Sustaining Open Communities

Exploring Open Knowledge Models Through Case Studies

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Where this work comes from

I will start this series of documents with a note on me. My hope is to express that the following reflections and learnings can not be separated from my perspective. I am not an objective we. At it's core, this research is coming from a fusion of my desire to learn how I might be able to work better with those around me and my desire to graduate.

The choice to explore collaboration through the perspective of the commons came to me from three questions.

> Question 1: How might I create incentives and scaffolding that helps my team better actualize our information?

After working in a startup team for three months, our notion was overwhelming and full of latent and largely unusable knowledge. All we wanted was to use and reuse what we had learned, share and reshare ideas, and collaborate deeply with each other and with those outside of our team. But the volume of information coming in wasn't transferable to each other or others. Our collaboration methodology was misaligned with our collaboration goals.

> Question 2: How might we have collaboration practices that allow us to elaborate and incorporate the different skill sets that we have?

In parallel to my work in this team, I spent a year in a psychology lab exploring the paradox of diversity in teams. Every paper I read wanted to say diversity was a magic bullet, but the results of many studies were inconsistent. They expressed that diversity could be helpful in some cases, but seemingly overwhelmingly detrimental in others. Out of this confusion emerged the concept of categorization-elaboration theory (van Knippenberg et al., 2004). Part of this theory states that collaborating will create a higher cost to determining a solution by the fact that you need to also coordinate across differences. That cost can either make solutions less effective and take more time, or it can significantly improve how robust a solution is. The 'switch' for effective collaboration vs ineffective collaboration comes if a team adequately hears each other and digs into everyones differences to ensure that the outcome is actually well informed.

> Question 3: How might we develop a collaborative system that reinforces the regeneration of our built up capital (labor, health, intellectual,

> monetary, etc) for ourselves and for those around us so we can keep working together, and with others?

In Junior year, I began to explore the idea of knowledge as a common resource. One that could be shared more freely than the current global system of Intellectual Property allowed. Inspired by Elinor Ostrom's Governing the Commons (1990), the slightly baffling success of the Open Source Movement (from a homo economicus view), and a constant drip of anarchism, feminism, and good vibes from my community at university, I wanted to know how I could more actively steward the capital I shared with my team.

Guided by these questions, my position as the collaboration systems developer in my team, a university system to support my research, and a complete dedication to the idea of sharing better resources more freely. I eventually converged on a desire to have a very deep understanding of organizations who were successfully creating knowledge, deeply engaging with the people who were creating that knowledge, and sharing that knowledge. This way within my work, I could learn from their successes and failures.

Thus all this research is done with a bias that what these organizations are doing is good, and it's done with a bias towards understanding the tools they have used.

Acknowledgments

I am no longer collaborating with the startup team I was originally working with, nor am I working on the psychology research that inspired this project. However, the inspiration and form of this project was heavily informed by my collaboration with Finn Macken, Andre Vacha, and Leo Ware and even after our team separated, each of them supported me as I continued to explore collaboration.

I am no longer working in Frank Keil's Cognitive Psychology Lab either. But both of my advisors Emory Richardson and Nicole Betz were consistently encouraging and supportive as I explored the many different outcomes that diversity in teams might lead to. They helped me through learning to research with constant conversations, study designs, and prompting realizations that… duh, differences are messy and hard and so far from a magic bullet.

In addition to these more formal influences, I want to thank Shreya for sharing Elinor Ostrom's work which formed my methodology, Yufei for consistently listening to my brain dumps and providing a computational understanding of my wild social speculation, Michelle for keeping my realizations rooted in social reality, Trang for reminding me not to work every once in a while, and Erik and my friends at DeSci for helping me understand the newest form of online blockchain cooperatives, and the various professors along the way who helped keep this project moving forward instead of outward. And a final - thank you to Prof. Powers, Prof. Digby, Prof. Zoogman, and Prof. Odera for bringing the research and reality into my exploration.

The research, documentation, and explorations held below, while written by me, are equally the result of constant collaboration and interaction with this community.

Executive Summary

Knowledge is a funky resource. If I share my knowledge with you, I still keep that knowledge for myself. This makes knowledge **non-rivalrous**. A step further, by sharing knowledge I can inspire more people. This makes knowledge **anti-scarce**. But while these factors make it seem like we should always share knowledge - because we can get more knowledge by doing so - knowledge is also very expensive to create. (Maskus, 2000)

Thus we have a contradiction. We make more knowledge by sharing knowledge freely, but we don't have enough resources to create knowledge if we don't somehow get paid.

This contradiction spurred the development of our patent structure today. The patent system argued that to support knowledge creators, we must box the knowledge and ask others to pay for access. But now, the patent structure is cracking. Too many large companies restrict access to innovation through litigation slowing innovation (van Pottelsberghe, 2009).

We see the growing reaction in the Open Knowledge system. The premise of this new system is that knowledge should be shared freely. However, this system currently lacks rigorous quality control (Berberi & Roche, 2022), or a strong incentive to maintain this knowledge over the time because the knowledge creators don't get paid (Pénin, 2007).

Currently neither of these movements solve the problem of knowledge - *how do we take advantage of knowledge's anti-scarce properties while still supporting the knowledge creators?*

In my research, I explore how a freelancer's cooperative (Enspiral, n.d) and a decentralized file storage network (Filecoin, n.d.) attempt to solve this problem by sharing resources among their members and reinvesting those resources into high-quality knowledge production. Effectively, they **remove** the need for the knowledge to make money while providing the necessary **structures and regulation** to verify knowledge and continue its maintenance.

From this analysis, I pose a question for further research which highlights the differences between how Enspiral and Filecoin have organized their resources.

Abstract

Knowledge is a non-rivalrous resource which currently has no satisfactory resolution to its core problem - in theory sharing knowledge creates new knowledge, but in reality without proper resources to create high quality knowledge, sharing knowledge does nothing. The two battling mechanisms for promoting a knowledge economy are the Patent Economy or the Traditional IP system, and the Open Knowledge movement. However the Patent Economy has increasingly been failing to successfully boost the rate of innovation globally (Huebner, 2005), and the Open Knowledge movement seems to fail to produce outcomes that resemble the utopic claims of free, high-quality, and verified knowledge for all to use and access. In my research I evaluate that both of these systems focus to often on the individual creator as the unit of innovation. Instead I take an organizational approach. I use the Institutional Analysis and Design framework developed by Elinor Ostrom to evaluate how two organizations set up the regulations to evaluate knowledge, the monetary resources to maintain that knowledge, and the rules to ensure that that knowledge is consistently shared with the rest of the world for free. My results indicate that the biggest areas for risk within these structures are the lack of checks and balances on the financial distributor, and the lack of mechanisms for developing social consensus around the common resource.

Literature Review

Introduction

Knowledge is money.

In the growing knowledge economy, business developers increasingly point to knowledge as the most valuable resource that businesses have and can generate (Clarke, 2001). However, we've diverged on how we *should* create, share, and build this 'most valuable resource'. On one hand the proprietary intellectual property (IP) system is booming with increasing patent applications year after year (WIPO, 2021) in a constant race to package our knowledge and price it appropriately. But just as boistrous we have the open knowledge movement[1] (Cormier, 2022) which claims knowledge as a public good that should never be put in a box hidden from a potential explorer.

Answering the question of which rules need to be used to coordinate knowledge development across the *entire world* is understandably complicated. Beyond the fact that coordinating people is hard, knowledge itself is a non-standard economic good. Knowledge is non-rivalrous. When I read a book. Anyone else can still read that book. Knowledge is never really consumed thus it isn't scarce (Maskus, 2000). Further, when I read a book, I gain more inspiration and evidence to write a new book. Knowledge isn't just not scarce, it's **anti-scarce**. When anyone consumes knowledge, it produces more knowledge. Despite it being anti-scarce, the resources needed to make that book are scarce. It is essentially free for me to read a book, but it is very difficult for someone else to write that book.

We find a crux. The Open Knowledge movement sees the non-rivalrous and anti-scarce nature of knowledge as evidence for sharing it freely, but it currently ignores the true cost of knowledge production (Clarke, 2001). Our current intellectual property system tries to resolve the difference between the cost to consume knowledge and the cost to create knowledge by forcing us to pay to get access to knowledge. In this process, they barred people from gaining the knowledge needed to make new knowledge production. Neither of these solutions sufficiently solve the economic dilemma of knowledge.

[1] I use this term to refer to various 'Open' movements such as the open source software movement, open science, and open innovation

These aren't only the two options, however. Adjacent and sometimes as an alternative to these movements, various organizations have begun creating microcosms in which the organization both supports individuals to create high-quality knowledge and shares that knowledge. Online Creation Communities (OCCs) like Wikipedia (Glott et al., 2010), organizations like Enspiral Ventures (Enspiral, n.d.), or service economies like Filecoin (Filecoin, n.d.) each share knowledge freely to anyone who would like to access. Through this process they manage to create a global resource of commonly-held knowledge, or the global knowledge commons, while also sustainably running a business.

Despite the emergence of groups that use collaborative governance to bridge individual and global levels of analysis, the literature has largely focused on how to create these knowledge commons by incentivizing the individual. Various movements have blossomed around how we might best use crypto currencies to pay individual contributors small dividends for their work (Protocol, 2020), connecting contributions to a permanent digital identity to gain individual social capital from them (Weyl et. al., 2022), or creating stronger internet norms for open source contribution. Even when considering organizations, these literatures reduce businesses to 'individuals' that gain or lose as a unit from sharing in the global commons (Pénin, 2007). Ultimately, this has left a gap in our understanding of how businesses act as multi-dimensional agents[2] which bridge the gap between individual incentives and organizational support when contributing to the global knowledge commons.

Thus to fill this gap I aim to systematically explore strengths and weaknesses of the internal structure of two organizations that have reshaped their incentives and collaborations to better contribute to the global knowledge commons by sustainably managing a monetary resource to support the people developing knowledge creation, developing a quality assurance mechanism for knowledge, and sharing all that knowledge freely.

The rest of the paper will be organized as follows: An exploration of the current IP system vs the Open Knowledge Movement, a deep dive into Knowledge Sharing in Organizations, and then conducting two case studies on Enspiral and Filecoin and

[2] I use the word agents throughout my paper to refer to entities which have the ability to take a verifiable action. This doesn't constrain agents to be sentient or an individual.

finally a discussion section where I suggest next steps in developing more actionable knowledge management systems and the limitations of my approach

IP vs Open Knowledge

The traditional IP system and Open Knowledge contradict each other, but they ask the same question. How do we regulate knowledge when it is a **commonly held resource** (Hess & Ostrom, 2007)? This definition belies how high quality knowledge requires past knowledge, but by sharing knowledge, it is subject to the failures of the relationships and regulations that surround it. Both of these systems recognize that to avoid a 'tragedy of the knowledge commons'[3] We need to create rules around this resource.

Ironically, these two movements attempt to optimize for very similar outcomes.

For the open knowledge movement fully sharing knowledge would lead to the following outcomes:

- Increase democratic participation in knowledge creation (Jordan et al., 2003; Bollier, 2007)
- Accelerate the rate and quality of innovation (Ramakrishnan et al., 2021; Nonaka, 1998)
- Create a more resilient and sustainable knowledge economy (Ricciardi et al., 2021).

And for the IP system they believed that by incentivizing knowledge creation through exclusive rights to knowledge distribution they would:

- Increase participation in knowledge creation
- Accelerate the rate and quality of innovation
- Incentivize a robust knowledge economy.

The difference isn't in the problem these movements try to solve, or the objectives they're optimizing for, but in their implementation of the solution and how close they come to reaching their joint goal.

[3] Throughout the paper, I will refer to the Knowledge Commons as the knowledge we hold in common that we want to regulate

The IP system has taken us far. This system has incentivized knowledge and ensured that some people are adequately compensated for their work. However, recently instead of incentivizing equitable knowledge markets that gave anyone a chance to develop knowledge, IP has begun become a method for litigation over innovation (Burstein, 2015), reinforced power structures, provided regulation for *creating* knowledge monopolies (van Pottelsberghe, 2009), and made it difficult for any but the socially, materially, or intellectually wealthy to gain access to knowledge. Market failures around the system have proliferated, producing a movement of considering how else we might organize our knowledge sharing system (Andersen et al., 2010).

The Open Knowledge Movement was created as a reaction to the perceived system failure. Recently, Open Knowledge has similarly begun stimulating the knowledge economy. The Open Science movement provided the infrastructure for global effort to resolve the COVID-19 pandemic through data sharing and pre-prints (Watson, 2022). Within Open Source Software, Open Innovation, and the maker movement (Smith, 2020) we see rapidly growing repositories of data, code, or open access product that would previously have been considered individual intellectual property protected behind patents and non-disclosure agreements (Bauwens & Kostakis, 2014). Despite this improved access, the Open Knowledge Movement seems to similarly fail at its own goals despite entirely restructuring its method.

One key limitation is the systematic misalignment of incentives of individuals with the common good (Sharma & Bhattacharya, 2013). The Open Knowledge movement currently works on the margins. No one is getting paid to share their knowledge, thus making them much less likely to do so. Especially in the context of a competitive business landscape in which sharing knowledge is likely to lead to other agents in the system undercutting their business model. Secondly, if you eliminate the payment for knowledge, you similarly often eliminate the checks and balances required to ensure the quality of the knowledge. Peer review is a controversial method for ensuring scientific quality, however, its existence does represent a mechanism for ensuring that knowledge is checked and double checked before being relied upon as truth (Kelly et al., 2014). Despite the Open Knowledge Movement claiming that more eyes or access to information will ensure that open papers will be verified, empirical results have found little evidence that open papers are evaluated for quality more than traditional mechanisms, or at all (Berberi & Roche, 2022). Finally, because there are few substantial monetary incentives, only those who have the time and capacity to participate due to their personal preference or emotional satisfaction participate in this

system. This limitation contributes to systematic biases in who creates the knowledge. We see this in the disproportionate amount of Open Source contributors who are men (around 90%) or non-minority groups. In open source, every single minority group excluding LGBTQ+ individuals are underrepresented in the Open Source space (Grzegorzewska, 2021). We see these patterns repeat themselves across the open internet at Wikipedia, in Flickr, and other OCCs (Fuster-Morell, 2014). These replicated power structures indicate that simply opening the gate to knowledge *is not* sufficient to create a sustainable knowledge commons that increases access to knowledge as the Open Knowledge movement and the traditional IP system attempts to do.

The reality of the failure of both the current IP system and the Open Source Movement reinforces the definition of a commons as 'a shared resource that is subject to social dilemmas.' (Hess & Ostrom, 2007) Right now, the IP system tried to solve the 'social dilemma' portion of the definition by eliminating knowledge sharing. But instead they reinforced have reinforced inequalities making it difficult for many people to create knowledge. And the Open Source Movement is fighting to make the resource fully shared, but hasn't managed to resolve the resulting failure to evaluate knowledge or the systematic exclusion of various groups.

Knowledge Sharing in Organizations

The final unique characteristic of knowledge that in part causes its non-rivalrous nature is how the creation of knowledge is a largely social practice of combining and actualizing past knowledge.

Despite the inherently social nature of knowledge production, current solutions are largely considered at the individual or country level. The 'Web3' space - or the internet built on decentralization through the blockchain instead of centralization around corporations - often sees micro-incentives as a potential solution to knowledge dilemmas. In a perfectly considered blockchain ecosystem each publication to the blockchain or service in the ecosystem can be evaluated and each agent can be incentivized or disincentivized each time they contribute to the system. Thus we could include an automatic system for incentivizing contributions, but it would also incentivize review of code or documents, comments on past work, and linking to other relevant work (Protocol, 2021). On the other extreme, Open Science often leaves much of the funding up to the government, grant agencies, or universities. While each of these

lines of research and funding mechanisms are essential for determining how we might support individual contribution to the global knowledge commons, this literature ignores the multi-faceted nature of organizations as intermediaries.While both of these levels of the commons are essential - incentivizing individuals, and finding funding for these incentives - they lack a clear regulatory mechanism for defining effective rules of a common resource. Currently, we explore what we might incentive people with, but we don't explore the agents who ensure that those incentives are pointed in the right direction. Similarly, by abstracting funding away to institutions, we eliminate the problem of determining which projects are funded, because they are funded by entities that already have set objectives like academic journals or universities.

This literature largely ignores the organization as an agent of regulation which brings people together to contribute towards a knowledge commons. Without considering the organization we have found that to collaborate and to create knowledge we need to develop cultures around knowledge sharing (Kosmynin, 2022; Shuhuai et al., 2009) and better knowledge management tools (Lutters et al., 2001; Rozenfeld & Eversheim, 2002) but the literature hasn't successfully established how organizations might form these cultures or define these tools.

The literature that does consider the organizational level, explores worker cooperatives on the theoretical level (Bauwens & Kostakis, 2014), as a mechanism for increasing democracy (Cheney et al., 2014), or the types of knowledge that may be created through commoning (Ramakrishnan et al., 2021). However, when it has considered knowledge communities (Fuster Morell, 2014), it hasn't systematically explored the practices of the organization that reinforce the maintenance of the commons and largely hasn't considered how the organization may act as an agent that brings many people together to create quality-controlled, and representative knowledge through supporting collaborative practices.

Case Study Methodology

Choosing the Study Design

The goal of my research is to understand how organizations have managed to create structures in which they can support their contributors and curate high-quality knowledge capital for the benefit of the global knowledge commons. As noted in my literature review, these criteria are not typically jointly satisfied. This leads to

1. A small sample size of organizations who have successfully managed to meet these criteria
2. A low resolution understanding of the conditions which make it possible for these criteria to be met.
3. A lack of research into organizations that seem to successfully meet these criteria.

Following from these three conditions, I choose to use a case study approach (Crowe et al., 2011) to understand the extensive context around these organizations. The first condition makes it difficult to obtain sufficient quantitative data to compare these organizations because quantitative research has difficultly seeing the interactions between variables with limited sample sizes. A case study approach responds to the second condition because by choosing cases, I can produce research that systematically tracks the rules, relationships between agents, and defined goals of the organization and create an internally valid picture of ways that some organizations have managed to create their current outcomes. Finally, because these cases have not been explored in relation to their satisfaction of these three criteria, I will conduct these case studies as a plausibility probe (Thomas, 2011) to determine if further research into the structure of these growing organizations is essential. This goal will inform my methodology to be *exploratory and exhaustive.*

Choosing the Organizations

Responding to the case study purpose chosen above, I largely used a constraint satisfaction method. I needed the organizations to satisfy the following three criteria.

1. The organization must have consistently contributed to the knowledge commons while also continuing contributing to their member contributors.
2. The organization must publish their operating rules and practices so I can accurately assess the organizational structure.

3. The organization has been sustainably contributing to the knowledge commons over a significant period of time.

I chose these three criteria was because they ensured that the organization I considered covered the criteria mentioned above. They contribute knowledge, they have a way of ensuring that the knowledge is useful, and they support the knowledge creators. I added the final criteria of stability over time because it was a more effective external measure of success. If the organization has managed to continue within this open paradigm for several years, it is more likely that their structure is resilient to potential shocks, and thus a better example to understand the differences between their structure and other organizations structure.

After I choose my cases, I determined that I will analyze these studies as both deviant cases and maximum variation cases (Flyvbjerg, 2006). The cases I choose both constitute deviant cases because counter to most open source organizations or traditional organizations they manage to sustainably share all of their knowledge openly while still paying the contributors to their projects. And they are maximum variation from each other because when selecting the two cases I choose them based on how different their intentions were as a method of increasing the external validity of my study, so while they both meet the criteria I have set above they both have at their core very different use cases.

The characteristics of these cases act to set up my analysis as a method for discovering which variables should be further investigated as causal variables in creating sustainable and open organizations.

Institutional Analysis and Design Framework

Informed by my exploration of Elinor Ostrom's research into common resources (2005) and shared resources, and the need for my methodology to thoroughly explore these organizations I choose to use her Institutional Analysis and Design Framework (IAD) (Figure 1) for the methodology of the case studies.

This framework has often been used when exploring open organizations (Fuster Morell, 2014; Ramakrishnan et al., 2021; Smajgl et al., 2009) and is most often applied when trying to gain a systematic understanding of how an organization is collaborating around a shared or a common resource. It specifically provides framework for evaluating how many different potential causal factors might work together to structure

how agents interact as they are determining how to allocate or define joint resources or knowledge. I choose to use this framework because it met the constraints of considering common resources, emphasizing the interaction of agents within the system, and providing a framework through which I might be able to systematically evaluate the rules and practices of the organizations I choose to consider.

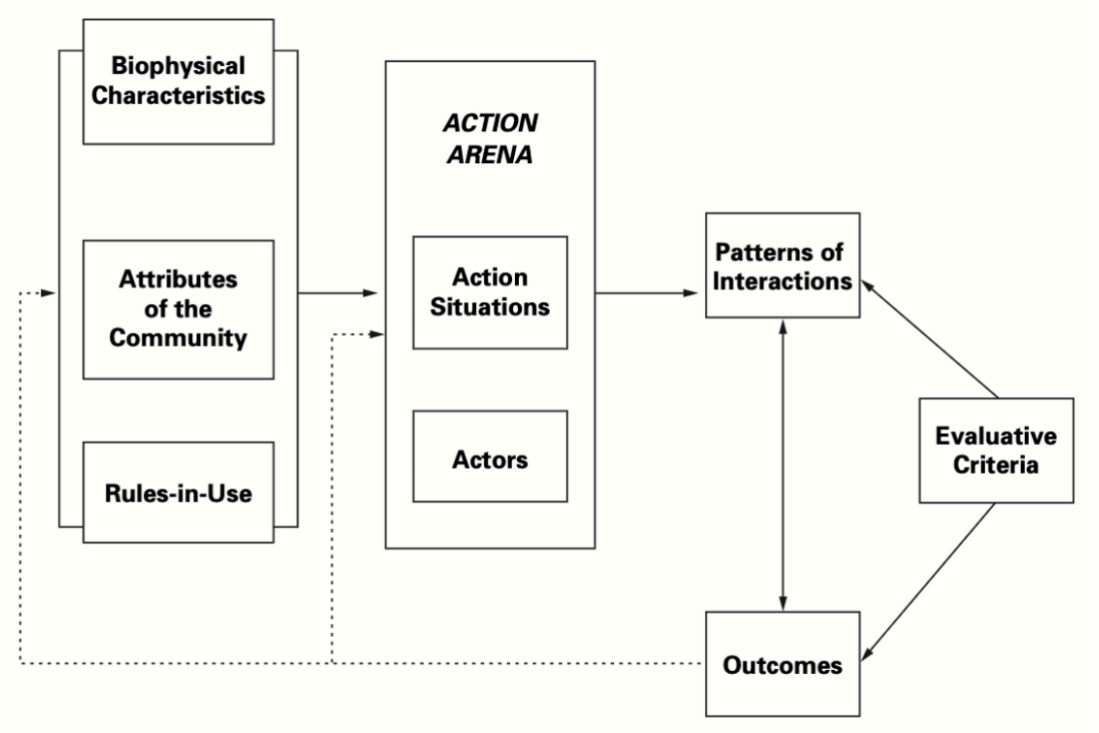

Figure 1: The IAD framework capturing the three discrete steps of institutional analysis. On the far left, the traits of the community itself, in the middle the action arena where people decide how to manage their common resources, and on the right the patterns and outcomes that come from the combination of the situation traits into the action arena. (Ostrom, 2005)

The IAD framework captures three broad areas of consideration.

The characteristics of a system. According to the IAD, each interaction between the agents you consider in your case study is defined in part by the system that already

exists. In order to know how any interaction might go, we need to evaluate the broader context. To do this the IAD breaks up this context into three key areas.

1. Biophysical Characteristics - these characteristics define the resource that the community is sharing. These characteristics can include how the resource can be shared, the limits of the resource, and it's status as an economic good.
2. Attributes of the Community - this focuses on the community using the resource and considers the scale of the community, the needs of the individuals, and their positional relationship to the resource and too each other.
3. Rules-in-Use - these rules are set in place by the community, or by external agents and they determine how the community will interact and make decisions around the resource.

The action arena. This is the second portion of the IAD and it is enclosed in a box in the center of Figure 1. The action arena is a situation in which actors are placed within the action situation

1. Actors - the individuals or groups that need to make a joint decision about the resource they're sharing.
2. Action Situation - The decision the actors need to make. This situation is structured by the attributes considered previously. To make this clear, if I want to buy a fish, I can enter into an action situation with a fish seller in which we must negotiate how I will get the fish. The law puts up one wall of the 'box' - I cannot steal the fish. The characteristics of the community, might put up another wall, in some countries I might barter with the fish seller. Finally, biophysical characteristics the fish the might put up another barrier - if I live in a landlocked city without access to a ready supply of fish, fish might be expensive, or only sold in certain stores. Each of these factors put up walls that constrain how I will behave and the expensive, cheap, sea, fresh water, or other fish that I leave the action situation with.

The results of the action situation. On the right we see the results of the interaction in the action arena.

1. Patterns of interaction - These are habits created from how actors interact within the constraints of the rules-in-use they have set for themselves, the biophysical characteristics of the resource, and the characteristics of them as a community. In

game theory this might be called the strategy that is taken in the action situation to achieve an outcome.
2. Outcomes - The outcome is the payout or physical result of your interaction. It answers the question - how was the resource allocated?
3. Evaluative Criteria are the rules that determine if the outcomes are 'good' or in the direction that the community wanted.

One of the most clear benefits of this structure for understanding communities that surround a common resource is the clear consideration of the community itself, the formal and informal rules in use, and the unintentional or intentional patterns of interaction that are developed. These frameworks are essential for deeply understanding how the cooperatives organize their internal knowledge and resources such that they can contribute to the knowledge commons.

Importantly, a single interaction between individuals around a common resource isn't particularly interesting. However, to return to the fish analogy, when you add all of the times that anyone interacts, we can understand all the different walls that constrain everyone's actions, and we can begin to get a sense of how the fish market 'works'. This more holistic analysis of interactions can show the ruts that we humans form for ourselves and we can both observe and begin to predict future outcomes based on these constraining walls.

I will use these three main components to structure my case study. I'll begin by defining and describing the monetary and knowledge commons that each organization has developed. I'll then define the community and the rules-in-use by systematically going through their published materials and rules and including all relevant relationships. I'll then describe how decisions are made around the common resource and evaluate how these decisions currently lead to the outcomes I have defined either congruent with or incongruent with these rules.

Finally, I will evaluate the outcomes of the organizations based on Ostrom's theory of commons governance (Ostrom, 1990). 'Governing the Commons' was Elinor Ostrom's theoretic approach to understanding how a common resource could be jointly managed by a community to create increasing returns. This concept countered the prevailing paradigm developed by Hardin (1968) which claimed that any commonly held resource would inevitably be over-exploited. This reformulation provides both optimism and the tools for successfully managing a commonly held resource.

Within her book, Elinor Ostrom used her Institutional Analysis and Design framework (IAD) to develop several case studies and form 8 principles of commons governance:

1. C*learly defined boundaries:* The resource needs to be defined in a way that you can determine how far it can be appropriated.
2. *Congruence between appropriation and provision rules and local conditions*: You should only be able to extract from the resource as much as is sustainable for the resource, while also ensuring that each person has needs met.
3. *Collective-Choice Decision Arenas*: There must be some mechanism for determining the rules that everyone will follow while including everyone.
4. *Monitoring:* Either the people participating in the resource extraction or some trusted external agent must ensure that regulations are being followed.
5. *Graduated Sanctions*: In the case of violations, punishment should be variable to the extent and repeated nature of the violation.
6. *Low Cost and Readily Available Conflict Resolution*: In the case of disputes, the cost of resolving these disputes should not be costly.
7. *Right to Organize*: The people sharing the resource must recognize that they also have the autonomy to develop new organizations.
8. *(When Applicable) Nested Levels of Organization*: In the case of large resource sharing situations, nested levels of governance are essential to maintain individual autonomy.

Each of these principles are a core part of what forms success for a community trying to organize around a common resource. While the original literature was formed around physical commons, in 2007, Hess & Ostrom published a book further developing what it looked like for Knowledge to be a common resource. This book began a conversation on how we might develop the tools to adequately regulate knowledge.

This structure and methodology effectively provides me with the tools to first explore many of the relevant variables in each of the organizations, the relationships between them, and finally a framework on which to evaluate the results of the study. Thus using this methodology I hope to answer the puzzle of how these organizations create microstructures that pay people to create knowledge, while sharing high-quality knowledge freely.

Case Study 1: Enspiral

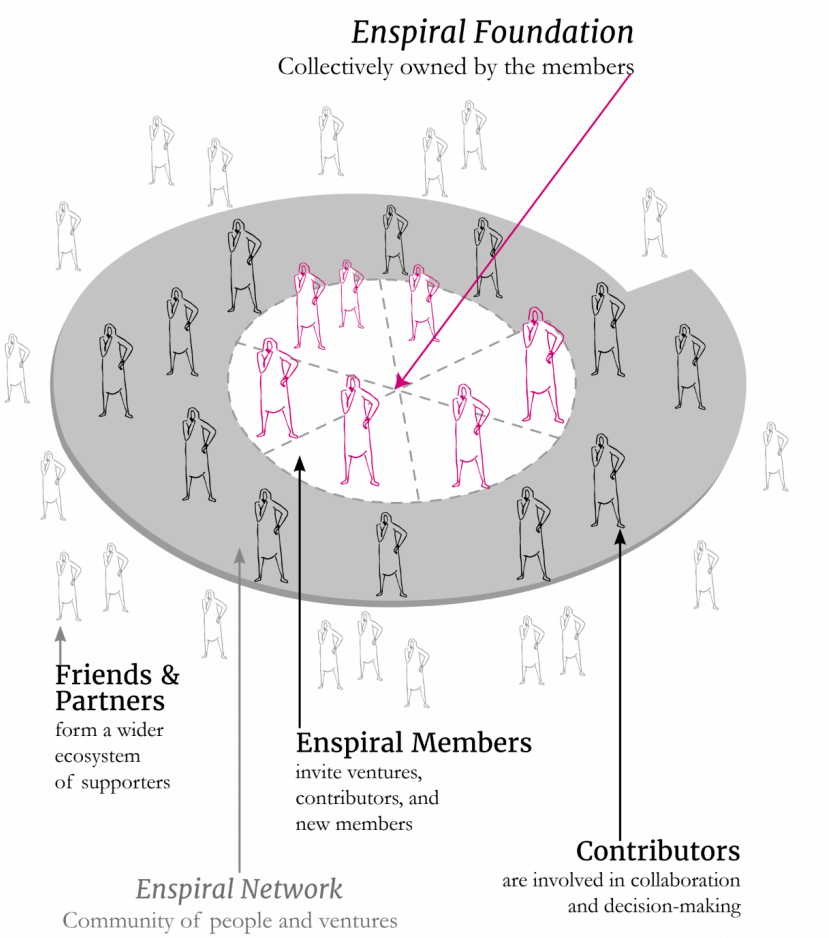

Figure 2: A figure from Better Work Together (Cabraal and Basterfield, 2019). This describes the levels of involvement in the Enspiral Network. It represents how the network is largely socially defined.

In 2010, Joshua Vial decided he didn't want to spend four days of his week extracting money just to push the work he really cared about into the remaining time. So, he turned his consulting company into the cooperative now known as Enspiral (Cabraal & Basterfield, 2019). Since that moment, Enspiral has grown from a small collective of consultants coworking together to a network of 26 members and 124 contributors by 2020 (Bevensee et. al., 2020).

Today Enspiral is bustling and is sustained largely by members and contributors who each contribute a portion of their income to the collective resource pool. With those resources anyone can propose to make something new. Together the members jointly manage monetary resources and have spun off around 8 ventures or independent companies and various other intiatives (Our Ventures, n.d.). These ventures and projects that have come out of this structure range in application from collaborative governance platforms, software for sharing commonly held monetary resources, and an activism platform that helps activists mobilize large groups of people.

To understand how Enspiral has continually supported new projects and released high-quality knowledge for free, I define and analyze how they jointly manage their money and their knowledge resources.

Biophysical Characteristics of the Money and Knowledge Commons

Enspiral is oriented around many common resources including skills, client relationships, and sour dough starters. I aim to understand how the community remains monitarily successful despite or because of sharing open source knowlege, thus I will explore their shared monetary and knowledge resources.

I will first categorize each of these resources by how easy it is to exclude someone from using the resource, and the degree to which the resource is non-rivalrous.

In Enspiral, their monetary resource remains accessible to everyone who contributes to it, but no one else and use of any portion of that money reduces the potential for other members to use that money. In general, money is highly excludable, and rivalrous. However in this case, because the monetary commons is being paid into by a group of people who are inputting into that resource in order to guide it, this resource is only partially excludable. Thus this monetary common is a common-pool resource, but it is easily exhaustible and susceptible capture by a single party. Because of these risks, clear monitoring and a constant understanding of the flow of the resource into and out of the common pool is essential to ensure the sustainability of the resource.

Knowledge within Enspiral, however, is not limited and anyone can use the knowledge outputs that Enspiral creates. And similarly, it is not exhaustable. Anyone can use that knowledge without limiting further access to that knowledge. However, this knowledge

represents their organization and is a source of income for the organization. This means that while knowledge can not be ‘exhausted’ it’s value to Enspiral can be significantly reduced by low quality outputs, or by a failure to continue funding ongoing outputs. Similarly, while the knowledge can’t be ‘captured’, the value of the knowledge can be captured by a single entity despite the collective funding it. This means that the highest risks for the knowledge commons is poor quality outputs, lack of outputs, and exclusive benefit from the knowledge.

The core relationship between these commons is represented by the transformation of monetary resources into knoweldge outputs. Thus the knowledge commons is guaranteed continued development by investment of the monetary commons, and the monetary commons can grow largely in response to outputting high quality resources. This reciprocal relationship then requires both of these commons to be effectively managed in order to ensure the mutual success of the other.

Attributes of the Community

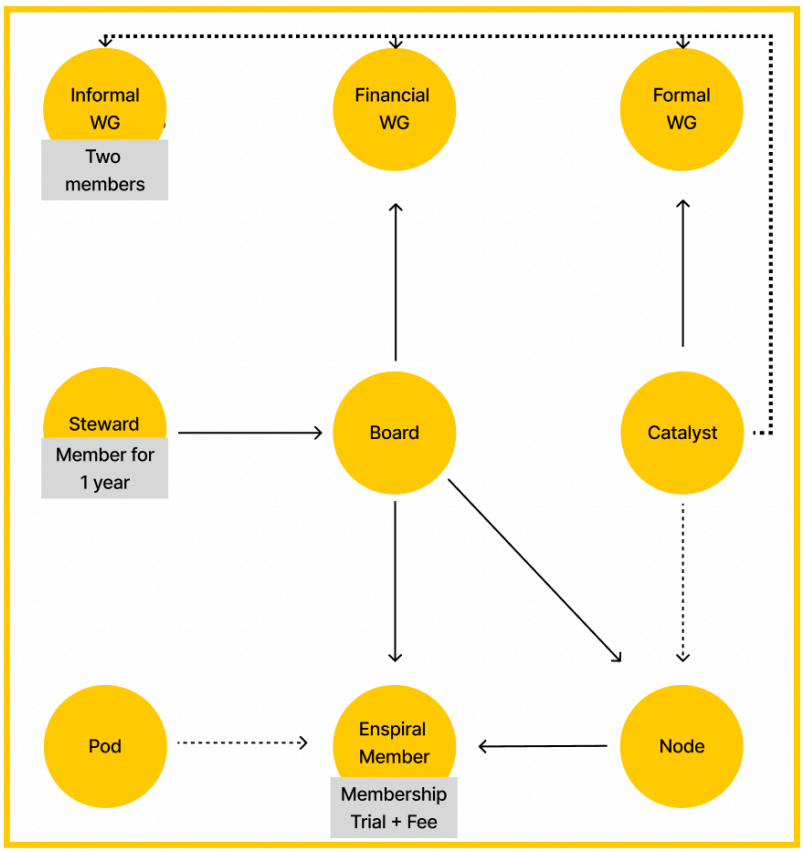

Figure 3: Yellow circles indicate various membership groups within the Enspiral organization. Grey boxes indicate enforced requirements to be a part of the associated groups, if there is no grey box, the only requirement is to be an Enspiral Member. Solid arrows indicate regulatory relationships where one group can control who is able to be a part of the group on the end of the arrow. Dotted arrows indicate support relationships where one group provides educational, financial, emotional or professional support to the group on the end of the arrow. The Yellow box indicates that all of these relationships are happening within the organization. WG stands for working group.

Figure 3 represents how agents within Enspiral are organized and relate to each other. The types of agents within Enspiral are builders, regulators, and supporters. Builders are those actively creating projects to support the network, regulators are those ensuring that the prescribed rules are followed, and supporters aim to provide emotional, monetary, or technical support to builders or individuals within the network.

Within the network overall, there are 3 formal support-based relationships and 6 formal regulatory relationships.

The board has the highest number of regulatory arrows going out of it at 3 solid arrows. This represents their role as the elected regulators of the Enspiral Commons. Despite this power, the board is accountable to the members through the Foundational Stewards which are made up entirely of self-elected members who have been part of the network for greater than one year. In addition, board members are all made up of members who have achieved the requirements of becoming an Enspiral member. This requirement is different than the typical corporate selection of board members who are either brought in as professional business people or people who have a significant financial stake in the company independent of their relationship to the organization.

Catalysts on the other hand have the most support arrows going out from them with dotted arrows going toward four of the other actors in the network. Represented in the diagram are two types of support relationships. Catalysts are responsible for supporting work that is going on in the network, while pods[4] are responsible for supporting individuals on any dimension determined necessary by the pod. This can include monetary support, emotional support, professional support, or other types.

To enter the network, everyone must overcome the base barrier to entry which includes an invitation to the network by the board or a node[5], a successful 4-month membership trial, and paying a membership fee determined by the board. At this point, members are eligible to participate in financial and network decisions and participate and gain benefits from the support structure of the network. And in the case of foundational stewards, they must also be members for at least a year before electing to become a steward.

Each of the arrows here represents a personal relationship. Core to Enspiral's narrative is that *their business is the people*. Thus we see that Enspiral has worked to develop both a culture and a structure for support. They have developed a culture of support through practices like meeting check-ins which provide a space for everyone to speak at the beginning of a meeting, hand gestures to create a space for contribution without the friction of disruption, a clear description of who and how to include relevant individuals inappropriate decisions, and a precedent for clear and open communication throughout their handbook. Structurally, this ideal of caring about the people is represented by the diversity and accessibility of support that can be found in the pod and catalyst roles. Each of these roles are support roles. Pods provide support in any way that the pod

[4] Pods are groups of 3-5 people in the Enspiral network chosen by the members.
[5] Nodes are formal entities within Enspiral made up of Enspiral members who are pursuing a joint initiative. They define their size and mission and may request funds from the network.

might define this, including pooling monetary resources, emotional support, and buisiness support. A catalyst is specifically a support structure for people who are building professional outputs within Enspiral. In addition, Enspiral has developed spaces like Loomio (an online decision-making software) and Cobudget (a way to manage joint funds) that ensure all organizational decisions both include everyone who is relevant and provide transparency for everyone in the organization. Overall, both the regulatory and the support-based relationships in Enspiral are retained through personal interactions and an ethic of ensuring that each person is engaged and able to be heard in decisions that pertain to them. In the following exploration of the formal rules around monetary resources and knowledge resources, I will call back to the nature of these personal, support-based, and regulatory relationships as the motivation behind the current structure.

A core simplified understanding of the economic model for this common can be seen as a network profit model in which joining the network I show in figure 3 is the value proposition of the organization. Enspiral runs by having members pay to gain access to their commons. In this case we see that the **Fee to join the network > Economic Return.** Thus, a member is likely to spend more money within the network than they were to if they were alone given the greater amount of money spent on projects than returns from those projects (Bevensee & Buck, 2020).

However, because each member still joins and maintains connections to the network despite having very low cost of leaving it indicates that the **Fee < Benefit.** And from above and in the following exploration I will show how this network provides benefits including **resources for projects + agency over collective capital + access to collective capital + social and support benefits.**

Rules-in-Use for the Financial Commons

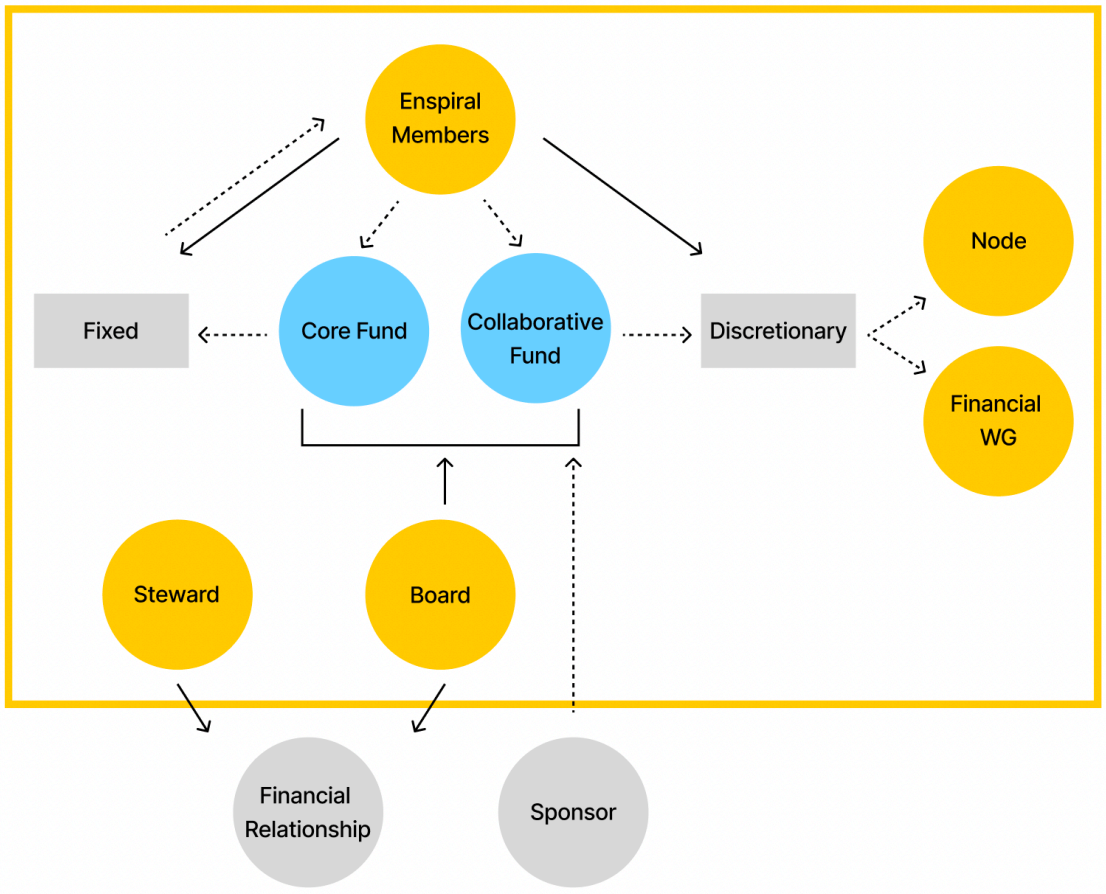

Figure 4: Yellow circles indicate various membership groups within the Enspiral organization. Grey boxes indicate types of spending that are regulated by the members. Solid arrows indicate regulatory relationships where one group can control other groups or the ways that money is spent. Dotted arrows indicate support relationships where the actor or the fund monetarily supports the entity at the end of the arrow.

Figure 4 represents the set of operational rules and relationships that govern how the collective funds are stocked, distributed, and maintained.

There are two funds defined in Enspiral as the Core Fund and the Collaborative Fund. The core fund goes towards the fixed and recurring costs of the organization and is paid by into Enspiral membership fees by Enspiral Members. The collaborative fund is paid

into by external sponsors or by Enspiral Members. In this diagram I consider Enspiral Ventures (independent organizations that are part of the Enspiral Network) to be Enspiral Members as well and any contributions they give to Enspiral go into collaborative funds.

The topology of the network indicates that the Enspiral Member is most well connected to the monetary resource. They are the core beneficiaries of the funds, and in response gain autonomy over where those funds are allocated through the online platforms developed by Enspiral. The organization uses Loomio to determine where fixed costs should go such as getting joint services like Gsuite access. The second way they manage these resources are through Cobudget where collaborative funds are allocated. Each 6 months members, nodes, and other entities within Enspiral and collectively funded by members. In line with the narrative of care and mutual support, these funding rounds are open to any proposal from the community members. Support for catalysts who have helped the network, new projects, non-profit projects, or emergency support can be funded as chosen by each of the members in the network. Thus these structures, tools, and practices ensure that all members have a say in where collective and fixed funds should be distributed.

On the other hand, the Board has regulatory power over the funds, but not where the funds are allocated. The role of the board is to ensure that there are sufficient funds to sustain the network for 12 months at any given point. To do this, the board sets member fees, manages external financial relationships, and monitors the funds. Bringing in the regulatory relationships from above, the board members are held accountable to distributing funds to the appropriate locations by foundation stewards, ensuring the access to the common pool doesn't centralize the monetary power of the collective pool in the hands of the board.

Through these rules we see that the monetary resource is treated as another mechanism for supporting other individuals in the network and thus Enspiral's monetary 'business' model is to ensure that the benefit of the network - not just monetarily but collaboratively - are greater than the perceived cost of being part of the network.

Rules-in-Use for the Knowledge Commons

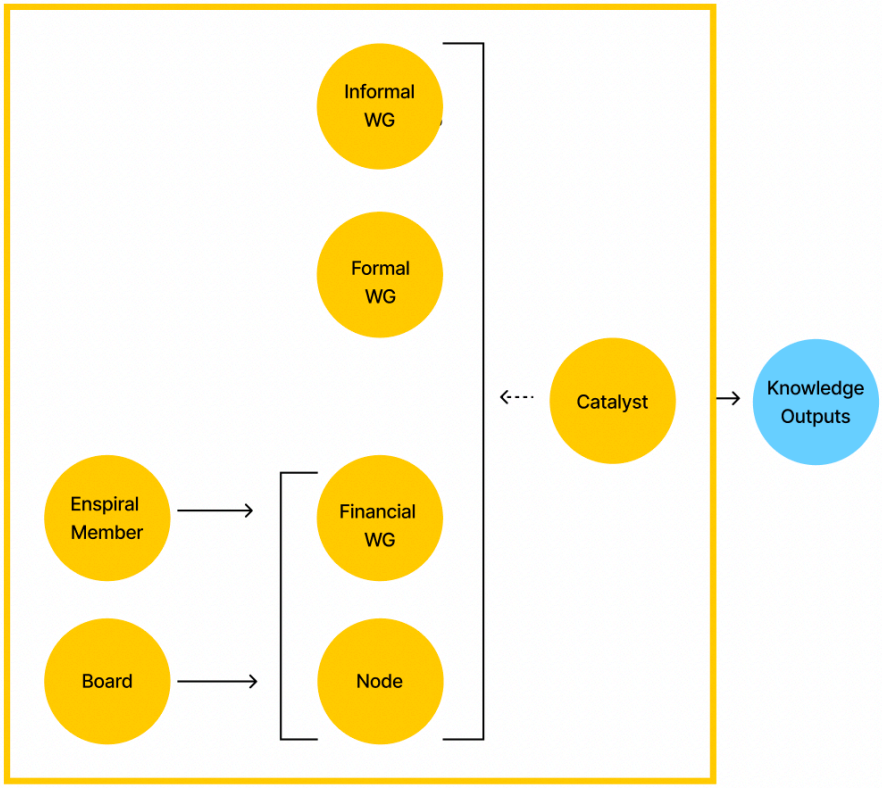

Figure 5: Yellow circles indicate various membership groups within the Enspiral organization. Solid arrows indicate regulatory relationships where one group can control other groups or the ways that money is spent. Dotted arrows indicate support relationships where the actor supports the actor at the other end of the arrow monetarily or educationally.

Figure 5 represents multiple filters through which the knowledge outputs of Enspiral must pass before being shared into the global commons. First, any knowledge that requires monetary support must meet both the criteria of the community, and the criteria that it will not threaten the common resource in order to gain funding. This initial filter ensures that within the organization only convincing projects are able to be funded and the additional social information that each person has about the actualizers of the projects ensures that 'bad actors' who might propose a project and fail to follow through in bad faith are easily discoverable.

In addition we see that each of these groups, once approved, are required to keep an ongoing update of their work to the network and to the catalysts and the board. The catalyst is a role that has been created to serve as a support network for each of these knowledge outputs. Thus the catalyst helps each team organize and develop their product such that it is contributing to the organization and in line with the groups intentions.

Outcomes and Patterns of Interaction

Here I'll describe the outcomes as defined by my criteria for a successful organization: Sustained, High quality, and Free knowledge. And I will also synthesize the core patterns of interaction that I have observed which reinforce these criteria. These patterns, rules, and characteristics are summarized in Table 1 below.

First, Enspiral balances the inputs and outputs of both their monetary and knowledge commons.

On the monetary side this balance between input from the members and investment into knowledge creation means that the current network has continually grown over the past 10 years and now has a consistent monetary resource of $100,000 of which a part is allocated to crowdfunding each 6 months (Personal Communication). You can see how this balance is maintained through satisfying the rules for the commons above. More specifically, the profit model of only allowing those who pay a membership fee to access the monetary resource, the *distributed regulation structure* ensuring that the resource is constantly monitored by good faith actors, the *distributed income streams* as a freelancer's collective which means that which means they are less likely to fail all at once, a clearly *defined responsible monitoring body*, and *multiple technical and decision making tools* which allow them to include every relevant individual in a decision.

On the knowledge side, we can see a consistent output of quality knowledge resources in the form of continued ventures such as GatherIn a consulting service and educational group, DevAcademy a learning network, and Loomio, a collaboration software. The network regulates this resource through *high entry barriers* ensuring that only good faith actors can contribute, *multiple modes of support* to ensure these people are fully able to continue creating the things that matter to them, a clearly defined *responsible*

monitoring body and multiple *technical and decision making tools* which allow them to include *every* relevant individual in a decision.

Principle	Resource	Application
Clearly Defined Boundaries	Money	Only members can request funds Core funds and collaborative funds are separated for appropriate use Enspiral Members determine who gets to access funds
	Knowledge	Enspiral members create knowledge resources using funds allocated by the community The created knowledge/tools/etc can be accessed by all
Congruence between appropriation and provision rules and local conditions	Money	Funding is approved according to capacity determined by the board The funds and membership fees required to run the organization are defined by the board Funds are derived from individuals who have separate income streams
	Knowledge	Funds for knowledge creation is determined by the community Catalysts ensure that the proejct is high quality Pods provide a social resource to ensure members remain within their capability
Collective-Choice Decision Arenas	Money	Monetary resources are allocated using Cobudget Core funds are defined by Members using Loomio
	Knowledge	Projects are approved by the Members by allocating funding
Monitoring	Money	The board is responsible for ensuring sufficient funds Foundational Stewards (Members who choose this role) monitor the board
	Knowledge	Catalysts help support the quality of the knowledge resource The community of users determines quality of external facing resources
Graduated Sanctions	Money and Knowledge	There are no formal sanctions for poor use of monetary or knowledge resources Misuse of any resources are managed largely at the collaborator level Nodes and the Board can exclude members
Low Cost and Readily Available Conflict Resolution	Money	The Money Game, cobudget, and other money sharing practices reinforce a narrative of talking about conflicts around money Pods can be used for support through conflict internal and external to the system
	Knowledge	Open Communication practices provide precedent for individual conflict resolution Catalysts and Board members can be brought on as mediators
Right to Organize	Money and Knowledge	Each sub-level of organization is regulated by another level of organization providing the ability for each group to organize for their rights internally. Enspiral maintains legal accordance with New Zealand laws
Nested Levels of Organization	Money and Knowledge	The levels of organization are Enspiral Member, nodes and pods, foundational stewards, board, catalyst, or working groups. These groups are not mutually exclusive

Table 1: This table summarizes the informal, formal, and structural factors that are captured in my analysis above. It then relates them to each of the rules for the commons set out by Elinor Ostrom.

Finally, all of this knowledge on their platform and coming from their initiatives remains free. We see this largely because the network has eliminated the need for the knowledge to make money. Their business model requires individuals to pay to access the network which supports the continued development of the network creating a consistent pattern of contribution to the commons. Secondly, the members have a built up narrative about the importance of transparent and free information and a rich way of reinforcing that narrative through deep social ties which reinforce this informal rule.

Summary and Analysis

We see above how Enspirial implements the rules for the commons through the various factors I mention. Elinor Ostrom's principles are limited in that they only describe the 'what' of a common resource. Common resources need monitoring. But they don't describe the best way to go about this in various scenarios. Thus I hope to represent how each of the characteristics of Enspiral's resolution of this problem might be generalizable in the case of these common resources by understanding how each of their structures influence the two core risk factors for common resources - the risk of capture by a single agent, and the risk of resource exhaustion.

The variables I mentioned above that help mitigate the risk of capture which is when a single actor ultimately controls the resource can be summarized as:

- *high entry barriers*. These barriers ensure that no one who hasn't demonstrated good faith can enter the network and control resources. This could also create a 'monolithic' culture in which no one who disagrees with the network can join.
- *Multiple decision making practices and tools*. The multiple modes of interaction allow Enspiral to include nearly every relevant individual in a decision. This includes the relationships in pods, loomio, cobudget, synchronous meetings, and other practices of inclusion. These structures help ensure that everyone is aware of decisions that are being made when prevents a single group or actor from making hidden decisions.
- *Distributed regulation structure*. By ensuring that every body is regulated by another one Enspiral ensures that no single body would have the power to completely control one of the resources.

- *No requirement to share knowledge*. Enspiral has no formal rules to share knowledge freely, and thus far each organization has largely chosen to remain open. This means that any organization could gain funds from the network to create a proprietary knowledge resource.

These other variables help mitigate the risk of resource exhaustion by either ensuring the continued input of resources into the common pool or by making sure that resources don't leave too quickly.

- *Network profit model*. This model ensures that the knowledge being created doesn't need to provide money back to the collective.
- *Multiple modes of support*. While the knowledge doesn't need to make money for the collective, the individuals who are creating the knowledge and paying into the network need to remain healthy to be a part of the network. Within Enspiral they have structures like pods and catalysts which facilitate whole being and project wellness allowing each individual to be more resilient to challenges.
- *Responsible monitoring body*. The board is responsible for monitoring the resource which ensures that the resource is not depleted.
- *Distributed regulation structure*. The board while responsible for monitoring doesn't gain any more access to the resources than other members. This ensures that the resource isn't depleted for the hidden needs of the board.
- *Distributed income streams*. As a freelancer's collective, Enspiral has income streams from many different individuals. This likely means that any shock to an individual is not likely to affect the collective.
- *Small network*. This variable could either support or limit the exhaustion of the resource. Having a small network is more likely to fail to aggregate enough resources for the network to survive. However, it is more able to enact a truly distributed format which can prevent capture.

In summary, Enspiral has set up a network that has achieved the core criteria of my study - they provide a sustained resource of free, high-quality knowledge. However, the core risks for Enspiral lie in their small network size which can be more easily exhausted as a resource, and the lack of formal requirements to continue to share knowledge. In the case that resources become more and more scarce, the network could evolve towards maintaining more closed resources.

Case Study 2: Filecoin

Figure 6: A diagram put together by Filecoin describing the three layers of crypto-economics for the Filecoin network (Filecoin, 2020).

Filecoin[6] was launched in 2017 as a mechanism for creating a market to permit long-term storage of files stored using the InterPlanetaryFileSystem (IPFS) (Guidi et. al, 2022). The goal of IPFS was to create a cooperative, distributed, content-addressing framework to retrieve data from across the world. Currently, Filecoin acts as a cooperative storage cloud in which participants can contribute storage, their files, technical updates, or governing roles to the protocol (Filecoin, n.d.). Through these mechanisms, a community has built up around the protocol and its implementation of the core goal of creating a "useful storage network." In order to achieve this goal, they push for transparency, graduated trust, completely open-source code, community governance, and effective dispute resolution.

As a protocol, Filecoin aims to use the blockchain and a native cryptocurrency to create economic incentives which make storage more reliable and ensure a trustless storage solution. What this means is instead of needing to trust that a corporation will continue to store your files which promotes a pattern of storing files with the largest, most difficult-to-eliminate storage providers, you can store files with any provider without needing to trust that they will continue storing them because their activity will be tracked on an (essentially) immutable record. Using this mechanism and an internalized economic currency, the Filecoin community effectively creates costless reliability and a stable ecosystem that supports further developments to the protocol itself. These improvements are all released as open-source resources for the global knowledge commons.

To understand how the Filecoin Network has continually supported and paid for improvements to their organization and released high-quality knowledge for free, I define and analyze how they jointly manage their money and their knowledge resources.

[6]Filecoin has many distinct programs and legal entities which represent superstructures to the agents I consider. To distinguish these I use the following terms. The Filecoin Network describes all the agents I consider. Within the Filecoin Network, there are three superstructures: Filecoin is the organization where economic actors trade money for services, FIL+ is a social trust layer on top of Filecoin, and the Filecoin Foundation is the regulatory body of the ecosystem.

Biophysical Characteristics of the Money and Knowledge Resources

Similarly to Enspiral, I will consider the monetary and knowledge resource in Filecoin and each of these resources can be categorized on how easy it is to exclude someone from using the resource, and if it is rivalrous.

The Filecoin Foundation's monetary resources are both highly excludable and rivalrous. In theory, this makes it more of a private good, however, they have pledged much of their resource to open-source developers in the Filecoin Network, thus creating a joint resource. This resource is maintained by the success of the economic layer because it is made up of the increasing valuation that the Filecoin Foundation has as their holdings of $FIL. Thus managing the inflow of this common resource requires managing the success of the entire network.

Currently, the knowledge that Filecoin is releasing free improvements on the protocol that they use to regulate their network of storage providers and clients, however, the Filecoin Network also distributes all of its governance and procedural documents as well as educational materials on GitHub. Thus for their knowledge resource, they don't exclude anyone from it, however, they do define carefully who can make this resource by having a process for incorporating new requests to update the code and having a proposal process that determines which developer teams get funding for their work.

Attributes of the Filecoin Community

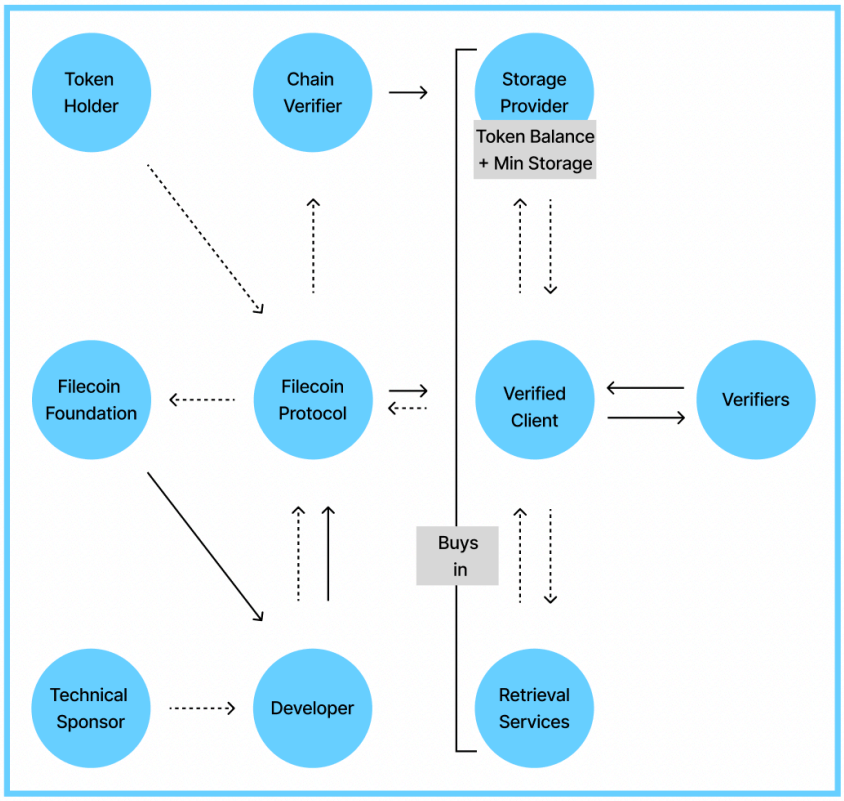

Figure 7: Blue circles indicate various agents within the Filecoin Network. Grey boxes indicate enforced requirements to be a part of the associated groups, if there is no grey box the only requirement is to satisfy the regulatory body attached. Solid arrows indicate regulatory relationships where one group can control the membership of the other group and/or can impose sanctions for bad behavior. Dotted arrows indicate support relationships where one group provides technical or financial resources to the group on the end of the arrow.

Within Filecoin the relationships between many agents are purely economically defined. I have created an aggregate agent of the three core value-producing agents within Filecoin because the value of the Filecoin Protocol is increased as a direct result of their economic interactions but not necessarily from their individual actions.

The Filecoin Foundation, the Filecoin Protocol, and Verifiers largely represent agents that regulate the network either through enforcing rules or through allocating economic incentives for good or bad behavior, while the Token holders, Chain Verifiers, and the constant economic transactions between Storage Providers, Clients, and Retrieval services provide monetary support for the network and Technical Sponsors provide

technical support to developers. Finally, we have the developers/knowledge creators who continually improve the service of the Filecoin Protocol.

The most connected node is the Filecoin Protocol itself. The protocol fully determines and enforces the relationships between the economic actors within Filecoin, by defining how monetary incentives are allocated for various services that don't take place between a client and the storage miner or retrieval services. Any support relationships are financial in any direction. This protocol is regulated indirectly through the community which has the power to suggest improvements to the Filecoin Foundation, and directly through the Developers who develop the improvements. Developers are fully regulated by monetary support provided by the Filecoin Foundation representing that Filecoin Foundation is the regulatory body of the Filecoin Protocol. All support-based relationships except for the Technical Sponsor are monetary. The Technical sponsor optionally provides services to assist projects that are working on the core functionality of the network.

Each of these arrows almost exclusively represents monetary relationships. The only exception to this is the Technical Sponsor who provides technical support, the Developer who provides updates to the protocol, and the verifiers who have powers such as adding and removing nodes external to the protocol itself. In addition, there is one dotted arrow flowing from the three nodes on the far right to the file coin protocol and that relationship takes place in biweekly community calls or in the issue system where any one of the economic stakeholders can submit improvement requests.

Part of the network profit model which informs the relationships within Filecoin is how they have defined the edges between each actor. Their core goal is to increase participation in the network because the benefit of the network and the value of $FIL is increased as more members join. Thus Filecoin has optimized to ensure that the only calculation that members need to make is the **cost of buying in ≤ benefit of the service.** The benefit of the service can be exactly equal to the stated benefits on Filecoin's website - ultra competitive prices for storage, high reliability through replication, etc. Thus an actor can make a purely economic decision to join the network.

Thus within the Filecoin network what makes sure that the common resource is constantly replenished is that the **fee < service provided** for clients, the **benefit > other options** for storage providers (which isn't difficult given that many of these storage providers previously wouldn't have had a mechanism of selling their extra

space). And the **increase in value > 0** for token holders and other investors who provide liquidity to the market. As a result, the Filecoin Foundation can focus on optimizing this set of equations to ensure the market is balanced which benefits them.

Rules-in-use for the financial commons

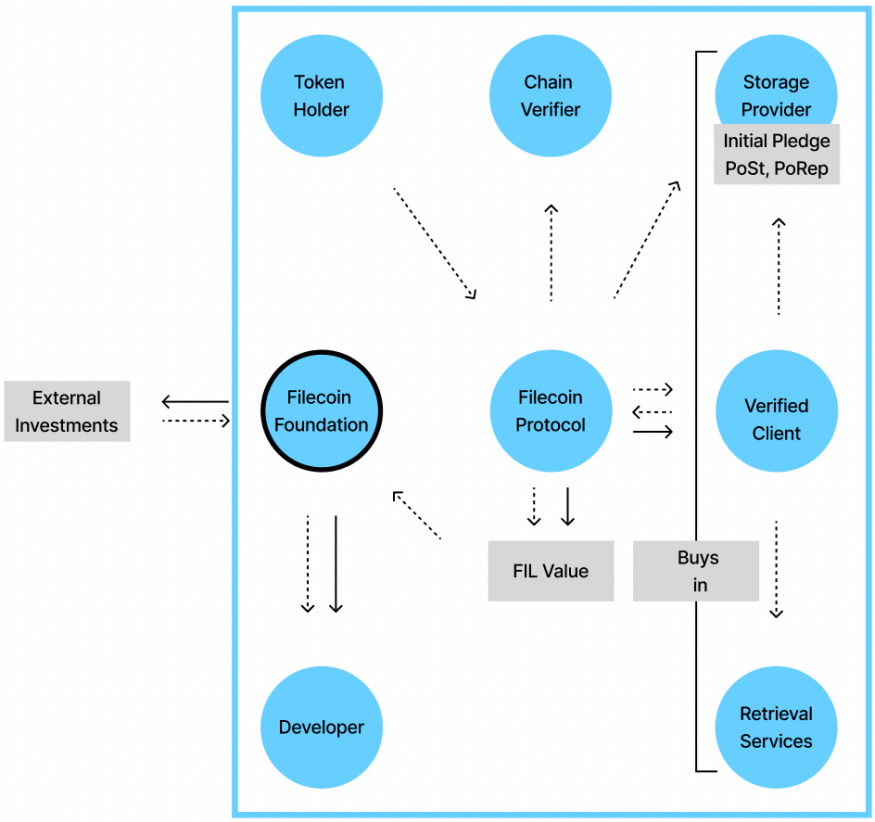

Figure 8: Blue circles indicate various agents within the Filecoin Network. Grey boxes indicate enforced requirements to be a part of the associated groups, if there is no grey box the only requirement is to satisfy the regulatory body attached. Solid arrows indicate regulatory relationships where one group can control the membership of the other group and/or can impose sanctions for bad behavior. Because we're discussing the accumulated financial resource, dotted arrows one group provides financial resources to the group on the end of the arrow.

This diagram represents the set of operational rules that govern how the Filecoin funds are stocked, distributed, and maintained.

The Filecoin funds are stocked via value inflation of the Cryptocurrency associated with Filecoin. Within the Filecoin Protocol, more coins are released slowly in relation to how much storage is on the Filecoin Network, and enough liquidity is maintained in the network. This ensures that the value of Filecoin is sufficiently scarce to increase in value over time. This increase in value then creates the funds for further development of the Filecoin Network because the Filecoin Foundation holds 5% of the Initial Coin Offering (Tepper, 2017) and an increase in the value of the coin increases its valuation. In addition, the Filecoin Foundation invests in other Web3 projects and ICOs to have a continual income.

In this case, the monetary resource is completely held by a single entity that has ultimate power over where those resources are distributed. I determine that it has ultimate power because there is no documented regulatory mechanism within the network. However, there are mechanisms through which the community can inform where the money is spent through Filecoin Improvement Protocols (FIP). These protocols are community-developed protocols that represent how the Foundation should allocate money to improve the network governance or the Filecoin protocol itself. In addition, if Filecoin were to allocate funds to projects that weren't supported by the community, the group could lose trust in the organization and stop contributing to the storage network. This gives them a collective but likely difficult-to-achieve mechanism for keeping the foundation accountable.

Thus we see that there is informal community governance of the funds created by their economic activity and by the process of submitting issues and proposals, but the power to allocate those funds is fully on the Filecoin Foundation.

Rules-in-use for the knowledge commons

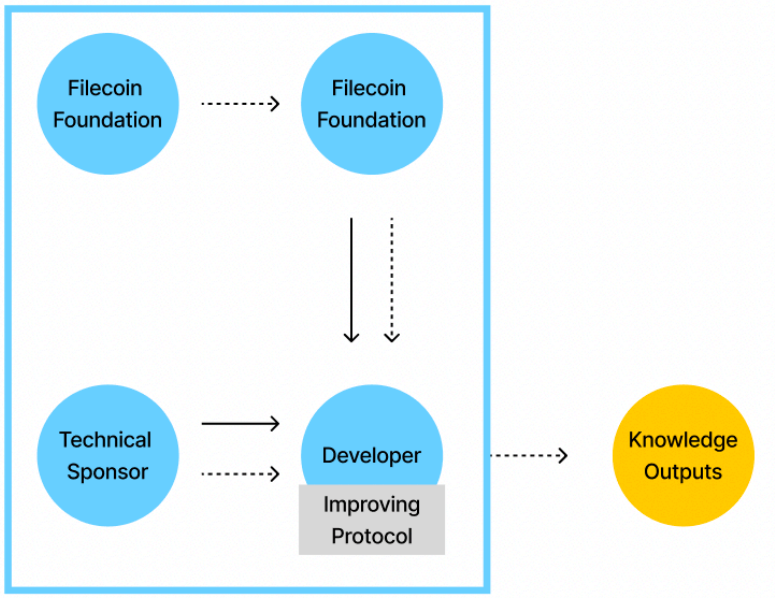

Figure 9: Blue circles indicate various agents within the Filecoin Network. Grey boxes indicate enforced requirements to be a part of the associated groups, if there is no grey box the only requirement is to satisfy the regulatory body attached. Solid arrows indicate regulatory relationships where one group can control the membership of the other group and/or can impose sanctions for bad behavior. Because we're discussing the associated knowledge outputs, dotted arrows indicate one group providing resources to the group on the end of the arrow based on the knowledge they're developing.

Figure 9 represents the required filters for knowledge to go through to push 'knowledge' into the knowledge commons. There are two methods of determining which improvements are necessary for the network.

1. I define the relationship between the community and the Filecoin Foundation as a support-based relationship because while they can suggest Filecoin Improvement Protocols (FIPs) the community has no formal control over the Filecoin Foundation. These protocols can be proposed by anyone and are then voted on by the community to determine if they should be implemented. These proposals fall under three types: Organizational, Technical, and Fault proposals.
2. The Filecoin Foundation develops requests for proposals (RFPs), which developers can then propose solutions to and gain funding for doing so. Or

> alternatively, developers can propose a change and the Foundation can choose to accept their solution and fund it or reject the solution.

While there is or can be a link between the FIPs contributed to the communities, there is not a required link between the FIPs and what developers gain funding for. From my analysis, it is my understanding that the Filecoin Foundation independently reviews developer proposals, and determines the requests for proposals to determine who gets funding for improvements to the network.

Outcomes and Patterns of Interaction

Through these rules, the community, and the biophysical characteristics of money and knowledge resources, Table 1 summarizes how Filecoin also demonstrates the repeated outcomes of maintaining a sustainable income and sharing high-quality knowledge freely.

To do this they currently manage the inputs and outputs of their resource in the following ways.

On the monetary side, Filecoin has a business model such that as its network grows, the $FIL cryptocurrency increases in value, and thus the joint resource held by the Filecoin Foundation increases its value. Over the past five years since their initial public offering, $FIL has largely remained around $5 USD in value with a significant spike in March 2021 (CoinMarketCap, 2023) after a Chinese company decided to invest in them. Currently, they are continually allocating more funds to developing the network (Henn, 2023). They balance this increase in value and the output for improvements in the network by *regulating the currency scarcity* based on actual use in the network, using *low barriers to entry* for people buying into the network, using *high barriers to entry* for those trying to access monetary resources, using a *centralized regulation structure* where the Filecoin Foundation largely determines improvements in the network and funding allocation, focusing on building a *single income stream* through fostering a robust network, and *voluntary decision making structures* which garner input from the community about where to allocate funds.

Filecoin consistently outputs new updates to its blockchain protocol and remains a leader in considering and releasing green applications of the blockchain, implementing the FIL+ program which ensures high-quality knowledge storage (Filecoin, 2022), and programs like Bacalhau (Bacalhau, n.d) which significantly improves the speed of storage across a decentralized network. They manage this resource by creating *high*

barriers to funded knowledge creation, but *low barriers* to participation. *Project-specific support* for those who would like it, *voluntary decision-making structures* where people can participate in improving the network, and a *central regulator* who determines what knowledge is accepted into the repository.

Principle	Resource	Application
Clearly Defined Boundaries	Money	Application and Approval Process Filecoin Foundation regulates who can access the resource Anyone can join the network provided they buy into it
	Knowledge	Anyone can access the knowledge base Protocol contributions can be supported or accepted
Congruence between appropriation and provision rules and local conditions	Money	Filecoin Foundation releases RFPs in accordance with funding capacity The $FIL value and use defines the size of the monetary resource input Filecoin Protocol defines token releases which impacts the value of $FIL
	Knowledge	Filecoin Foundation submits RFPs and funds continued knowledge development The community can create FIPs to prompt knowledge development Filecoin Foundation ensures quality through technical advisors, and vetting development applications
Collective-Choice Decision Arenas	Money	The community doesn't have collective choice over monetary allocation Filecoin considers FIPs and community calls for next steps
	Knowledge	The community can suggest or indepenently implement next steps The Filecoin Foundation determines which next steps are supported
Monitoring	Money	The Filecoin Foundation monitors the monetary resource
	Knowledge	Technical Sponsors ensure the projects compatible with the current code The community can voice needs for protocol improvements
Graduated Sanctions	Money	The network quality is maintained through graduated sanctions on economic actors
	Knowledge	There are no graduated sanctions for knowledge developers
Low Cost and Readily Available Conflict Resolution	Money	Filecoin defines conflict resolution among the economic actors, the verifiers, and the developers through bi-weekly community calls and Foundation staff No conflict resolution for conflict with the foundation
	Knowledge	FIP's provide a location for discussion and disagreement around next steps
Right to Organize	Money and Knowledge	Each of the individual groups are able to organize via community calls Filecoin is a recognized legal entity
Nested Levels of Organization	Money and Knowledge	Filecoin is separated into the economic actors (clients, storage providers etc) developers, and the Filecoin Foundation

Table 2: This table summarizes how Filecoin implements the rules for Elinor Ostrom's commons

This regulated knowledge is also completely free to the public. This remains so in relation to Filecoin's drive to have a *very large network* where many people are buying into the network and has a value model in which the increase in that network size leads to the continued growth of the common resource. Secondly, they have a set of *formal rules requiring open-source* licensing for all projects funded by them.

Summary and Analysis

Similarly to Enspiral, we see that Filecoin has implemented the rules for the commons as represented in Table 2, and these patterns have contributed to the continued free distribution of their knowledge commons. However, Filecoin has made several decisions that are significantly different from Enspiral to get to their current state which seems as if they would affect the likelihood that Filecoin's commons are captured or exhausted.

To parallel the Enspiral analysis, the variables that I mention that might contribute to strengths or weaknesses in Filecoin's network related to resource capture are as follows:

- *Low barriers to entry for contributors*. Specifically easy access to the network for those who are buying into the network for the storage benefits and who then gain voting power over the network development. This easy access to the network could provide an open door to many different voices participating and affecting how the network grows preventing a single entity from benefitting independently of others. However, it could lead to easy access by bad actors.
- *Voluntary decision-making structures*. This structure garners input from the community about where to allocate funds. The voluntary nature leads to a significantly smaller participation rate (there are ~ 65 contributors to the community and Filecoin improvement page on the network git hub compared to the many thousands of participants) (Filecoin Community Github, n.d). This could lead to misrepresentation of the network and lead to control of the resource towards the specific group of contributors.
- C*entralized regulation structure*. The Filecoin Foundation has the ultimate power in the network and funding allocation. This centralized structure is likely to be more coherent and efficient which may lead to a greater ability to regulate the content. Or as the greatest risk, this centralized structure is the hardest to regulate meaning in the case of resource failure, this structure has the full capability to 'capture' the resource.

- *Very large network*. This network size could create a much more robust network value because as the number of people grows, the likelihood of network failure is much lower. This could make the network much more difficult to regulate however creating a chance that a single actor aggregates resources.

Secondly, Filecoin makes several structural and regulatory decisions that may affect the likelihood of resource exhaustion.

- *Single income stream*. Filecoin regulates the continual growth and development of the Filecoin network including limiting the released number of tokens, and creating low barriers to contribution to the commons to ensure that the network is growing. While the network is growing the common resource is growing. While this may be a robust mechanism because it relies on the success of a large network, it may be limited because in the case that the storage market is unstable the entire corporation could falter.
- *Project-specific support*. They ensure high-quality knowledge and good knowledge integration despite diverse knowledge inputs by creating a technical sponsor who can ensure there is high-quality knowledge.
- *Very large network*. This network size could create a much more robust network value because as the number of people grows, the likelihood of network failure is much lower. This would make the income stream much more stable.
- *Formal rules requiring open-source* licensing for all projects funded by them. This ensures that each project is open source and continues to be.
- *High barriers to entry for developers*. For those trying to access monetary resources. Their RFP framework and grant requirements ensure that the knowledge resource is of high quality.

Thus we see there are several decisions that Filecoin has made which have the potential to affect the continued success of their free, knowledge commons. While they are currently successful, the opportunities for resource exhaustion or capture in Filecoin largely fall under the realm of the low regulation of the Filecoin Foundation, and the linked nature of the common resource to the value of $FIL.

Throughout the analysis, I could find no formal mechanisms for holding the Filecoin Foundation accountable. This means that the community technically has no right to organize against the Filecoin Foundation where it behaves out of line with the Community's suggestions. In addition, the Filecoin Foundation holds the entirety of the

Monetary commons giving them formally exclusive control over both common resources.

Despite the lack of formal rules to hold the Filecoin Foundation accountable. It thus far has enacted rules to ensure that all knowledge must be open-source and continued to support community proposals. This is in line with the Filecoin narrative that they aim to be community governed. There is accountability to this value in the network through the linkage between community satisfaction and the continued increase in the value of $FIL.

Overextraction is unlikely to happen because the common resource is regulated largely by the Filecoin Foundation however network failure could happen. Cryptocurrencies are known to be volatile. To increase the stability of the network, Filecoin has defined most of the relationships between agents to ensure that they are constantly in a positive economic state. Storage Providers, Chain Verifiers, and Developers can earn $FIL where their storage, computation, or development may have been wasted, or uncompensated before. Clients benefit from a higher quality of storage. And Token Holders can participate in an economic market that is based on real work instead of speculation. In addition, they've defined the release of the coin to respond specifically to the use of the $FIL which attempts to ensure the network is stable.

In summary, Filecoin successfully implements many different practices to develop a successful knowledge commons with few risks.

Discussion

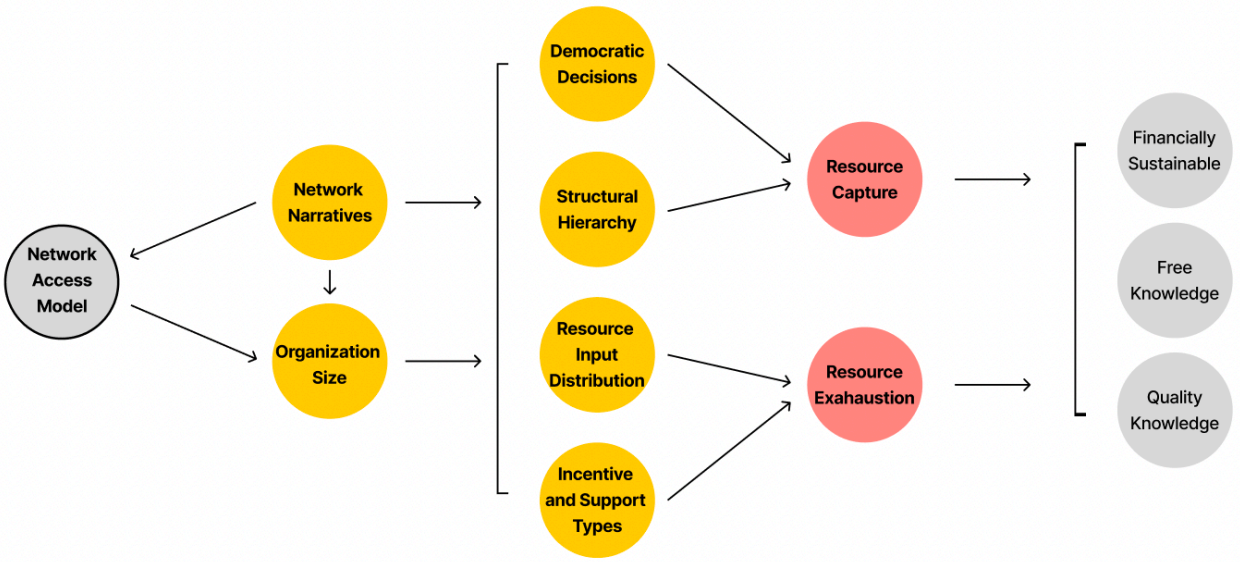

Figure 10: This figure shows the relationships between the variables within Filecoin and Enspiral that have significantly different approaches. This is a DAG in which arrows represent the influence (not positive or negative) of one variable on the other. Yellow variables are the variables from my analysis that differed. Red variables are the failure points for commons, and the grey variables are the exposure and the outcomes. The bracket indicates that organization size and Network Narratives might affect all of the four variables.

The core conclusions I draw from these case studies are that each of them has reasonably implemented various versions of Elinor Ostrom's framework for a successful commons. However, when exploring the structural, and real implications of these implementations we see that while there are many similarities (See Appendix B for the total list of comparable variables), there are a few core differences between each of these organizations.

I have chosen to exclude the similarities between Enspiral and Filecoin and focus on the differences because the differences in their structure are likely to reveal either organizational variables that organizations can have more flexibility with or variables that I can test in the future to explore the differences in how resilient Enspiral or Filecoin would be to resource capture or exhaustion.

In figure 4 I have drawn a Directed Acyclic Graph which describes the core differences that I see between Enspiral and Filecoin based on the case studies. The first two yellow variables are Network Narratives and Organization Size. Enspiral's narrative focuses on developing rich social ties and an ethic of open information leading to them having less

formal rules around requiring open knowledge but only informal institutions that reinforce this practice. On the other hand, Filecoin focuses on efficiency and creating a more perfect economic market which reinforces the focus on formal rules for maintaining an open knowledge commons.

Size is a clearer difference. Enspiral has about 200 members while Filecoin has around 570 developers and 35,000 network participants.

While there were other characteristics that were different between the organizations (such as the use of blockchain, the type of participants, and the type of shared output), these variables had the most plausible relationship to the following four variables which represented the core differences in the implementation of Elinor Ostrom's rules for the commons.

- **Incentive and support types:** Described as the number of different mechanisms there are for regulating through support, incentives, or sanctions a resource. These can include monetary, social, information, penal or other sanctions and incentives.
- **Structural Hierarchy:** Described as the degree to which one or a few actors have full autonomy over the resource.
- **Resource input distribution:** Described as the degree to which the income of the network is dependent on a single source. In Filecoin - the entire profit is coming from the use of the Filecoin Network. In Enspiral, each individual who joins is technically an independent contractor responsible for bringing in resources based on their skills.
- **Democratic Decisions:** Operationalized as the percentage of individuals who actively participate in decisions that affect them.

These four variables each represent ways that Enspiral or Filecoin may fail to maintain their commons, and thus their method of sustaining their open source development.

Within Enspiral they have had many different types of regulating the interactions between people. This includes ways of creating strong social bonds which ensures a social incentive to join the network, access to a monetary commons, and access to collaborators. These structures define the benefit of the network in terms of social, emotional, stability, and monetary benefit. This diverse structure of incentives means that regulation (including support and sanctions) throughout the network is applied not only at the monetary level but also by communicating and navigating these different

types of support. For Filecoin, bad behavior was largely addressed monetarily. For the economic interaction, your rewards would be slashed for failure to store, or for the developer creation if you didn't create an effective tool the resolution was large to reduce future funding. Similarly, support mechanisms were reduced to only project-based support. This means that the only type of support you could gain outside of monetary support was technical support. These different mechanisms have the potential to affect how easy it is to capture a resource for a particular need. Having many different places for conflict resolution that can be applied in meetings, in discussions with people within consistent groups that you interact with, or in online forums, as well as the psychological safety to do so is more likely to lead to people speaking up in the case of conflict. On the other hand, the single mode of monetary sanction is significantly simpler and easier to interpret potentially leading to more straightforward results. Thus we see that while Enspiral uses multiple types of capital to regulate its network, Filecoin uses only one or two. *I would like to know how these opposite approaches lead to a network that is less likely to be 'captured' by a single entity.*

Secondly, we see a difference in the structural hierarchy of Filecoin when compared with Enspiral. There are two levels to this. First, each of the Regulatory groups in Enspiral has a regulatory arrow pointing toward them. This ensures that if any group begins to bend the commons to only serve their group, there are ways to regulate this. Secondly, the groups are not mutually exclusive. Members are also foundational stewards, and board members are part of pods. This means that each of the groups is also comprised of many different perspectives in the organization. In Filecoin we see that there is a single strict regulatory loop. The Foundation has ultimate control over the protocol and thus the monetary and knowledge resource. This hierarchy is limited, and Filecoin has created several places to accept suggestions from the community through GitHub and community calls, however, there is no formal power of the community over the organization. A more hierarchical structure could lead to easier capture of the resource because the regulatory mechanism against the most powerful node is weak, however, a more distributed network could lead to implicit leaders that are harder to see. *I want to know how a strong hierarchy affects the likelihood of resource capture.*

Third, we see that these networks each have different functional mechanisms for securing monetary valuation. In Enspiral, independent individuals, organizations, and sponsors pay into the network creating a multi-faceted income stream. While in Filecoin, the continued valuation of the coin comes from the success of the network as a whole. Thus the success and growth is reliant on the success of the storage market set up in Filecoin. In this case, a single market could be more likely to be disrupted leading to a

failure in the Filecoin income. For example, when Xinyuan Technology invested in Filecoin (Henn, 2023) it created a huge spike in the market. If the speculation went in the opposite direction, it could have eliminated the Filecoin Network. *I would like to know the impact of how likely a resource is to be exhausted by how many different types of income it gains.*

Finally, we see the level of democratic decision-making. This is operationalized in terms of how many people are making decisions relevant to them. This is difficult to describe, however, in Enspiral they take a total decision structure. They define when a decision requires a whole network discussion and when it doesn't. They have a structure for including a wide range of stakeholders in the decision-making using Loomio and Cobudget. Thus, every member allocates money, and every member makes decisions about where core funds are allocated. In Filecoin, participation in decision-making is much less active. On their GitHub there are 51 active contributors to the community git where proposals are requested and about 10 people arrive at community calls. *I want to know the impact of by default including all the members in a network instead of by default excluding them from decisions on how likely the resource is to be exhausted.*

To understand these four questions, however, I need to understand them in the context of the size of the organization and the intent of the organization. I need to do this because of the direction of the arrow from the network model to the size of the organization and the direction of the arrow from the network narrative to the network model. What this means is that the network narrative could be a confounding factor where a causal analysis of the effect of having a network profit model on a successful knowledge commons is dependent on having a particular network narrative that informs how each of the variables I choose is implemented, and thus if the resource is able to remain out of the phase space of capture or exhaustion. However, size is not a confounding factor. Instead it would be a mediating factor. If we were to explore the hypothesis that size was the core factor in the success of a network through a set of variables like the ones I have taken from my case study above, then we would see that as the size grows, the effect of any of these variables on capture or resource exhaustion may change.

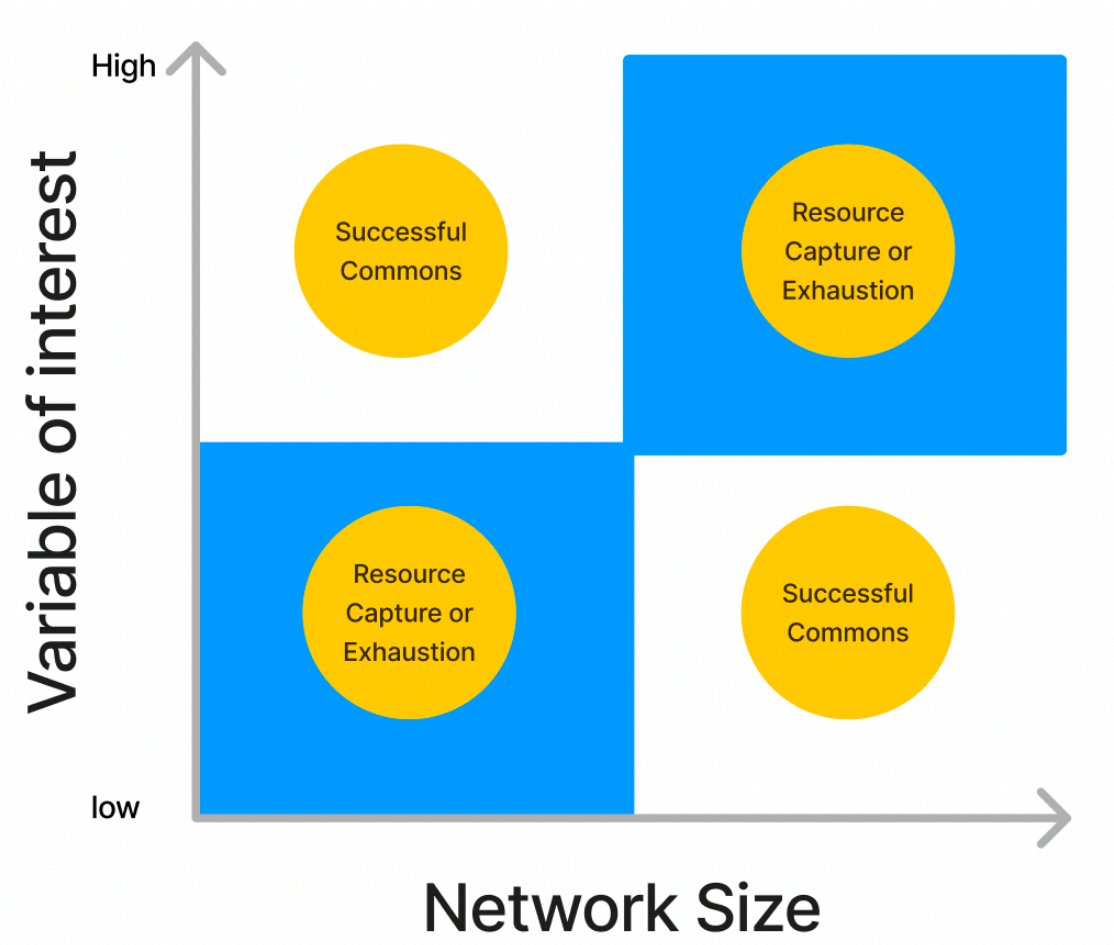

Figure 11: this is a phase diagram that posits a potential set of attractor states, and a phase space that would represent how these variables might interact to create successful network design.

Figure 11 demonstrates how any of these variables might be investigated. Currently, there seems to be a dichotomy within the networks where Enspiral, which has a highly human-centered and small network has made each one of the variables of interest highly distributed. In addition, they have been successful at remaining within the 'successful commons' attractor space. However, Filecoin which is highly market-centric and large has generally centralized most of the authority and decision-making, and network regulation into economic incentives and the Filecoin Foundation. However, thus far they have similarly been successful at maintaining their common resource. Thus the next steps for this case study would be to explore in network profit models if larger networks *require* more simplified mechanisms to be successful, and smaller ones

require more distributed mechanisms. If this were true we would see a pattern such as the phase diagram I have seen above.

There are two other potential outcomes. First - the variables I have extracted are variables that have *no effect* on the success of the common resource. This would be interesting because it would have significant implications on the current hype which promotes decentralized and distributed organizations. Second, size isn't a significant factor in creating the phase diagram. In this case, we would see that either high variable distribution or low variable distribution is better for both large and small networks. This would imply that the success of the current commons I have analyzed is largely short term and one of them is in a very shallow attractor state of a successful commons.

Conclusions

I chose to highlight these differences in Filecoin and Enspiral to represent an extension to Elinor Ostrom's rules for the commons. Currently, she establishes that there are 7 generally accepted rules that should be followed to implement a regulation schemata for the commons. However, through exploring these case studies I found that there are many ways to implement these different rules. While Ostrom describes that we need to monitor our commons, she explicitly doesn't help us decide how we might do this in different contexts. However, I have seen the emergence of a specific model of the company which uses access to social or distributed networks as a mode of gathering value instead of creating proprietary knowledge. By understanding this model, I would then hope to begin exploring the most successful and robust designs of these networks. By finding the differences between Enspiral and Filecoin, I hope to inform further research into the mechanisms through which we might be able to reinforce successful common business models and organizational structures.

Through this study, I have determined that there is a potential relationship between the basic characteristics of the organization and which strategies might be most successful at creating continued growth in these organizations. This potential relationship merits further exploration and understanding in order to explore how we might be able to create support organizations with Network Profit Models to begin contributing to the wider knowledge ecosystem. This alternate model would aim to successfully reduce the heavy litigation and monopolization of the Proprietary Patent system and also remains a sustainable and reliable mechanism for delivering consistent quality knowledge.

Limitations

There are three core limitations to my case studies and analysis. These case studies may be incomparable to each other. Their rule books may be implemented poorly. And finally, the structures may not be generalizable to 'organizations with network profit models'.

First, while I explore the benefits and tradeoffs of these organizational structures, the lack of clear and comparable evidence for the outcomes I claim potentially makes these organizations irreconcilable. In the future, I would explore more case studies and consider more thoroughly the variables I would control when comparing the cases. For this study, I choose organizations based on how different they were from each other without considering which variables I should have controlled. For example, there is an arrow between the network narrative and network size creating a potentially confounding relationship that might not have been observed in the case of a more constrained set of case studies. In addition, I could speak of outputs that both had created, but I didn't have access to how much knowledge each had made and the success of the actual quality of this knowledge. Instead, I could only argue that they had set up systems to make this knowledge quality. Thus far, I can only make narrative explanations and connections and then formulate them as questions to be answered with more data later on. This limitation limits how valid the variables I have chosen to focus on may be.

Secondly, the method I have chosen relies highly on the assumption that the rules within these organizations are implemented. There is a chance however that the rule books represent an ideal that is not a true reality. This difference would limit the potential for further study. If I were to analyze the effect of one of the variables on the success of the commons, I couldn't say if that variable were the cause or if poor implementation of that variable were the cause. This introduces an unobserved confounder in any future studies.

Finally, these structures may be inherently ungeneralizable. Enspiral is made up largely of freelancers and consultants who still gain income from producing outputs for companies that restrict knowledge output. Thus while the organization itself is sharing lots of knowledge, this model wouldn't represent a new economic model because if it were to scale up there would be no group to pay the consultant who then contributes to the commons. Instead, this open knowledge sharing could be a new economic niche similar to open-source knowledge. A niche where people who have excess from the traditional structure can go to support creative endeavors. Similarly for Filecoin, they

are producing an economic structure that seems to increase in value only in comparison to the traditional economy. If there were no proprietary knowledge that clients wanted to protect and store, then the network might not have users. Essentially, my scope is limited by only considering the organizational level. I have determined how these organizations manage to create a structure within themselves but have not evaluated how these organizational structures might fail were the dominant economic paradigm to shift to a fully open knowledge model.

These limitations inform my next steps which would be to analyze the robustness of each of these network structures to shocks to the system by determining an operationalization of the difference between the social and economic networks. And to expand my levels of analysis to better understand how organizations with these structures interact together in a global system.

Appendix

Appendix A

To compare Filecoin and Enspiral I found the formal rules for each organization and documented each of them in a table. I then systematically categorized them into the following categories.

1. Rule Type (Ostrom, 2005)
2. Rule Level (Constitutional, Collective Choice, Operational)
3. The Commons the Rule was Regulating
4. The Agent(s) the Rule Related to
5. If the Rule Could Adequately/Practically Be Enforced

Using this information I then used the following exclusion criteria to narrow the number of rules I considered.

1. Does the rule occur at the operational level?
2. Does the rule pertain to the money or knowledge commons?
3. Does the rule describe how an agent should interact with the money or knowledge commons?
4. Is the rule able to be enforced, or is it enforced?

Once I had a smaller subset of rules for each common resource, I then systematically included simplified versions of them in the diagram through arrows, blocks, circles, and other symbols. I further described essential rules in the data section ultimately representing the larger level network patterns in the network.

Appendix B

This is a summary table of all of the variables I identified. I have italicized the variables that are different from eacother but that I have excluded in my final analysis. Italicized and bolded those that I have included in my final analysis because they are different from eachother. And left plain those I have excluded from my analysis because they are constant between the two groups.

	Filecoin	**Enspiral**	**Dimension**
Capture			
	Low barriers to entry for contributors to the monetary common.	*high entry barriers for contributors to the monetary and knowledge commons.*	***Excluded because there are multiple cases in which Enspiral doesn't have a high barrier, and filecoin does making it a poor generalization*
	Voluntary decision making structures	***Multiple decision making practices and tools***	***Democratic Decisions***
	Centralized regulation structure	***Distributed regulation structure***	***Structural Hierarcy***
	Very large network.	***Very small network***	***Network Size***
Exhaustion			
	Network profit model	Network profit model	

	Single income stream	***Distributed regulation structure***	***Resource Distrubtion***
	Project specific support.	***Multiple modes of support***	***Incentive and Support types***
	Very large network	***Very small network***	***Network Size***
	Formal rules requiring open source	***Informal rules requiring open source.***	***Network Narrative***
	High barriers to entry for developers.	High barriers to entry for developers	

Appendix C

Custom LO Design + Rubric

#collaborationbydesign

- Recognize that collaboration among individuals is unique to each group, but can benefit from more generalizable principles. Thus when designing collaborations, practices should scaffold research based actions, but not prescribe outcomes.

🔴 1: Does not evaluate, or use the differences, situations, or relevant outcomes desired from a given collaboration, or does so mostly or entirely ineffectively.

🟠 2: Evaluates or uses the differences, situations, or relevant outcomes only somewhat effectively.

🟢 3: Effectively selects relevant differences and preferred outcomes to better understand the collaboration; effectively structures the collaborative situations that team members would find themselves, while ensuring the agency of the individuals within the collaboration.

🔵 4: In addition to effectively selecting the relevant differences and preferred outcomes (or examining other's collaborations), explains the basis or justification for the selection and contribution to the preferred outcomes. (If applicable) when designing collaborative practices, they justify with evidence or a method of testing why a given intervention may lead to the desired outcome.

🟣 5: Evaluates the salient characteristics of a working group in a creative and effective way, relying on a novel perspective.

HC Index

#interpretivelens: I begin my paper by identifying the lens I have in beginning this project. I represent first that my motive for this project is to gain a procedural understanding of organizations. And secondly, I wanted to do this in a way that can inform my scaffolding for a team that has lots of knowledge to share and very little time to curate that knowledge. Instead of rejecting this lens, I acknowledge it for the reader and use it as a constraint to define my procedure. My lens informed how I chose the organizations I was interested in - specifically, they had achieved the outcome I was interested in exploring. And it informed my use of the IAD framework which gave me a procedural and in-depth understanding of the structure and practices within these organizations so that I could replicate them in my professional life.

#biasmitigation: My 'where this work comes from' section represents that I want an outcome in my work that says that greater distribution is good, and we can share knowledge freely without needing to pay a fee for that knowledge. Through this identification, I then recognized that my conclusions from the case study methodology were vulnerable to my bias because it relied on me representing recognizable patterns to the reader. Pattern formation can often be a highly implicit process where I won't have access to the reasons why I noticed those particular patterns. To mitigate this bias I worked with Prof. Odera to develop a systematic methodology to evaluate the organizations through their formal rules and informal rules.

Secondly, I both represent my personal experience and call back to the fact that ***I*** am analyzing this work in line with my prior experience by using the personal Pronoun I in my academic writing instead of the royal we. This makes my work more effectively adhere to researcher best practices by ensuring that every potential source of bias is elaborated and continually acknowledged to the reader instead of abstracting away the potential bias my perspective can bring in. In this way, I remind readers to be critical instead of asking them to assume accuracy by my objective presentation.

#breakitdown: In my introduction and literature review I break down the economic problem of knowledge then I use this breakdown to inform the method I design to understand the dilemma. First I represent the economic problem of how knowledge is non-excludable, and anti-scarce. I then break this problem down into the multiple solutions that exist - IP, Open Source, and the Knowledge Commons. I eliminate IP and Open-Source by evaluating them against the goals for a system of knowledge. Finally, I then break down current literature on the Knowledge Commons movement into a

individual level of analysis as opposed to an organizational perspective and identify the failure to deeply understand the organizational perspective. This leads to my scoped research question which asks what the structures of two organizations within this movement do to ensure that they meet the economic requirements established above. This breakitdown represented an iterative process of carefully narrowing my focus ebay considering the constraints of my preference to understand organizations and the constraints of the contradiction in Knowledge Management. Thus I was able to reduce the problem from how might I solve an economic problem that hasn't been resolved yet to, how might the rules in organizations create a mechanism for improving our management of Knowledge Commons.

#levelsofanalysis: In my literature review, I determine the different levels that the literature has explored. I define how methods of approaching the knowledge problem has attempted to use a dichotomous individual and global level of analysis. Where many movements attempt to incentivize individual people to contribute to a global knowledge commons with funds that are gathered globally from the government, corporations or other institutions. I determine then that this perspective critically misses the organizational regulatory level. I justify how adding in a careful analysis of the organizational mechanism which incentivizes and supports individual to contribute to the global knowledge commons through discoverable community rules and characteristics, we can better understand how to aggregate individuals towards the goal of a global knowledge commons.

Throughout my methodology, while I focus on the organizational level, I represent how the organizational level incentivizes and supports the individual to contribute to the knowledge commons. And how the internal organizational common structure facilitates sharing knowledge at a global instead of just local level. Thus I represent how the organizational level can act as a bridge which reinforces individual incentives and global benefit.

#critique: Within my section Traditional IP vs Open Knowledge, I critique these movements by first discovering the criteria that they have set for themselves. Using this criteria I evaluate both of them and represent the weaknesses of how each of them implement their criteria. I then represent how IP assumed that competition among patent holders would create compensation for the best inventions, but failed to account for large corporations in their system creating an exploitable loop hole. And Open Source creates implicit barriers because they assume that Open means anyone will

contribute. I then use this critique to form the basis for my argument which claims there are at least three organizational requirements for resolving the economic dilemma.

#casestudy: I determine from the context of my study, the feasible sample size, and the goals of my analysis that a case study was the best approach to take. I acknowledge that using a case study necessarily limits the external validity of my study and address this limitation by completing two case studies instead of just focusing on one organization. In addition, I acknowledge the intent of the study which is largely exploratory and my selection of cases that were as different as possible from eachother. To create an internally consistent study, I select the Institutional Analysis and Design framework which provides a framework to compare two case studies. Finally, I determine a clear and replicable methodology in which I define the community and both of the action situations for my case study by the published rules and create a one to one relationship of the rules to my analysis allowing me to make comparisons across my case studies while also making my conclusions arguable and well-defined.

#powerdynamics: I analyze how Enspiral sets up interrelated sets of organizational groups which and creates easy paths of regulation both in their informal narratives and practices and in the way they structure relationships between these groups. I analyze how Enspiral creates shared decision making power through online platforms, flexible authority power through individuals who relate in different types of groups, and a very strong social network ensuring the power of strong social norms to keep directing the network. The practices around actively sharing power make it very difficult to aggregate in a single person or group. I compare this to Filecoin who has a single regulatory power who controls the knowledge that is supported, and the money commons. In this case the power is concentrated both in a single group of people who is largely mutually exclusive with the community they are serving. This actor acts in good faith, however, the organization has the power to enclose or reallocate the commons to its own purpose. Through this dynamic, Filecoin can at any point define what gets developed without input provided they believe it benefits them. Thus when analyzing these organizations, I recognize how these dynamics might shape collective and individual behavior in the future in the case that a single entity in either of these organizations were to try to control the common resource. Specifically that differing power dynamics in Filecoin might more easily turn into regulatory capture.

#systemdynamics: Through my analysis using the IAD Framework I define how successful commons management requires both robustness of their common resources to depletion and to capture. I then end this study by representing the phase space that I

propose is accurate. I create a phase diagram with size of the organization on one end and the variable that I consider from my analysis on the vertical axis. I then represent how change in any of these variables might lead to capture or exhaustion. Within this analysis I include an understanding of the implications for designing a network with this phase space in mind then use the different structural considerations in a phase space to represent the various conclusions I might be able to come to upon further analysis. By considering these different dimensions I am able to come to an empirical question about how resilient these networks might be to depletion or capture.

#utility: To understand how each of these organizations are able to maximize their utility functions - sustainability + increased membership for sustained knowledge production - I explore how they create incentives for individuals to join their network. Specifically I highlight the difference between Enspiral who distributes the benefits of the network in two ways - creating access to resources (such as other collaborators, funds, skills, clients, and social and professional support), and mitigating risk. However, Filecoin largely aims to optimize the benefits of joining the network as providing value for contributing to the resource however they don't necessarily provide a structure for continued care of these contributors. Thus we see that Enspiral at the high level seems to have 'irrational' economic actors who are paying to be part of a network without gaining an equal economic benefit. However, the support structure represents the types of resources and methods for providing stability that may still lead an economic actor to join the network despite potentially having a lower pay out than they would have had if they remained an independent agent. On the other hand, Filecoin aims to make it as transparent as possible for people to see the value in joining the network. In addition, the goal was for this storage to be cheaper than other alternativse. Thus all of the incentives for the network members are include into the economic benefit increasing their ability to scale, and decreasing their need for strong social cohesion between the groups.

#carrotandstick: I use carrot and stick to evaluate the economic incentives and disincentives that Enspiral and Filecoin provide to their participants. I further evaluate how this radically recreates the economic incentives for an individual such that an individual who is least likely to contribute to open source - a freelancer who needs to spend all their working hours contributing to projects for the companies they are working for, securing more clients, or managing their own ops can now be one of the most likely individuals to contribute to the Knowledge Commons. I then evaluate how the incentives and rules the company has set up act to formulate the action situations in

which the freelance participants find themselves ensuring that they are more often able to contribute to the Global Knowledge Commons while still earning their own salary + contributing to the organization Commons. Thus in both Enspiral and Filecoin, they provide a positive incentive for contributing to the commons and largely eliminate the need for a strong negative repercussion to not participating in these commons.

#communicationdesign: I used communication design to develop all the figures throughout my capstone. I was faced with the difficult problem of capturing numerous formal rules that structured the dynamics of these networks. As a result, I first systematically included and understood all the rules, then was able to determine the core information of those rules that had to be communicated to the reader in order to make my argument clear and coherent. I then used the principle of repetition where I replicated a single structure throughout my designs to ensure that the reader was able to understand the figures in relation to each other. I then used the principle of minimal difference to ensure that the number of colors and variables that a reader was tracking was as few as possible. Beyond this, I created multiple iterations of these designs and evaluated them with Professor Digby, Professor Powers, Professor Odera, as well as several friends including Leo and Yufei. This feedback helped me consistently narrow my scope and split the information into various sections to make the relationships more clear.

#evidencebased: Throughout my case studies I systematically present determine which evidence is relevant to include (criteria in Appendix A), I then carefully narrow the evidence into an organized set of information which represents how both Filecoin and Enspiral are meeting the regulations of Elinor Ostrom's Commons and the criteria I have set up for successfully managing a common resource. I then further distill this evidence down into the core differences between Filecoin and Enspiral. By effectively presenting this evidence in this way I provide a way for my readers to understand and critique the logic I use. I then use all of this evidence to support my causal graph and understand how my information doesn't represent a causal relationship. I then create a causal question that is informed by this evidence and describe the evidence I would need to support it.

#testability

Using my causal diagram I recognize how my current case study set up fails to give me testable conclusions in part because I have multiple interacting variables which may be

affecting the organizations I am considering. I then represent how in order to test if size is the causal factor behind creating these different levels of resource capture or exhaustion, I would need to control for the company narrative. However, I recognize the limitations in this method because the actual implementation of a specific narrative might be more or less complete. I then identify that this difficult to observe 'execution' variable confounds the testability of my results. I further create a phase diagram representing the potential implications of my findings developing at last an at very least theoretically testable basis for further research which can explore which mechanisms should be brought into organizations.

#constraints: I developed a diverse set of constraints - on the personal level I needed a method and subject of study that helped me work better with teams. Secondly, I implemented constraints in the way I wrote based on a belief about how I could make most clear the interpretive lens that I was approaching the study with. Because I was most inexperienced with the structure of setting up teams, I constrained myself to deeply exploring the structure of teams. Secondly, I used the constraints of the capstone project and my social science major to limit myself to an academic paper. Using these constraints, I then found a framework that could help me explore organizations more clearly, and choose a methodology that would emphasize and explore the practices that I might want to implement when working with my teams. Thus I successfully developed a set of core constraints, justified their use related to my personal and professional interests, and finally used it to design a solution in the form of my capstone methodology.

#professionalism: Throughout the capstone process I managed ongoing meetings with multiple professors including Professor Odera and Professor Powers to ensure that my capstone was in line with relevant standards. I used an APA template to ensure that all of my work was properly and consistently formatted in line with an accepted academic standard in my field. I consistently worked with Professor Digby to set intermediate deadlines and update my work in order to account for my weaknesses - such as continually expanding my research without delivering a conclusion. Through these efforts I have delivered a professional capstone assignment both procedurally and in the deliverable I have presented.

#organization: I have worked and iterated this document multiple times including various figures, headings, and parallel structures throughout the case studies. I have similarly included highlights of the most important words and phrases and

implemented consistent use of tables, bullet lists, and formatting to reinforce the core points of my content. Despite this being particularly long, I use the principle of repetition throughout the project to reinforce the core outcomes I am exploring and ensure that at the end of the paper the reader leaves with a whole picture of my analysis.

LO Index

#ss110-researcherbestpractices: I have implemented researcher best practices throughout my study including - creating an iterative notion which maintains a record of the ongoing thoughts and analysis that I was developing. Explicitly stating when decisions I made in my capstone were post hoc (including the decision to describe the case studies as maximum difference). These practices ensure I didn't have the leeway to edit prior work and present it as a pre-registered hypothesis.

#custom-collaborationbydesign: The core claim I am making with this capstone is that in order to achieve goals, we need to intentionally set up the collaboration infrastructure by using theory, our team characteristics, and our tools. In the case study, I used the regulations, practices of the team, and narratives they were telling themselves to explore the collaborative outcome of contributing to the knowledge commons. I hope to evaluate how robust these mechanisms are to continue to contribute to the knowledge commons over time. This LO helps capture the effective integration of each of these disparate parts of my capstone. Thus by describing the potential variables that I would explore to develop design principles for common resource organizations I have successfully implemented this LO.

#ss156-ruleandoutcomes: I represented how the rules in Enspiral and formulate and frame the action situation that each individual finds themselves in at the collective choice and operational levels. I then in addition represent how this transformation from collective-choice regulations into default 'operational' infrastructure at Enspiral contributes to their ability to focus purely on working together while also being profitable and successfully contributing to the Knowledge Commons. In addition, I understand how these rules aren't simply formal and physical, but they are also informal and used through the institutional structure of these organizations. Thus the cultural dedication to collaboration, open knowledge sharing, the solidarity economy, and non-hierarchy then forces the company to develop structures that allow them to act on these tightly held values. I then hope to continue to use this application

#ss156-informalrules: Informal rules are defined by practices and narratives. Within my analysis of the Enspiral Case study I bring in the role of informal rules on the dimension of how they are propagated. I recognize the core distinction between Enspiral which develops lots of joint social practices as a result of their network structure and the regulatory mechanisms they have. In addition, I recognize how their social narratives

are propagated through their practices and regulations around creating barriers to entry for their network. I then evaluate how the social mechanism for propagating informal rules is much weaker in filecoin which is compensated for by the rigid enforcement of the Filecoin Protocol, and the need for a stronger hierarchical structure which can navigate around significant disputes.

#ss154- causalgraph: Within my case studies I have extracted out a set of variables and described the relationships between them. I then analyzed how the relationships would lead to confounding in the case of the network narrative, and mediation of the effect of a network model on successful commons in the case of the size of the organization. By setting up my causal graph I was then able to describe the phase space that I would test by testing the causal connections. This graph helped me attempt to discover an insight about the causal question - how does organizational level regulation and structure contribute to a sustainable strategy of contributing to the knowledge commons. Using this LO, I end my paper with a causal question that I would like to answer in future research.

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