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Self-Regulation and Code of Conduct in the Community: Four Pilots on Utilising Decentralisation Technologies for Improving Sustainability and Collective Governance

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Year: 2024

Version: Accepted manuscript

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https://doi.org/10.1007/978-3-031-56619-6_10

Please cite the original version:

Hakanen, E., Wolff, J., Eloranta, V. & Shaw, C. (2024). Self-Regulation and Code of Conduct in the Community: Four Pilots on Utilising Decentralisation Technologies for Improving Sustainability and Collective Governance. In B. Díaz Díaz, S. O. Idowu, R. Schmidpeter, N. E. Nedzel, M. Del Baldo & I. Guia Arraiano (Eds.), *Building Global Societies Towards an ESG World: A Sustainable Development Goal in the 21st Century* (pp. 167–186). CSR, Sustainability, Ethics & Governance. Springer. https://doi.org/10.1007/978-3-031-56619-6_10

This is an authors' version of a manuscript as accepted for publishing after the review process.

Hakanen, E., Wolff, J., Eloranta, V., & Shaw, C. (2024). Self-Regulation and Code of Conduct in the Community: Four Pilots on Utilising Decentralisation Technologies for Improving Sustainability and Collective Governance. In B. Díaz Díaz, S. O. Idowu, R. Schmidpeter, N. E. Nedzel, M. Del Baldo, & I. Guia Arraiano (Eds.), Building Global Societies Towards an ESG World: A Sustainable Development Goal in the 21st Century. Springer Cham.

Researchers are kindly asked to use the official publication in references.

Self-regulation and Code of Conduct in the Community: Four Pilots on Utilising Decentralisation Technologies for Improving Sustainability and Collective Governance

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ABSTRACT

Decentralisation technologies, such as those based on blockchain, provide exciting possibilities to coordinate cooperative actions and contributions of independent actors in favour of more sustainable operations. These technologies offer means to operationalise and define rules for the code of conduct for community members and create incentive mechanisms to motivate self-regulation among individuals. However, while such technologies add ways to increase alignment and avoid selfish actions, they are often perceived as technologically complex and challenging to comprehend and rarely utilised in solving collective, practical problems.

We challenge this notion based on four practical pilot experiments utilising novel decentralisation technology to engage community members toward more sustainable operations for collective benefits. The four pilots demonstrate how decentralisation technology can support highly different communities to better attain their goals: "Tracey" provides reliable catch and trade data on tuna fishing; "Barcelona Green Shops" encourages more sustainable shopping behaviour; "Food Futures" measures the environmental sustainability of meal choices; "Streamr Community" incentivises open-source software development. All the pilots have made the solution easy to approach for the intended audience, greatly simplifying the complexity related to the technological protocols. These successes illustrate how translation practices facilitate self-regulation and a shared code of conduct for the community.

The evidence and insights drawn from these pilots pave the way toward more sustainable and inclusive business models. We explain how effective translation of digital solutions is highly impactful in reducing social struggles on a global scale. We highlight why the formalised protocols enable effective self-regulation and align actions to benefit the community. Our work illustrates how decentralisation technologies can foster sustainable, collective governance for a more prosperous future for partnerships, people, and the planet.

Keywords: digital commons, sustainability, blockchain, sociology of translation, ecosystems

Introduction

Technology development has provided exciting possibilities for improving the sustainability of actions and decisions in our everyday lives. One example of such prospects is the opportunity to coordinate cooperative actions and contributions among independent actors through decentralisation technologies, such as blockchains (Lovett & Thomas, 2021; Swan, 2015). These technologies provide means to operationalise and concretise rules that define the code of conduct for community members and create incentive mechanisms to motivate self-regulation among individuals. These rules are specified in the formal protocols that lay the technological foundation of the blockchain (Berg et al., 2020; De Filippi et al., 2020). The protocol and its rules are accessible and open to anyone willing to review the smart contract or the white paper of the project.

However, while such technologies provide means to increase alignment and guide members to more collaborative actions, they are often perceived as technologically complex and challenging to comprehend (Hakanen et al., 2022; Lovett & Thomas, 2021). Instead of attracting new participants to join communities, thanks to more egalitarian and fair governance structures enabled by the decentralisation protocol (De Filippi et al., 2020; Dierksmeier & Seele, 2018), these solutions may have the opposite effect of alienating people who are not familiar with the technology or do not feel confident exploring it (Atzori, 2015). This digital divide (Greco & Floridi, 2004) separates participants and non-participants based on their technological savviness. Consequentially, despite having the potential for empowering social movements on a global scale, decentralisation technologies and blockchains are rarely used when solving collective, practical, or social problems. This chapter addresses that deficiency and shows how novel decentralisation technology can engage community members to achieve more sustainable operations and collective benefits.

In this work, we demonstrate how decentralisation technologies can prove valuable in coordinating cooperative actions and contributions of independent actors in different contexts. We provide evidence from four practical pilot experiments that demonstrate how blockchains support highly different communities to attain social goals. First, the “Tracey” pilot illustrates how blockchains can be used for reliable catch and trade data on tuna fishing, combining data provenance and user incentivisation. Second, the pilot on “Barcelona Green Shops” uses a similar technology to encourage more sustainable shopping behaviour with the support of a similar technology. Third, “Food Futures” uses blockchains to accurately measure the environmental sustainability of our collective meal choices and enable more informed choices. Last, the “Streamr Community” pilot utilises decentralisation technology to align and motivate collective efforts toward open-source software development. A distinctive characteristic in all the pilots is the ensured approachability of the solution for the intended audience. Simplifying the technological complexity related to the underlying technological protocols requires a careful translation between the leading team and the community members they represent (Callon, 1984; Hakanen et al., 2022). However, the successes of these experiments illustrate how, when successful, the translation practices can facilitate self-regulation and a shared code of conduct for a diverse community with local and global impact.

This paper is organised as follows. Next, we shortly explicate the conceptual background of our study: digital commons and decentralisation technology, their relevance for community regulation and governance, and the translation processes behind them. The methodology section describes the ethnographical approach that provides the data for our insights. The results and discussion section presents the four pilots and their main implications in relation to past research. We conclude by highlighting the promise of decentralisation technology for a more equal, sustainable, and better-functioning society for all individuals.

Background

Developing and maintaining digital resources within a community

This study focuses on a specific type of organising that relies on emerging decentralisation technologies: digital commons. It 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). In turn, “commons” refer to common-pool resources that are accessible to society’s members, with typical examples ranging from clean air and fresh water to natural resources or stocks of ocean fish (Ostrom, 1990). Accordingly, digital commons can support more sustainable societies (Ascuí et al., 2018; Lovett & Thomas, 2021) that increase the societal value created while decreasing the environmental impact. Like their physical counterparts, digital commons are affected by social connections and trust among members, who benefit from an aligned community which allows them to pursue collective goals. A “community” is a collection of people, who—in this context—rely on digital structures to provide coordinated actions among its members for collective benefits (de Rosnay & Stalder, 2020; Ostrom, 1990).

The digital commons often utilise decentralisation technology or distributed ledger technologies (DLTs), for example blockchains, to create digital tokens that account for the value created in the community and facilitate the governance of the commons through a process of tokenisation (Dal Mas et al., 2020; Hakanen et al., 2022). In its most simple form, a “digital token” refers to a concrete representation of a member’s share, contribution, or achievement for a specific community that is recorded and maintained via a digital protocol. As such, digital commons build on the characteristics of digital technologies and goods, as they rely on resources that are easy and cheap to copy, distribute and combine across various instances (Birkinbine, 2018; de Rosnay & Stalder, 2020). These possibilities easily lead to benefits that grow and accrue in practically an exponential manner (Olleros, 2018).

Many communities behind the digital commons have proclaimed to be on a mission for the common good and to pursue various social values (Dierksmeier & Seele, 2018; Kleineberg & Helbing, 2016). Such an approach can attract hobbyists and open-source activists (de Rosnay & Stalder, 2020; Stalder, 2010) and investors intrigued by the ideological or social objectives (Fisch et al., 2021). As an example of a DLT protocol-enforced digital commons, SolarCoin is a project that aims to enable a solar-powered planet. The project network uses its cryptographic token of value to incentivise solar

panel installations. The goal is to provide free, abundant solar energy to humanity (Solarcoin, 2021). In a similar vein, projects such as Single.Earth or Efforce look to tokenise the value created in natural carbon capture processes or when improving companies' energy efficiency, respectively. The Single.Earth project aims to couple nature with the rate of economic growth by valuing and monetising the intrinsic value of nature. They mint "MERIT" tokens for landowners who commit to preserving their lands, maintaining biodiversity and carbon sequestration. The project challenges us to consider the forests, nature, and Earth as more than just raw materials to be exploited at will. In turn, Efforce provides a possibility to fund and commit to projects improving energy efficiency. Their protocols tokenise saved energy measured in kilowatt-hours (kWh). Efforce has introduced a decentralised platform that allows anyone to invest in energy efficiency projects worldwide, attaining profits based on realised energy savings. With the help of DLT protocols, such digital commons initiatives try to establish socio-digital capital around collective goals, promote diversity in the system to maximise innovation, and, at the same time, mitigate the risk of monopolistic control (Kleineberg & Helbing, 2016; Stalder, 2010).

Nevertheless, similar to the commons in the physical realm, digital commons exhibit social struggles over access to and command of space, territory, place, region, and resources. The members of the community face uncertainty regarding the behaviour and motives of their fellow participants in their environment (Hardin, 1968), exaggerated the anonymous or pseudonymous settings of the online environment (Fisch et al., 2021; Skågeby, 2010). Such challenges shape collective action since it may be difficult to identify actors who silently deviate from the collective frontier. This is at the heart of the tragedy of the commons, where "*the greediest herdsman would gain—for a while*" (Hardin, 1998, p. 682) before all would be ruined. However, the reality is that it is impossible to surely know the total cost or even the direction of impact of specific actions on all the other members before the consequences have been realised. Instead of the true impact of individual actions, the members of the community require a more functional proxy for evaluating the morality and motives of the behaviour of other members. Therefore, transparent and easily understood norms and rules in the community are vital for the sustainability of the commons, in addition to setting transparent policies on how the rules are set or can be changed (Aligica & Tarko, 2012). An essential feature of any (decentralised) community, such as for digital commons, is the ability to form a collective consensus within the group. Coincidentally, the decentralisation technology also provides a means for attaining self-regulation and setting the desired code of conduct for the community.

Self-regulation and code of conduct using decentralisation technology

We have now suggested that modern accounting technologies can address the issues of governing the commons or forming a consensus. However, while the protocol-enforced tokenised value creation and sharing, in principle, offer means to organise around collective aims in the digital commons, the practice is often far less egalitarian (Dierksmeier & Seele, 2018). Paradoxically, the DLT protocols that were initially used to avoid monopolistic power centres and capitalistic enclosure often result in systems with high economic centralisation, to the extent of being plutocratic (De Filippi et al.,

2020). Moreover, although decentralised protocols and accounting systems offer a solution to prevent freeriding and vandalism, such technologies increase institutional and technological complexity, resulting in an increased digital divide (Greco & Floridi, 2004). Not surprisingly, then, the state-of-the-art critique against protocol-enforced value tokenisation in the digital commons context is that such technologies not only replicate the problems of financial enclosure and centralisation but boost such issues by rendering the institutional structures too challenging to comprehend and regulate (e.g. Dierksmeier & Seele, 2018; Hakanen et al., 2022; Zavolokina et al., 2020).

Put differently, the decentralisation protocols rely on a sense of togetherness, social relationships and mutual understanding that are considered difficult, even impossible, to obtain without face-to-face interaction (Aligica & Tarko, 2012; Berlant, 2016; Marshall et al., 2020; Ostrom, 2009; Skågeby, 2010). Yet, the examples such as SolarCoin, Single.Earth and Efforce illustrate that digital commons enabled by decentralisation protocols can emerge and evolve in a setting without traditional social relationships. The traditional means of creating togetherness and trust with social interactions, communication, and personal encounters (Ostrom, 2000) are unattainable in the contexts of these projects. Digital commons can even be anonymous if made-up nicknames or randomly generated strings of letters and numbers (e.g. specifying wallet addresses in a blockchain transaction) protect the user identities. If so, the digital commons may lack personal, bonding relationships.

Instead of personal touch and relationships, decentralisation technology can provide digital commons with tailor-made accounting systems that establish governance systems, rewarding mechanisms, policy management processes, and dispute resolution systems without a centralised authority. Additionally, DLT protocols can be enforced at the community level to avoid excessive centralisation (Birkinbine, 2018; Stalder, 2010) or to prevent the risk of freeriding and vandalism (Greco & Floridi, 2004). In detail, the technological protocols define member-to-member relationships, automatically reward contributions to commons, and deterministically punish malicious actions—thereby aligning collective actions toward a joint goal (Swan, 2015). However, the resulting system must have clear structures to evade the tragedy of the commons that guide the self-regulation and code of conduct within the community (Aligica & Tarko, 2012; Ostrom, 1990). While setting these structures in the form of coded DLT protocols, one must carefully balance the diverse voices of the community members.

Representing the diverse voices of a community

While decentralisation protocols provide the basis for digital institutions and more collective governance mechanisms, their development is highly centralised. Especially in the first stages of growing the community for digital commons, the formulation, facilitation, and interpretation of signals rely on the decisions of a small group of entities, affecting everyone in the community. Interestingly, such challenges resonate with Callon's (1984) work on the "sociology of translation." In the following, we explain the connection between these discourses.

Callon's sociology of translation focuses on the mechanisms of power and the resulting controversies over social explanations. In more practical terms, the sociology of translation explores the full range of consensual and coercive mechanisms of enrolment and disenrolment (Best & Walters, 2013). Such actions bring notable challenges to the translation process when single individuals act as the representatives of a much larger community (Callon, 1984). Paradoxically, to *"speak for others is to first silence those in whose name we speak"* (Callon, 1984, p. 216), as the aspiring leaders present the whole community's views with one voice. Moreover, a single community may have multiple overlapping, even contesting, identities (Ingram Bogusz & Morisse, 2018). Thus, an unsuccessful translation process can cause the community members to feel alienated from the group's social identity and endanger the sense of togetherness vital for the community. The sociology of translation is a process—not an outcome to be accomplished (Callon, 1984)—that can be aided by compelling narratives and other processes that reduce complexity and make the systems more approachable and understandable.

Digital commons are initially based on the vision of the leading consortium, materialised in the project's white paper and other documentation. However, while the public documentation is the primary source of information behind the supporter's participation decisions, not all the participants read and understand the documents in full detail (Fisch et al., 2021). Additionally, the actual implementation of the digital commons project may change considerably from what is described in the documentation (May, 2017), and the participants generally lack control over their resource investments and the implementation of the project (Zook & Grote, 2020). Therefore, it is conceivable that the participation decisions in this setting are considered more from an emotional point of view than the more traditional investment instruments, increasing the role of ideological motives, new financial logic, and compelling narratives behind the participation decisions (Fisch et al., 2021; Gasparro & Monk, 2020; Zook & Grote, 2020). From this perspective, the view of the leading consortium significantly shapes the digital commons.

Yet, when successful, decentralisation technology and digital commons can prove highly effective as tools for empowering a community to generate global impact. It has been suggested that the DLT protocols can *"create new foundations for our economic and social systems"* (Iansiti & Lakhani, 2017, p. 121). Accordingly, past research has noted that decentralisation technology and blockchains can lead to more sustainable and socially inclusive business models (Dal Mas et al., 2020), for instance, by helping to close material loops and increase resource efficiency throughout value chains (Rajala et al., 2018). In general, sustainable business models focus on capturing economic, social and environmental value across various stakeholders (Bocken et al., 2014; Boons & Lüdeke-Freund, 2013). Examples involving decentralisation technology feature blockchain-based solutions increasing stakeholder involvement and transparency, eliminating middlemen, and democratising entrepreneurial investments (Dal Mas et al., 2020). More generally, decentralisation technologies can help create "ecosystem-level" business models (Eloranta et al., 2019; Hakanen, 2021) that create and align complex incentive structures by motivating collaboration among multiple parties. The most audacious initiatives present solutions that challenge our fundamental economic structures; for instance, by defining constitutional rules for the decentralised

community (Berg et al., 2020) or suggesting an alternative means of accounting better suited for digital goods (Elo et al., 2023; Hakanen et al., 2023).

While connecting to the discussions above, this paper explores the potential of decentralisation technologies and the DLT-enabled decentralised protocols in aligning diverse groups of people and their collective efforts in digital commons. In addition, we address the potential of such an approach in providing a novel organisational form (Morrison et al., 2020), increasing sustainability (Lovett & Thomas, 2021), establishing a group identity (Ingram Bogusz & Morisse, 2018), and developing governance models (Zavolokina et al., 2020). The processes for establishing alignment among the members in digital commons differ significantly from conventional social mechanisms (Etzioni, 2019; Lovett & Thomas, 2021). Our insights are based on qualitative evidence from four pilot experiments using DLT protocols for collective action.

Methodology

Research design

Our insights are based on the ground-breaking ATARCA project (Accounting Technologies for Anti-Rival Coordination and Allocation, <https://atarca.eu>), which explored decentralisation technologies to facilitate collective action. This project was funded through the European Commission's instrument on Future Emerging Technologies, which funds "*early-stage science and technology research exploring new foundations for radically new future technologies by challenging current paradigms and venturing into unknown areas*". The project challenged many of the foundational structures and institutions of our economic systems, such as the focus on the appropriability of scarce rival goods (e.g. money or natural resources). Instead, ATARCA focused on resources like knowledge, reputation, and practically any digital good. These "anti-rival" goods increase in value with use, challenging the scarcity logic of our current global economy (Elo et al., 2023; Hakanen et al., 2022; Olleros, 2018). Hence, the project signals a transformative shift in our global economy towards sustainability and collaboration. The project was considered successful, as demonstrated by multiple "Innovation Radar Prizes" by the European Commission.¹ Accordingly, the pilot experiments conducted in this project were likely to provide novel insights about the implications of emerging decentralisation technologies.

The results of this study are based on four pilot pilots that exhibit the potential impact of decentralisation technologies for attaining collective goals. The pilots are considered preliminary feasibility studies or pilots documenting the potential for subsequent, more extensive studies. All our insights are backed by an ethnographic account of the two-year ATARCA project. All authors have worked on the project and have first-hand knowledge about the design, implementation, and results of the experiments. We worked intensively with members from Streamr and TX, who implemented and led the

¹ Find out more at the European Commission's page for Innovation Radar Prizes: <https://innovation-radar.ec.europa.eu/resultbykeyword?keyword=atarca>

Tracey pilot that preceded the ATARCA project. Before that, we analysed the Streamr project based on public information, starting from this effort in 2018. During the ATARCA project, we have explored the potential of decentralisation technologies in various contexts but have continuously reflected on the work conducted for the Tracey project.

Data collection and analysis

Our research data collection and analysis build on ethnographic observations in various forms that differed slightly between the four pilots. Since one of the pilots, Tracey (on collecting reliable fishing catch and trade data), took place prior to the primary data collection period for this research, this experiment provided us with a contrasting perspective to the three other pilots (Barcelona Green Shops, Food Futures, and Streamr Community) for which we have followed the whole process across designing, executing, and evaluating the results of the obtained experiments. Moreover, since the people leading the Tracey pilot planning have also been involved in the ATARCA project, we have been able to obtain ethnographic observations on how they have retrospectively evaluated the pilot, its results, and, in hindsight, what could or should have been done differently. The obtained data include project meeting minutes, project-wide instant messaging discourse (Slack business account), recorded online workshop meetings (Zoom), and outputs generated with collaborative online tools (e.g. Miro boards mapping the ecosystem design process).

In line with the principles of ethnographic research, the authors have been personally involved with the social context being studied (Gioia & Chittipeddi, 1991). However, since the studied social fabric is largely guided by digital resources and online (or non-personal) communication, the conventional approaches to ethnographic research have required some adaptations to be fitted to such contexts (for an extended discussion, see e.g. Kozinets, 2022). Our purpose is not theory generation, per se, but rather theory elaboration (Ketokivi & Choi, 2014) with the support of the abductive analysis process (Dubois & Gadde, 2002, 2014).

While the ethnographic investigation provides an opportunity to become deeply involved in the study context and collect rich data through interviews, participant observations, and field notes, it is also adamant that the researcher(s) are able to distance themselves from the immersion to their context (Gioia & Chittipeddi, 1991). Adequate distance allows for a more objective and generalizable account of their findings and conclusions by extending from the intricacies of the study in hand (Dubois & Gadde, 2014; Ketokivi & Choi, 2014). In our work, we did not involve external researchers (as suggested by e.g. Gioia & Chittipeddi, 1991) but instead extended our ethnographic analysis with cross-case comparison and analysis, a style more commonly utilized in qualitative case research (Eisenhardt & Graebner, 2007). We found such an approach helpful in demonstrating how the observed practices deviate from the past, more predictable trajectories. The result can be a “*weak theory*” that “*observes, interprets, and yields to emerging knowledge*” with the prospect of having “*small facts speak to large concerns*” (Gibson-Graham, 2014), such as when challenging and rethinking the very foundation of our economic structures. Next, we will present the

key findings of the four pilot experiments and discuss their implications in coordinating cooperative actions and contributions of independent actors in favour of more sustainable operations.

Results and discussion

The four pilot cases showed promising results on the effectiveness of decentralisation technologies for improving sustainability and collective governance. All cases rely on decentralisation technology and DLT-protocols as the core foundation providing collective governance mechanisms. However, it should be noted that all cases exemplify effective translation processes in which a small group of people have taken a leading role in specifying the key issues of the represented community and shaping a decentralisation protocol (a DLT) that operationalises collective means to address those issues.

DLTs are crucial to facilitate sustainability and collective governance in all cases. They are used to set and formalise incentives for member self-regulation. In practice, the respective DLT specifies incentives for actions that are considered valuable for the community (while disincentivising actions that likely increase the identified issues of the represented community). This DLT also formalises the rules and code of conduct for all participating members. Thanks to the technological reliability of its implementation, it is practically impossible to forge records or otherwise cheat when using these DLT systems. This enables the members to reliably observe the impact on collective action that the documented actions produce for the community. The key results and insights indicate that the decentralisation protocol has a slightly different impact across cases.

The main results are summarised in Table 1. Overall, the results from the pilot case are promising and indicate that, in fact, DLTs can be effective for facilitating collective action in various use cases. Based on our findings, we argue that decentralisation technologies can foster sustainable, collective governance for a more prosperous future of partnerships, people, and the planet. In the following section, we briefly explain each pilot and discuss the obtained results and key implications.

(INSERT TABLE 1 ABOUT HERE)

Pilot case	Tracey	Barcelona Green Shops	Food Futures	Streamr Community
Purpose/aim	Provide reliable catch and trade data on tuna fishing to support wildlife conservation	Encourage more sustainable shopping and local production	Measure the environmental sustainability of individuals' meal choices	Incentivise open-source software development through non-monetary rewards
Data collection period	2018-2021 (secondary data) 10/2021-06/2022 (primary data, retrospective reflection)	10/2021-03/2023 (primary data, observations from planning to obtained results)	03/2022-03/2023 (primary data, observations from planning to obtained results)	10/2022-05/2023 (primary data, observations from planning to obtained results)
Leaders & their role	TX & Streamr employees (program lead & developer), WWF (sponsor & client)	Novact (program lead), Qbit (developer), REC (promote)	Aalto/UoH (program lead & education), Unicafe (vendor), Flowa (developer)	Streamr team (program lead), Ethereum network (evaluate & facilitate)
Sociology of translation	What are the main issues of fisherfolk in rural areas and developing countries	Challenges of small business owners Unmet customer demand and shopping preferences	Climate impact of specific meal choices Interpreting the observed consumption habits and preferences of consumers	Defining the community vision Shaping the community future by choosing the contributions to endorse
Use of DLT protocol	Document catch and trade data Accumulate reliable data to monitor fish stock levels Ensure audit trail and provenance of data	Document customer choices in participating shops Facilitate knowledge sharing among shop owners	Document individual meal choices Accumulate collective consumption data Increase transparency and enable more conscious choices	Recognise and acknowledge member contributions Share merit on collective work
Set incentives for self-regulation	Rewards (micro-payment subsidies) for data inputs Create and maintain a working history record Participate in data union by pooling created data	Reward customers for making sustainable choices in shops Reward shop owners for sharing best practices (e.g. on reducing packaging waste)	Customers get to know the true impact of their daily consumption Vendors get feedback on rationale behind meal choices Gamified rewards for making better choices	Contributing members gain higher visibility for their valuable efforts Easier to align collective work Contribute to the sense of unity and togetherness among members
Defined rules and code of conduct	Catch and trade data must be documented with the Tracey app	Customers got rewards for participating (cf. gamification) Shop owners gain visibility and stature in their network for shared insights	Buy your lunch using the app (instead of over the counter) Sustainability data provided for each lunch option Possibility to self-report other meals consumed at remote locations	Leading team members credit contributions they see worthy Receivers can share merit with contributing members Any member can upvote contributions they see as valuable
Observed impact on collective action	Participants (fishers, traders, other stakeholders) valued the system's potential Subsidies were effective in engaging fishers	Customer participation and engagement increased over time Shop owners liked and used the system, despite not receiving subsidies or other direct rewards	App users made more sustainable meal choices than non-users People reacted positively to non-monetary incentives Vendors found the solution promising	Community members appreciated the system Members felt more motivated to contribute DLT system can increase alignment on contributions
Key results and insights	User participation relied largely on subsidies → System design could be improved	Increasing transparency on user actions motivated participation to the community	DLT systems can guide consumer behaviour with non-monetary incentives	The non-monetary incentives can be effective in guiding and attracting member contributions

Table 1. Summary of the cases

Tracey – collecting reliable fishing catch and trade data

Tracey is a grassroots-level application that explores the use of blockchains for organising artisanal tuna fishing and trading (Marttila et al., 2019). It is a collective effort among WWF Philippines (a local branch of the World Wildlife Foundation), UnionBank (universal bank in the Philippines looking for technological innovations), and TX (a consultancy partner of Streamr, which, in turn, is a distributed open-source software project). In addition, the project engages existing fishing communities in the Lagonoy Gulf and Mindoro Strait area in the Philippines and joins them in the prospect of a blockchain-based solution for documenting and verifying the catch and trade data of tuna fishing.

Tuna fishing provides the main economic income to thousands of small-scale fishers, many of them using artisanal, handline techniques for their catch. While the area provides an ideal environment for many valuable tuna species, many of the area's tuna fisheries are severely overfished (WWF Philippines, 2017). Therefore, the sustainability of the fishers' lifestyle and livelihood has become endangered, with alarming depletion in tuna stocks since 2000 (Llanto et al., 2018). Tracey builds on the work conducted by the WWF-Philippines' labelled as the Fishery Improvement Project (FIP) (WWF Philippines, 2017), and provides an example of *problematization*, in which the leading consortium characterises the represented actors and their problems (Callon, 1984).

The Tracey project gave highly promising initial results, while also some challenges. The fishers felt motivated to participate in the system, indicating that the leading team had succeeded in designing a system that addresses problems relevant for the represented community. The DLT system had implemented effective incentives for self-regulation and code of conduct rules. The fishers used the created mobile phone app to log their catch and trade data and were subsidised for data creation with micro payments. The system was found promising in enticing actions that were aligned with the project's purpose and aim. However, further examination also showed challenges that could mean the system might not be completely self-sustaining in the long run.

While the system benefitted from interlinked activities that were complementary to one another, it relied on a considerable part on subsidising the fishers for their data inputs. The original plan involved an idea of pooling data among the fishers into comprehensive data products that could be sold to subsequent users (e.g. environmental research agencies or regulation monitors) but that aspect did not proliferate as planned. Hence, the system became a reflection of a sponsor-based platform with a strong reliance on its leaders (Boumgarden et al., 2012) rather than a vibrant community among ecosystem members (Hakanen, 2021). While the system had a strong emphasis on digital commons (i.e. catch and trade data), its implementation still largely relied on monetary rewards for the participating members. Additionally, not all members were found equally motivated in changing the status quo (e.g. the "Casa," vendors buying the fish). In result, the pilot results suggest that system design could be improved to motivate and facilitate more collective governance structures that better account for the non-monetary incentives for participation (Elo et al., 2023; Hakanen, 2021).

Barcelona Green Shops – facilitating sustainable shopping

The Barcelona Green Shops case focused on encouraging consumers to shop more sustainable and local products in their neighbourhood shops. Led by ATARCA project partners Novact and Qbit, the experiment focused on the identified challenges of small business owners and combined those with the unmet customer demands among residents. It connected to the REC platform (Real Economic Currency, Barcelona's social currency that complements the euro, see <https://rec.barcelona>). Concrete goals were set for improving sustainable and responsible conduct among shop owners, for example, by reducing plastic packaging waste with the products sold and to help consumers choose products that are better for them and the environment.

The DLT system was designed to document consumer choices in participating shops and to facilitate the sharing of best practices among shop owners. It rewarded customers for making 'better' consumer choices and shop owners for sharing their knowledge with their peers. The system provided visibility and stature benefits to more active shop owners or other members who gave valuable community contributions.

The initial results of the experiment were encouraging. The quantitative evidence showed that the use of DLTs had a positive effect on customer engagement. In addition, the shop owners considered the system valuable, despite its inability to provide them with direct monetary benefits. Hence, the system showed the effectiveness of non-monetary rewards as motivating factors for guiding user behaviour (cf. gamification, see Deterding, 2012). Based on our findings, we argue that the increased transparency of actions conducted by the community members helped to increase motivation for value-creating activities. These results suggest that, indeed, digital commons can greatly benefit from accounting solutions that widely acknowledge non-monetary transactions and interactions (cf. Elo et al., 2023; Hakanen et al., 2023).

Food Futures – measuring the impact of our meal choices

Food Futures was a pilot designed as a feasibility study to see if individuals' diets can be affected by providing them with more transparent and accurate data on the sustainability impact of their meal choices. The pilot was led and designed by researchers from Aalto University and the University of Helsinki, and conducted in collaboration with a Finnish vendor focused on university student lunches, Unicafe, and an external software developer (Flowa). To address the overall aim, the project spent considerable effort establishing reliable criteria for evaluating the overall impact of each meal option on various criteria, including water usage, CO2 emissions, animal welfare, etc. This stage involved translating the problems to address and resulted in an *interessement* and *enrolment* device (the DLT system) that stabilised and consolidated the relationship and identity of stakeholders and actors through a shared intermediary platform while defining roles and coordinating actions among them (Callon, 1984).

The Food Futures DLT system was utilised to document individual meal choices,

accumulate collective consumption data, and increase the transparency behind different options. With these factors, the system generated clear incentives for user self-regulation toward common goals. In essence, the system generated gamified rewards for making better choices that facilitated subsequent benefits: the consumers got to know the true impact of their daily consumption habits while the vendors got detailed feedback on the rationale behind individuals' meal choices. These benefits were enabled by the DLT system rules, which encouraged consumers to use the app to buy their meals by having the additional benefit of accruing historical data on past choices. The system-generated lunch meal data collection was complemented with the option to add user-generated data on other meals consumed throughout the day by a self-reporting function. This combination of data sources provided a more comprehensive account from which to infer the participants' habits and preferences.

Overall, we found that the app users made more sustainable meal choices than the non-users in the same lunch venue. This indicates that the DLT system and the non-monetary rewards in place can, in fact, incentivise members of the digital commons to favour more ethical options (Etzioni, 2018) or engage in collective action for the betterment of the environment (Ostrom, 2000). Following the pilot, other vendors have found the system promising for supporting causes not motivated strictly by economic rationale. For instance, it has been suggested that such systems could help fast-food restaurants entice consumers to choose more plant-based options. Thus, the DLT systems offer non-monetary incentives which can effectively guide consumer behaviour.

Streamr Community – aligning digital commons for open-source software

Last, the Streamr Community case was focused on creating non-monetary incentive structures to encourage open-source software development. Like any leading team shaping responsible open-source development and the growth of digital commons, the key problem for Streamr is to concretely and accurately define a vision for the future that attracts a wide group of followers that feel united by a joint goal and a shared identity (Ingram Bogusz & Morisse, 2018), defined by problematisation and interessement (Callon, 1984). For this purpose, Streamr developed a DLT system that complements the existing Ethereum network (Hakanen et al., 2023). The goal is to help Streamr define and test their vision for the community's future.

The DLT system enables recognising and acknowledging member contributions (through tokens awarded by Streamr) and allows the token recipients to share the merit of their contributions with other participating members. In addition, other community members can shape the community's future by endorsing contributions. This system has clear incentives for self-regulation: contributing members get visibility on their valuable efforts, Streamr gets wide support for aligning future work, while all members giving endorsements of other inputs benefit from the sense of unity and togetherness of such a collective governance system. The code of conduct and rules of enrolment (Callon, 1984) follow a similar logic as Streamr credits contributions that they see worthy but with a transparent system that enables sharing the merit collectively with other contributors, who might not have been otherwise recognised by

the leading team. Moreover, since any member can upvote practically any contribution, the system is well-suited for mapping the community's collective vision with a decentralisation technology.

The results of this experiment were highly encouraging. The community members appreciated the system as it increased their motivation to participate. In addition, by increasing transparency between collaborators on past work and future demands, the DLT system can greatly improve the alignment of member contributions for the digital commons. The non-monetary incentives and the attribution of tokens were found to be effective in guiding and attracting member contributions by creating signals about an individual's skills, knowledge and efforts in service to the community (Ingram Bogusz & Morisse, 2018).

Implications for theory and practice

From a theoretical point of view, the ATARCA pilot experiments demonstrated the effectiveness of the DLT protocols for supporting different causes. However, the translation process must accurately define the problems addressed with the solution and how the DLT protocol can help in resolving them (Callon, 1984). All pilots demonstrated such designs by supporting self-regulation and a code of conduct guided by non-monetary incentives. Our findings corroborated the arguments that blockchains can facilitate more sustainable economic foundations for future businesses (Iansiti & Lakhani, 2017). In addition, the experiments demonstrated that increasing transparency can be essential in attracting community members for collective action. Our findings indicated that DLT protocols add tools for gamification and for creating more engaging, supportive and satisfying systems (Deterding, 2012).

Our results connect to multiple discussions. First, our findings elaborate the discourse on the digital commons (de Rosnay & Stalder, 2020; Stalder, 2010) and illustrate how they can facilitate more sustainable behaviour within a community and its members (Dal Mas et al., 2020; Lovett & Thomas, 2021; Mindel et al., 2018). Second, despite the lack of traditional, social relationships in developing a consensus and social norms (Ostrom, 2000), our results demonstrated that the decentralisation technology can, indeed, prevent the tragedy of commons through structures that guide the self-regulation and code of conduct among the community members (Aligica & Tarko, 2012; Ostrom, 1990). Third, while the decentralisation technologies for solving a community's collective action problem are often formalised via complicated technical solutions, coded by actors external to the community being helped (Callon, 1984), we found that a careful translation of the implemented technology and its problem-solving potential can lead to more sustainable and socially inclusive behaviour (Dal Mas et al., 2020; Iansiti & Lakhani, 2017).

In particular, our findings elaborate theory on Callon's work on sociology of translation (1984). All cases utilised an intricate DLT protocol to coordinate collective action for digital commons but were able to provide a simple and intuitive solution for the members. Thus, these simplified user interfaces provided devices of *interessement* and *enrolment* between the members of the community and the digital commons (Callon,

1984). For interestment, they defined and stabilised clear roles and identities for the members, whether they relate to catching or trading fish, enabling a more sustainable shopping experience, monitoring individual meal choices and their collective impact, recognising and rewarding member contributions, or practically any activity that support the digital commons. Simultaneously, the DLT protocols established the role of the leading team as an invaluable member of the whole network (Ascui et al., 2018; Callon, 1984). The mechanisms for self-regulation and code of conduct set in the DLT had an important role in enrolment by coordinating the members' actions. They enabled the enforcement of rules, persuaded members with concrete incentives, handled transactions securely, and ensured that participation was always consensual (Ostrom, 2000). In addition, all cases utilised narratives and digital storytelling to support the *mobilisation* phase of the translation (Callon, 1984). The narratives helped to build a positive reputation for the project, growing the legitimacy of the solution and forming a group identity within the community (Ingram Bogusz & Morisse, 2018; Marshall et al., 2020) and, subsequently, establishing a sustainable decentralised collective (Mindel et al., 2018).

From a practical point of view, our insights highlighted the potential of decentralisation technology in fostering a more sustainable community guided by more collective governance. As our findings and the considerations above illustrate, the DLT can engage community members more actively toward joint targets. Our suggestions to anyone considering their application are as follows:

1. **Invest in stakeholder analysis.** Understanding the problem at hand requires considerable effort to hear and learn from the voices of the represented community members. Clearly define the *mission to be solved*.
2. **Analyse the interactions and incentives.** Consider how the community's mission could be translated into concrete actions, interactions, and even strategic interactions among the members. The more detailed the better.
3. **Attract and engage stakeholders.** As "decentralised" implies, such a structure is not a centralised structure with a focal orchestrator. The designed system should represent and work for the community, not its original creator.

CONCLUSION

"The moral values of a society are not self-enforcing. They rely on two very different modes of engendering compliance. One is informal social controls, which draw on people's quest for approval and acceptance by others, on peer pressure, and voices of clergy and secular moral leaders. The other draws on the state's means of coercion." (Etzioni, 2018, p. 4)

As the quote above from Amitai Etzioni succinctly illustrates, the moral values of a society (or a community) cannot be taken for granted, but require constant efforts to maintain. Decentralisation technology, such as blockchains, provide interesting possibilities to support self-regulation and codes of conduct for various collectives through formal DLT protocols (Berg et al., 2020; De Filippi et al., 2020). Hence, DLT

protocols can provide new mechanisms for safeguarding the society's moral values. They can foster sustainable, collective governance to facilitate more prosperous collaboration for the good of the society, the environment, and the planet.

Hence, the set incentives for self-regulation and code of conduct in the studied cases were considerably more guided to support the psychological processes of self-efficacy, group identity, and social approval (Hakanen et al., 2022; Ingram Bogusz & Morisse, 2018). We found the evidence particularly promising for suggesting how the developed DLT protocols enabled complex incentive structures that motivated collaboration among multiple parties. All cases provided evidence for the notion that decentralisation technology can support more equal and sustainable digital institutions to solve complex practical problems (de Rosnay & Stalder, 2020; Lovett & Thomas, 2021; Mindel et al., 2018). Hence, we argue that the decentralisation technology, such as alternative accounting mechanisms aimed for facilitating the creation and sharing of digital goods (Elo et al., 2023; Hakanen et al., 2023), provide the basis for developing more equal, inclusive and sustainable business models (Eloranta et al., 2019; Hakanen, 2021) with global impact.

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