons (de Rosnay & Stalder, 2020), based on the accumulating catch and trade data. Due to the technical implementation, it is almost impossible to alter or forge the data stored in the decentralized blockchain, after it has been recorded. This makes it more reliable than paper-based documentation. The system can also create some limitations for dishonest actors. Overall, actions that are good for the community get rewarded, while actions that go against it become less attractive (e.g., facing a reputation risk for misbehaving or not participating, or losing out on the benefits of affordable loans through a credible working record).

Thus, our conceptualization implies that the ecosystem leaders have a fundamental role in suggesting the collective action goal and shaping the shared identity of the community. Since the decentralization protocol limits the leaders' hierarchical power over the followers and their actions (De Filippi et al., 2020; Mindel et al., 2018), an efficient and honest narrative of the benefits (and limitations) of collaboration is required to raise awareness and attract support for the ecosystem. When utilizing a decentralization technology, the aspiring leaders define concrete protocols that capture leaders' vision into actual, coded (digital) institution (cf. Lovett & Thomas, 2021), that formalize the actions that are recognized and incentivized through the protocol (i.e., acts that are considered aligned with the collective action goal). Hence, the decentralization protocol also contributes to the establishment of the shared identity among community members.

Signaling collective action in ecosystems with decentralization protocols and community narratives

The decentralization protocols can operate in an anonymous fashion, but they still rely on fostering a community of aligned supporters. Past research has identified the potential of decentralization protocols in aligning diverse groups of people by facilitating a novel organizational form (Morrison et al., 2020), increasing sustainability (Lovett & Thomas, 2021), establishing a group identity (Ingram Bogusz & Morisse, 2018), and developing new governance models (Zavolokina et al., 2020). However, such technologies cannot facilitate collective action and provide the desired societal value without collective identity (Berlant, 2016) or adequate legitimacy among the community (Thomas & Ritala, 2022). What makes the situation more complicated is that the boundaries of the community in digital commons take shape in a dynamic fashion, as they are constantly being contested and potentially modified by the producers, members, and users of the system (de Rosnay & Stalder, 2020; Garud & Giuliani, 2013). Further, the processes for establishing alignment among the members in digital commons differ significantly from conventional social mechanisms (Etzioni, 2019; Lovett & Thomas, 2021).

The signaling approach we embraced in this paper can help in addressing such a contested space of information, interpretations, and actions. Instead of enforcing a single interpretation of reality, the signals articulate the shared purpose of the digital commons and strengthen the social bonds and the sense of belonging of the community among the participating members. The signals represent the shared ideology and identity on shaping the digital commons, and the central, enduring, and distinctive characteristics behind the community (Peteraf & Shanley, 1997). Hence, as the Tracey case illustrated, the decentralization protocol captures the leading consortium's attempt to translate and formalize the social identity of the represented community into concrete rules and policies but, over time, will gradually develop among all members into more multivocal community narrative.

Thus, we argue that the decentralization protocols offer powerful solutions to empower and legitimize a community and its narrative. The protocols can offer clearly articulated rules, norms, and related governance mechanisms to provide the needed alignment for a distributed community. Moreover, a resulting system can provide concrete measures to evade the tragedy of commons (Aligica & Tarko, 2012; Ostrom, 1990), reducing the risk of actors with selfish interests eventually ruining the collective (Hardin, 1968, 1998). The decentralization protocol offers a formal coordination system in which the leading community or ecosystem orchestrator signals the policies and practices for the control, evolution, and future performance of the ecosystem (Bridoux & Stoelhorst, 2022; Thomas & Ritala, 2022). In addition, the aspiring leaders of the community should utilize narratives to make the proposed system comprehensible to the users, similar to how entrepreneurs frame institutional change (Suddaby & Greenwood, 2005; Thomas & Ritala, 2022) but that will be enforced through the concrete actions of the participating community members. Our evidence from the Tracey case showed promising indications that the decentralization protocols can be effective in empowering community narratives and facilitating collective action for solving problems related to contested physical resources, such as overfishing.

Social and societal value of digital commons in addressing grand challenges

Lastly, our observations provide valuable implications for the broader social value of decentralization technologies and digital commons. As global challenges (e.g., climate change, inequality, poverty) grow more pressing, we cannot rely solely on incumbent institutions or governments to provide solutions with a top-down approach. Instead, we need ways to involve stakeholders from various backgrounds and engage participants at the grassroots level. The digital protocols that aid in organizing digital commons provide an opportunity for fair and community-governed processes for managing both physical and digital resources.

Past research on distributed organizing, collective action, and ecosystems has emphasized how a strong identity supports the enrollment of new members, resolution of conflicts, and mobilization of action toward the system-level goal (Lindgren et al., 2015; Orlikowski, 2002; Thomas & Ritala, 2022). On the surface, the decentralization protocol can present an applicable solution for shaping the identity to facilitate the collective action on (digital) commons. Yet, critique has also been presented; for instance, Ossewaarde and Reijers (2017) feared that digital commons merely create “false consciousness,” in which the new solutions replicate the problems of other existing structures and are not able to initiate meaningful social change.

To alleviate such concerns, our observations about the Tracey case provided examples of multiple benefits of the digital commons that could have broader societal value. We illustrated how the decentralization protocols present a viable response to demands for more robust terms for creating alignment in the community (Berlant, 2016) and for discourses empowering social movements driven by a shared passion (Birkinbine, 2018). Organizing digital commons can improve the management of physical common-pool resources (e.g., ocean fish), facilitate better decision-making based on reliable data (e.g., defining parameters for sustainable fishing), and foster a shared identity about belonging to a community and participating in a social cause (likely, increasing the motivation for sustainable management of the commons). The ecosystem members can signal the viability of the ecosystem and their support for the social movement simply by participating in the community (Thomas & Ritala, 2022; Wade, 1995), for example, by adopting and implementing the decentralization protocol suggested by the leading consortium.

Furthermore, digital commons can empower communities to face challenges at both the local and global levels, despite diverse motivations (Kostakis, 2018; Papadimitropoulos, 2023). It is a natural, human tendency to seek companionship through social identity and "*cognitive, moral, or emotional attachment to a group based on similar attributes*" (Webb et al., 2009, p. 497). Our model (in Figure 1) suggests how ecosystems can foster shared identity and embrace a more distributed governance model by utilizing decentralization protocols. The shared identity affects how the legitimacy of the leading consortium is evaluated, since the actions and motives of the leaders are also under assessment (Drover et al., 2018). After the shared identity among the ecosystem members is strong enough to merit community narratives, the subsequent development of that identity and the growth and future of the ecosystem is not in the leaders' hands anymore. Once the system is truly self-sustaining, it will cease being under its original leaders' control.

The benefits of digital commons are not limited to fishing. It is easy to extrapolate the potential to other environmental challenges and physical resources, such as logging, farming, or land use. It can also extend to the production of new goods. Here, the concept of "cosmolocalism" further combines the physical and non-physical, where global, digital knowledge commons support physical production in local settings (Papadimitropoulos, 2023). It is also possible to consider improved resource management and decision-making in less tangible fields, such as commons-based peer production of software, local community management, or even cultural commons. The Tracey case illustrated how the digital commons can also complement the management of physical resources and integrate deeply into existing social structures. Overall, we argue that the digital commons can provide a valuable tool in any context where data veracity, the utilization of common-pool resources, or recognition of individual's efforts toward a collective goal needs to be verified.

ALTERNATIVE EXPLANATIONS AND COMPLEMENTARY THEORIES

Our study has a multidisciplinary and phenomenon-driven focus, and it draws from numerous theoretical discourses. Instead of contributing to a single theoretical discussion, we seek to provide bridges across several interlinked discourses to offer converging insights and, perhaps, broaden the scope of past thinking. Regardless, there are numerous alternative theoretical perspectives that could provide different or complementary explanations to our conclusions. In the following, we briefly address three key perspectives that we see have the potential to elaborate our argumentation with further scrutiny: Ostrom's (1990) design principles on governing common-pool resources, sensemaking and sensegiving (Gioia & Chittipeddi, 1991), and social identity theory (Ashforth et al., 2023).

First, we call for works elaborating our conceptual model against the principles of governing the commons (Ostrom, 1990). Our conceptual model aligns with Ostrom's eight design principles for the sustainable governance of the common-pool resources (1990, 2005), while a more careful assessment of these ideas would be needed. Past research has elaborated that these principles are also applicable to digital environments, such as polycentric information commons (Mindel et al., 2018) or joint value creation among stakeholders (Bridoux & Stoelhorst, 2022). The distributed governance mechanism, enabled by the decentralization protocol, makes it possible for each member to impact the community's operational rules and monitor the actions taken by other members, including ecosystem orchestrators. While such a possibility was not explored in the Tracey case, the decentralization protocol could automatize the monitoring process and even hand out graduated sanctions to those who violate rules (Dietz et al., 2003; Ostrom, 1990). We see such designs as a particularly intriguing avenue for future research that would combine complex technological and sociological issues. While Ostrom's design principles are often implemented to govern common-pool resources in an egalitarian manner, a more constructivist perspective to the social institutions could better inform us about situations where various goals and social movements intersect (Singleton, 2017). Such diversity is often apparent in ecosystem research, as different evaluators may define the same situation differently (cf. Adner, 2017; Kapoor, 2018; Shipilov & Gawer, 2020).

Alternatively, the theories on sensemaking and sensegiving (Gioia & Chittipeddi, 1991) could provide valuable insights into exploring the development of collective action in ecosystems. Further exploration of the way the community leaders can engage in sensemaking and sensegiving processes when trying to attract support for their cause and explaining how the developed technology addresses the set collective goal is encouraged. Since sensemaking cycles between actions and the cognitive reactions to these actions (e.g., perceiving, interpreting) both intra- and interpersonally (Rheinhardt & Gioia, 2021), it can shed light on the way prospective community members make sense of the potential and utility of decentralization technologies on personal and collective levels. In particular, future studies on the model developed here could benefit from the stream of sensemaking that investigates the role of signals in affecting the reciprocal sensemaking process as the actors vary between the roles of a sender and an observer (e.g., Levine Daniel & Eckerd, 2019). However, since the decentralization technology drastically overhauls the traditional organizational hierarchy, the "upside-down organizational change" led by lower-level employees (or in this case, any community member) should prove more applicable for further inquiries (Rheinhardt & Gioia, 2021).

Third, social identity theory might be well applicable to explaining the development of a shared identity that we consider pivotal for collective action in ecosystems. As implied by the name, social identity theory and its application in management focuses primarily on social identities, affected by one's community, organization, workgroup, or other demographic categories (Ashforth et al., 2023). Social identity theory describes the affectionate relationships within a group (Brown, 2000) and argues that, by their membership in a group, people can experience self-worth and social belonging (Tajfel & Turner, 2004). The majority of the works on social identity theory are intertwined with the physical environment, investigating its role in shaping the identification and identity (Ashforth et al., 2023). The effect of anonymity has been considered complex and flexible, and it depends on various cognitive and strategic implications (Robertson, 2006). Anonymity has been found to even promote adherence to a group identity (Postmes et al., 2001; Robertson, 2006). However, if the group identity is not salient (as in the context of an emerging ecosystem), people are likely to adhere to their personal identities (Nicholls & Rice, 2017). Further research should address the applicability of social identity theory in the context of (anonymous) digital commons, collective action in (emerging) ecosystems, and, in general, communities facilitated by decentralization technologies.

CONCLUSION

The members of a community face uncertainty regarding the behavior and motives of their fellow participants in their environment. In particular, in contexts where multiple actors rely on a pool of common resources, it is essential to ensure that all members follow the commonly set rules, and the ones deviating from them are identified and excluded from the commons (Ostrom, 2000, 2009). Such demands apply especially to communities or ecosystems aiming for a common good, like ones set out to resolve social or environmental issues with collective action. Yet, it may be difficult to identify actors who silently deviate from the collective frontier, act with dishonest intentions, overconsume common resources, or disobey the joint rules.

In this paper, we described how the members of an emerging ecosystem could utilize a decentralization protocol and rely on tokenization, signals, and distributed coordination and governance for collective action. Our conceptual model presented a new perspective on organizing digital commons based on signals and signaling, inspired by natural ecosystems. The Tracey case illustrated how decentralization protocols that focus on the signals the community members can send and receive offer significant potential for creating more egalitarian, diversified, and sustainable (digital) institutions.

Essentially, these institutions connect (physical) common-pool resources to (digital) resources via digital commons.

In conclusion, our model argues that decentralization technologies can provide a signal-based coordination structure that aligns community members' interests and actions to facilitate collective action in ecosystems. We argued that in using decentralization technology, the focus should be on aligning actions and contributions: governing the signals and signaling that the members use when performing desired behaviors in the community. Taking such a perspective, we proposed that the decentralization protocols would not guide the digital commons toward market-like behavior or the inherent battle over scarce resources. Instead, the system would incentivize member behaviors that are aligned with the community and its mission, avoiding unnecessary social struggles.

References

Adar, E., & Huberman, B. A. (2000). Free riding on Gnutella. *First Monday*, *5*(10).

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of Management*, *43*(1), 39–58. https://doi.org/10.1177/0149206316678451

Adner, R. (2022). Sharing value for ecosystem success. *MIT Sloan Management Review*, *63*(2), 85–90.

Aligica, P. D., & Tarko, V. (2012). Polycentricity: From Polanyi to Ostrom, and beyond. *Governance*, *25*(2), 237–262. https://doi.org/10.1111/j.1468-0491.2011.01550.x

Ascui, F., Haward, M., & Lovell, H. (2018). Salmon, sensors, and translation: The agency of big data in environmental governance. *Environment and Planning D: Society and Space*, *36*(5), 905–925. https://doi.org/10.1177/0263775818766892

Ashforth, B. E., Caza, B. B., & Meister, A. (2023). My place: How workers become identified with their workplaces and why it matters. *Academy of Management Review*.

Ashforth, B. E., & Mael, F. (1989). Social identity theory and the organization. *Academy of Management Review*, *14*(1), 20–39. https://doi.org/10.5465/amr.1989.4278999

Bergh, D. D., Connelly, B. L., Ketchen, D. J., & Shannon, L. M. (2014). Signalling theory and equilibrium in strategic management research: An assessment and a research agenda. *Journal of Management Studies*, *51*(8), 1334–1360. https://doi.org/10.1111/joms.12097

Bergh, D. D., Ketchen, D. J., Orlandi, I., Heugens, P. P., & Boyd, B. K. (2019). Information asymmetry in management research: Past accomplishments and future opportunities. *Journal of Management*, *45*(1), 122–158. https://doi.org/10.1177/0149206318798026

Berlant, L. (2016). The commons: Infrastructures for troubling times*. *Environment and Planning D: Society and Space*, *34*(3), 393–419. https://doi.org/10.1177/0263775816645989

Bimber, B., Flanagin, A. J., & Stohl, C. (2005). Reconceptualizing collective action in the contemporary media environment. *Communication Theory*, *15*(4), 365–388. https://doi.org/10.1111/j.1468-2885.2005.tb00340.x

Birkinbine, B. J. (2018). Commons praxis: Towards a critical political economy of the digital commons. *TripleC*, *16*(1), 290–305. https://doi.org/10.31269/triplec.v16i1.929

Bliege Bird, R., & Smith, E. A. (2005). Signaling theory, strategic interaction, and symbolic capital. *Current Anthropology*, *46*(2), 221–248. https://doi.org/10.1086/427115

Bridoux, F., & Stoelhorst, J. W. (2022). Stakeholder governance: Solving the collective action problems in joint value creation. *Academy of Management Review*, *47*(2), 214–236. https://doi.org/10.5465/amr.2019.0441

Brown, R. (2000). Social identity theory: Past achievements, current problems and future challenges. *European Journal of Social Psychology*, *30*(6), 745–778. https://doi.org/10.1002/1099-0992(200011/12)30:6<745::AID-EJSP24>3.0.CO;2-O

Burke, P. J., & Stets, J. E. (2009). *Identity theory*. Oxford University Press.

Callon, M. (1984). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of Saint-Brieuc Bay. *The Sociological Review*, *32*(S1), 196–233. https://doi.org/10.22394/0869-5377-2017-2-49-90

Campling, L., & Colás, A. (2018). Capitalism and the sea: Sovereignty, territory and appropriation in the global ocean. *Environment and Planning D: Society and Space*, *36*(4), 776–794. https://doi.org/10.1177/0263775817737319

Connelly, B. L., Certo, S. T., Ireland, R. D., & Reutzel, C. R. (2011). Signaling theory: A review and assessment. *Journal of Management*, *37*(1), 39–67. https://doi.org/10.1177/0149206310388419

Cook, K. S., Cheshire, C., Rice, E. R. W., & Nakagawa, S. (2013). Social Exchange Theory. In J. DeLamater & A. Ward (Eds.), *Handbook of Social Psychology* (pp. 61–88). Springer. https://doi.org/10.1007/0-387-36921-x

Dattée, B., Alexy, O., & Autio, E. (2018). Maneuvering in poor visibility: How firms play the ecosystem game when uncertainty is high. *Academy of Management Journal*, *61*(2), 466–498. https://doi.org/10.5465/amj.2015.0869

De Filippi, P. (2017, March 15). What blockchain means for the sharing economy. *Harvard Business Review*, 2–5.

De Filippi, P., & Lavayssière, X. (2020). Blockchain Technology: Toward a Decentralized Governance of Digital Platforms? In A. Grear & D. Bollier (Eds.), *The Great Awakening: New Modes of Life amidst Capitalist Ruins* (pp. 185–222). punctum books. https://doi.org/10.2307/jj.2353884

De Filippi, P., Mannan, M., & Reijers, W. (2020). Blockchain as a confidence machine: The problem of trust & challenges of governance. *Technology in Society*, *62*, 101284. https://doi.org/10.1016/j.techsoc.2020.101284

de Rosnay, M. D., & Stalder, F. (2020). Digital commons. *Internet Policy Review*, *9*(4), 1–22. https://doi.org/10.14763/2020.4.1530

Dierksmeier, C., & Seele, P. (2018). Cryptocurrencies and business ethics. *Journal of Business Ethics*, *152*(1), 1–14. https://doi.org/10.1007/s10551-016-3298-0

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *Science*, *302*, 1907–1912. https://doi.org/10.4324/9781315092546-4

Drover, W., Wood, M. S., & Corbett, A. C. (2018). Toward a cognitive view of signalling theory: Individual attention and signal set interpretation. *Journal of Management Studies*, *55*(2), 209–231. https://doi.org/10.1111/joms.12282

Etzioni, A. (2019). Cyber trust. *Journal of Business Ethics*, *156*, 1–13. https://doi.org/10.1007/s10551-017-3627-y

Fisch, C., Masiak, C., Vismara, S., & Block, J. (2021). Motives and profiles of ICO investors. *Journal of Business Research*, *125*, 564–576. https://doi.org/10.1016/j.jbusres.2019.07.036

Gabrys, J. (2016). Practicing, materialising and contesting environmental data. *Big Data and Society*, *3*(2), 1–7. https://doi.org/10.1177/2053951716673391

Garud, R., & Giuliani, A. P. (2013). A narrative perspective on entrepreneurial opportunities. *Academy of Management Review*, *38*(1), 157–160. https://doi.org/10.5465/amr.2012.0055

Gioia, D. A., & Chittipeddi, K. (1991). Sensemaking and sensegiving in strategic change initiation. *Strategic Management Journal*, *12*(6), 433–448.

Grafen, A. (1990). Biological signals as handicaps. *Journal of Theoretical Biology*, *144*(4), 517–546. https://doi.org/10.1016/S0022-5193(05)80088-8

Greco, G. M., & Floridi, L. (2004). The tragedy of the digital commons. *Ethics and Information Technology*, *6*(2), 73–81. https://doi.org/10.1007/s10676-004-2895-2

Guilford, T., & Dawkins, M. S. (1991). Receiver psychology and the evolution of animal signals. *Animal Behaviour*, *42*(1), 1–14. https://doi.org/10.1016/S0003-3472(05)80600-1

Gulati, R., Puranam, P., & Tushman, M. (2012). Meta-organization design: Rethinking design in interorganizational and community contexts. *Strategic Management Journal*, *33*(6), 571–586. https://doi.org/10.1002/smj.1975

Hannan, M. T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, *82*(5), 929–964.

Hardin, G. (1968). The tragedy of the commons. *Science*, *162*, 1243–1248.

Hardin, G. (1998). Extensions of the tragedy of the commons. *Science*, *280*(5364), 682–683.

Harper, D. G. C. (2006). Maynard Smith: Amplifying the reasons for signal reliability. *Journal of Theoretical Biology*, *239*(2), 203–209. https://doi.org/10.1016/j.jtbi.2005.08.034

Hasson, O. (1997). Towards a general theory of biological signaling. *Journal of Theoretical Biology*, *185*(2), 139–156. https://doi.org/10.1006/jtbi.1996.0258

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2009). *Dynamic capabilities: Understanding strategic change in organizations*. Blackwell.

Howell, T. (2021). Coworking spaces offer a post-pandemic office alternative. *MIT Sloan Management Review*, *63*(2), 1–3.

Ingram Bogusz, C., & Morisse, M. (2018). How infrastructures anchor open entrepreneurship: The case of Bitcoin and stigma. *Information Systems Journal*, *28*(6), 1176–1212. https://doi.org/10.1111/isj.12204

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. *Strategic Management Journal*, *39*(8), 2255–2276. https://doi.org/10.1002/smj.2904

Johnstone, R. A., & Grafen, A. (1993). Dishonesty and the handicap principle. *Animal Behaviour*, *46*, 759–764.

Kapoor, R. (2018). Ecosystems: Broadening the locus of value creation. *Journal of Organization Design*, *7*(12). https://doi.org/10.1186/s41469-018-0035-4

Kleineberg, K.-K., & Helbing, D. (2016). A "social bitcoin" could sustain a democratic digital world. *SSRN Electronic Journal*, 1–7. https://doi.org/10.2139/ssrn.2771326

Kostakis, V. (2018). In defense of digital commoning. *Organization*, *25*(6), 812–818. https://doi.org/10.1177/1350508417749887

Lawrence, T. B., & Suddaby, R. (2006). Institutions and Institutional Work. In S. Clegg, H. C, T. B. Lawrence, & W. Nord (Eds.), *Handbook of Organization Studies* (pp. 215–254). Sage. https://doi.org/10.1007/s11786-007-0026-2

Leiponen, A., Thomas, L. D. W., & Wang, Q. (2021). The dApp economy: A new platform for distributed innovation? *Innovation: Organization and Management*, 1–19. https://doi.org/10.1080/14479338.2021.1965887

Levine Daniel, J., & Eckerd, A. (2019). Organizational sensegiving: Indicators and nonprofit signaling. *Nonprofit Management and Leadership*, *30*(2), 213–231. https://doi.org/10.1002/nml.21383

Lindgren, R., Eriksson, O., & Lyytinen, K. (2015). Managing identity tensions during mobile ecosystem evolution. *Journal of Information Technology*, *30*(3), 229–244. https://doi.org/10.1057/jit.2015.8

Linebaugh, P. (2008). *The Magna Carta Manifesto*. University of California Press.

Llanto, G. M., Ortiz, M. K. P., & Madriaga, C. A. D. (2018). The Philippines' Tuna Industry. In J. Gross & P. Intal, Jr. (Eds.), *Reducing Unnecessary Regulatory Burdens in ASEAN: Country Studies* (pp. 210–238). ERIA.

Lovett, M., & Thomas, L. (2021). A fork in the road: Perspectives on sustainability and decentralised governance in digital institutions. *First Monday*, *26*(11).

Lowe, N. J., & Feldman, M. P. (2017). Institutional life within an entrepreneurial region. *Geography Compass*, *11*(3), 1–10. https://doi.org/10.1111/gec3.12306

Margetts, H. Z., John, P., Hale, S. A., & Reissfelder, S. (2015). Leadership without leaders? Starters and followers in online collective action. *Political Studies*, *63*(2), 278–299. https://doi.org/10.1111/1467-9248.12075

Marshall, D. J., Staeheli, L. A., & Čelebičić, V. (2020). Why are "we" called "them"?: Storytelling and the contested terrain of post-conflict public formation. *Environment and Planning D: Society and Space*, *38*(2), 306–324. https://doi.org/10.1177/0263775819852124

Marttila, J., Nousiainen, M., Sheppard, B., Malka, M., & Karjalainen, R. (2019). *Tracey – your traceability and trade data companion* (pp. 1–52). TX.

Maynard Smith, J., & Harper, D. G. C. (1995). Animal signals: Models and terminology. *Journal of Theoretical Biology*, *177*, 305–311.

Mindel, V., Mathiassen, L., & Rai, A. (2018). The sustainability of polycentric information commons. *MIS Quarterly*, *42*(2), 607–631. https://doi.org/10.25300/MISQ/2018/14015

Moore, J. F. (1993). Predators and prey: A new ecology of competition. *Harvard Business Review*, *71*(3), 75–83.

Morrison, R., Mazey, N. C. H. L., & Wingreen, S. C. (2020). The DAO Controversy: The case for a new species of corporate governance? *Frontiers in Blockchain*, *3*(25). https://doi.org/10.3389/fbloc.2020.00025

Muñoz, P., Kibler, E., Mandakovic, V., & Amorós, J. E. (2022). Local entrepreneurial ecosystems as configural narratives: A new way of seeing and evaluating antecedents and outcomes. *Research Policy*, *51*(9). https://doi.org/10.1016/j.respol.2020.104065

Nicholls, S. B., & Rice, R. E. (2017). A dual-identity model of responses to deviance in online groups: Integrating social identity theory and expectancy violations theory: Group and personal responses to deviance online. *Communication Theory*, *27*(3), 243–268. https://doi.org/10.1111/comt.12113

Nost, E., & Goldstein, J. E. (2021). A political ecology of data. *Environment and Planning E: Nature and Space*, 251484862110435. https://doi.org/10.1177/25148486211043503

O'Mahony, S., & Ferraro, F. (2007). The emergence of governance in an open source community. *Academy of Management Journal*, *50*(5), 1079–1106.

O'Riordan, S., Emerson, B., Feller, J., & Kiely, G. (2023). The road to open news: A theory of social signaling in an open news production community. *Journal of Management Information Systems*, *40*(1), 130–162. https://doi.org/10.1080/07421222.2023.2172777

Orlikowski, W. J. (2002). Knowing in practice: Enacting a collective capability in distributed organizing. *Organization Science*, *13*(3), 249–273. https://doi.org/10.1287/orsc.13.3.249.2776

Ossewaarde, M., & Reijers, W. (2017). The illusion of the digital commons: 'False consciousness' in online alternative economies. *Organization*, *24*(5), 609–628. https://doi.org/10.1177/1350508417713217

Ostrom, E. (1990). *Governing the Commons* (J. E. Alt & D. C. North, Eds.). Cambridge University Press.

Ostrom, E. (2000). Collective action and the evolution of social norms. *Journal of Economic Perspectives*, *14*(3), 137–158. https://doi.org/10.1080/19390459.2014.935173

Ostrom, E. (2005). *Understanding Institutional Diversity*. Princeton University Press.

Ostrom, E. (2009). Beyond markets and states: Polycentric governance of complex economic systems, Prize lecture, December 8, 2009. *The Nobel Prizes*, 408–444.

Papadimitropoulos, V. (2023). The digital commons, cosmolocalism, and open cooperativism: The cases of P2P Lab and Tzoumakers. *Organization*, 135050842311562. https://doi.org/10.1177/13505084231156268

Peteraf, M., & Shanley, M. (1997). Getting to know you: A theory of strategic group identity. *Strategic Management Journal*, *18*, 165–186. https://doi.org/10.1002/(sici)1097-0266(199707)18:1+<165::aid-smj914>3.3.co;2-r

Postmes, T., Spears, R., Sakhel, K., & De Groot, D. (2001). Social influence in computer-mediated communication: The effects of anonymity on group behavior. *Personality and Social Psychology Bulletin*, *27*(10), 1243–1254. https://doi.org/10.1177/01461672012710001

Rheinhardt, A., & Gioia, D. A. (2021). Upside-down organizational change: Sensemaking, sensegiving, and the new generation. In M. S. Poole & A. H. Van De Ven (Eds.), *The Oxford Handbook of Organizational Change and Innovation* (2nd ed., pp. 77–105). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780198845973.001.0001

Robertson, T. (2006). Dissonance effects as conformity to consistency norms: The effect of anonymity and identity salience. *British Journal of Social Psychology*, *45*(4), 683–699. https://doi.org/10.1348/014466605X82855

Shipilov, A., & Gawer, A. (2020). Integrating research on inter-organizational networks and ecosystems. *Academy of Management Annals*, *14*(1), 92–121.

Simon, H. A. (2002). Organizing and coordinating talk and silence in organizations. *Industrial and Corporate Change*, *11*(3), 611–618. https://doi.org/10.1093/icc/11.3.611

Singleton, B. E. (2017). What's missing from Ostrom? Combining design principles with the theory of sociocultural viability. *Environmental Politics*, *26*(6), 994–1014. https://doi.org/10.1080/09644016.2017.1364150

Skågeby, J. (2010). Gift-giving as a conceptual framework: Framing social behavior in online networks. *Journal of Information Technology*, *25*(2), 170–177. https://doi.org/10.1057/jit.2010.5

Spence, M. (1974). Competitive and optimal responses to signals: An analysis of efficiency and distribution. *Journal of Economic Theory*, *7*, 296–332.

Spence, M. (2002). Signaling in retrospect and the informational structure of markets. *American Economic Review*, *92*(3), 434–459. https://doi.org/10.1257/00028280260136200

Spigel, B., & Harrison, R. (2018). Toward a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, *12*(1), 151–168. https://doi.org/10.1002/sej.1268

Stalder, F. (2010). Digital commons. In K. Hart, J.-L. Laville, & A. D. Cattani (Eds.), *The Human Economy* (pp. 313–324). Polity Press. https://doi.org/10.1017/cbo9780511707964.019

Steigenberger, N., & Wilhelm, H. (2018). Extending signaling theory to rhetorical signals: Evidence from crowdfunding. *Organization Science*, *29*(3), 529–546. https://doi.org/10.1287/orsc.2017.1195

Stets, J. E., & Serpe, R. T. (2013). Identity Theory. In J. DeLamater & A. Ward (Eds.), *Handbook of Social Psychology* (pp. 31–60). Springer.

Stiglitz, J. E. (2000). The contributions of the economics of information to twentieth century economics. *The Quarterly Journal of Economics*.

Stryker, S., & Burke, P. J. (2000). The past, present, and future of an identity theory. *Social Psychology Quarterly*, *63*(4), 284. https://doi.org/10.2307/2695840

Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, *20*(3), 571–610. https://doi.org/10.5465/amr.1995.9508080331

Suddaby, R., & Greenwood, R. (2005). Rhetorical strategies of legitimacy. *Administrative Science Quarterly*, *50*, 65–67.

Swan, M. (2015). *Blockchain–Blueprint for a New Economy*. O'Reilly Media.

Tajfel, H., & Turner, J. C. (2004). The Social Identity Theory of Intergroup Behavior. In J. T. Jost & J. Sidanius (Eds.), *Political Psychology: Key Readings*. Psychology Press.

Theodoraki, C., Messeghem, K., & Rice, M. P. (2018). A social capital approach to the development of sustainable entrepreneurial ecosystems: An explorative study. *Small Business Economics*, *51*(1), 153–170. https://doi.org/10.1007/s11187-017-9924-0

Thomas, L. D. W., & Ritala, P. (2022). Ecosystem legitimacy emergence: A collective action view. *Journal of Management*, *48*(3), 515–541. https://doi.org/10.1177/0149206320986617

TX. (2019). *TX Project: Tracey*. https://tx.company/projects/tracey/

Venkataraman, S., Sarasvathy, S. D., Dew, N., & Forster, W. R. (2013). Of narratives and artifacts. *Academy of Management Review*, *38*(1), 163–166.

Venkatraman, N., Lee, C.-H., & Iyer, B. (2008). Interconnect to Win: The Joint Effects of Business Strategy and Network Positions on the Performance of Software Firms. In J. A. Baum & T. J. Rowley (Eds.), *Advances in Strategic Management: Network Strategy* (pp. 391–424). JAI Press.

Wade, J. (1995). Dynamics of organizational communities and technological bandwagons: An empirical investigation of community evolution in the microprocessor market. *Strategic Management Journal*, *16*, 111–133. https://doi.org/10.1002/smj.4250160920

Webb, J. W., Tihanyi, L., Ireland, R. D., & Sirmon, D. G. (2009). You say illegal, I say legitimate: Entrepreneurship in the informal economy. *Academy of Management Review*, *34*(3), 492–510. https://doi.org/10.5465/AMR.2009.40632826

WWF Philippines. (2017). *Partnership program towards sustainable tuna*. https://wwf.org.ph/what-we-do/food/pptst/

Yang, S., Kher, R., & Newbert, S. L. (2020). What signals matter for social startups? It depends: The influence of gender role congruity on social impact accelerator selection decisions. *Journal of Business Venturing*, *35*(2), 105932. https://doi.org/10.1016/j.jbusvent.2019.03.001

Zahavi, A. (1975). Mate selection—A selection for a handicap. *Journal of Theoretical Biology*, *53*(1), 205–214. https://doi.org/10.1016/0022-5193(75)90111-3

Zavolokina, L., Ziolkowski, R., Bauer, I., & Schwabe, G. (2020). Management, governance, and value creation in a blockchain consortium. *MIS Quarterly Executive*, *19*(1), 1–17. https://doi.org/10.17705/2msqe.00022

Zook, M., & Grote, M. H. (2020). Initial coin offerings: Linking technology and financialization. *Environment and Planning A*, *52*(8), 1560–1582. https://doi.org/10.1177/0308518X20954440

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[1] As an example of a protocol-enforced tokenization within digital commons, SolarCoin is a project aiming for a solar-powered planet. It incentivizes solar panel installations with network's own cryptographic token of value. SolarCoin's goal is to provide free, abundant solar energy to humanity. In a similar vein, projects such as Single.Earth or Efforce look to tokenize the value created by capturing CO2 in biodiverse nature or improving companies' energy efficiency, respectively. Read more: https://solarcoin.org; https://www.single.earth; https://efforce.io (accessed 11-30-2023).

[2] Even in contexts where practically all work can be conducted remotely, such as in open source communities like Linux, it has been found that developers crave for face-to-face meetings for "*a less impersonal feel*" and facilitate coordination among the "*names we see on mailing lists*" (O'Mahony & Ferraro, 2007, p. 1099). More recently, the forced remote working setting caused by the global pandemic has verified such a craving for personal encounters (Howell, 2021).

[3] In this paper and in our conceptual model, we refer to these mediums as "leader narratives."

[4] For example, Single.Earth issues MERIT tokens that are designed to reflect the value of nature for keeping the planet habitable. Landowners can receive tokens based on the ecological value of their lands once they commit to preserving nature in the tokenized area. 1 MERIT token reflects 100 kg of CO_2 captured in biodiverse nature and is valued at 3 Euros. Read more: https://www.single.earth/nature-token-merit (accessed 11-30-2023).

[5] For more details, including a short video about the case, see https://tx.company/projects/tracey/ (accessed 11-24-2023).

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[6] The ATARCA project (Accounting Technologies for Anti-Rival Coordination and Allocation) explored the potential of decentralization technologies in facilitating efficient markets for digital goods. The project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 964678. See more at https://atarca.eu (accessed 02-23-2024).

[7] There were some observed problems in the Tracey project to getting the vendors (known as "Casa" in the Philippines) participate the system as intended, despite the fact they were offered a subsidy–comparable to what the fishers got–for participating in the system. While we do not have any evidence on the reasons for their reluctance, it is easy to observe that the Casa have the most lucrative position in the current situation. The vendors often combine the roles of fish intermediaries, money lenders, and boat owners, and are commonly seen as the wealthiest members in the current social community. It is logical to argue that the Casa have the lowest motivation to change the status quo in the community.

[8] We thank the anonymous reviewers and the special issue editors for inviting this discussion and providing inspiration for our argumentation.

[9] For example, a 5-minute video hosted on the Streamr and TX homepages presents several reasons for how the project contributes to valuable social goals. The video seeks to provide a compelling narrative to a wide audience—including the fishers, investors, consumers, technology advocates, and regulatory agencies—that would ultimately provide a sense of a community (Ingram Bogusz & Morisse, 2018) and an idea of "we" acting together (Marshall et al., 2020). According to the narrative presented in the video, the Tracey app offers multiple benefits to various participants. See the video at: https://streamr.network/case-studies/tracey/ (accessed 11-30-2023).

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