Cryptopolis

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1. Abstract

As the twenty-first century unfolds, it is becoming more and more evident that the major problems of our time; energy, economy, resource shortages, humanities influence on the ecosystem, international security or transitioning to a society integrated with artificial intelligence – cannot be understood in isolation. They are systemic problems and as such, they are all interconnected and interdependent.

Our economy is built on competition, which often turns into conflict. We compete at the level of countries, companies, in the companies, employees compete with each other, etc. As in Darwinian style, the bigger and stronger one wins, natural selection happens and this becomes the most effective method of evolution and survival. This leads to devoting a huge amount of resources to building and maintaining a position rather than achieving the organization's goal. Often maintaining this position is possible with maintaining clear borders of an organization (family, company, government), yet such a narrow minded and territorial approach ceases to be adequate in a global society in which we face global dilemmas. However, in the memorable words of Margulis and Sagan (1986): “Life did not take over the globe by combat, but by networking.”

All these issues, ultimately, must be seen as just different facets of one single crisis, which is largely a crisis of perception. Rotting from outdated ideas, world views and structures of power especially present in large social intuitions like companies or governments with little to no flexibility, we are unable to deal with a globally interconnected world in constant and rapid change. The financial system as a major decision making tool of power needs to shift radically to stand up to these challenges.

On The following pages we introduce the concept of a new cryptographic network. A decentralized autonomous organization that uses an advanced voting system based on the principles of liquid democracy in order to draw from the diverse and responsive wisdom of the crowd for better governance than is found in standard top-down organizations. Artificial Intelligence plays a key role assisting moderation to counteract fake news and misleading information. Last but not least, tokenomics provides a bridge between real world assets that back the stability of the currency in a decentralized way providing incentives for users to share their knowledge, ideas and time on the System. We hope that those tools will create a

flexible self-correcting system that enables users to work on the global scale in a more complex manner.

The Cryptopolis network is integrated with the pangea token. The token has a fixed supply, it can be used as a payment method within and outside of the network. It is designed to be deeply integrated with the DAO organization. Most of the transaction fees in pangea go to the vault where the system's users manage decisions about its purpose. A part of the transaction fee is allocated to decentralized backing of the currency, therefore with every transaction within the network there are created more assets that stabilize the currency. This is a unique approach to maintaining value - not through fiat currencies but through the digital and physical economy. We believe that these properties of the network and tokenomics create growth and stability without compromises to centralized institutions.

2. Introduction

a) Traditional Top - Down Organizations

Human-made systems can be abstracted to dots and circles, each dot representing an individual, and each circle an organization – a company, state, non-governmental organization, club or an informal community. In every circle there are dots connected in various ways; the structure and internal rules of each network determine the mechanisms of decision-making, how tasks are delegated, and the level of autonomy each individual has, as well as the general efficiency of the organization. There are also connections between circles, between dots and circles, and between dots themselves (peer-to-peer networks); all of this constitutes a complex web of actors with very different modes of operation. Compare, for example, the crowd of Wikipedia editors with a place-based community garden, or a company like Amazon. Yet, within this complexity there is a clear pattern: the big centralized organizations, namely corporations, states and international institutions, tend to dominate the landscape in most parts of the human world today. They feature military-style top-down command-and-control types of governance which, just as in the case of the army, are useful when the actions of such organizations are applied with the use of force: political, exercised by law and internal rules, or economical, put forth with the use of money, or both. Decisions are made by a small group of people or a single person (a general, a board of directors, a parliament, a president) while implementation is conducted by lower levels of management and private members of the organization that have limited (if any) right to influence the decisions directly (soldiers, employees, clerks, citizens). Indeed, the top-down organization is made for quick decision making: invasions, investments, redistribution policies – all geared towards persistence and growth of a particular organization, often at the cost of its low-level members, the environment, or competing actors. It is widely believed that the end result of limiting or eradicating democracy, with its endless discussions and need for compromising, is a highly efficient institution, capable of realizing its goals without much friction. But is that really the case? And what is the cost of this kind of decision making?

The main challenge that top-down organizations face is the discrepancy between reality and its model, the latter of which is used to make decisions that are designed to influence the misrepresented reality. A misinformed leader, even the most competent, is likely to make suboptimal decisions. Let's consider instead a perfect scenario: there is a highly capable CEO who is continuously receiving the most accurate information about the state of the company and its business environment (input), and being equipped with the most accurate evaluation of the consequences of his decisions (prognostic models), he chooses what he believes is best i.e. most profitable for the company (output), and because the information flow, delegation of tasks, and accountability of those executing the decisions are also near-perfect, the leader enjoys high-quality feedback which he utilizes to correct the course when needed – he or she is truly in control. Reality, however, is starkly different from this idealized picture.

The actual inefficiencies of information flow, such as the perverse incentives behind concealing essential information which revealed would harm the messenger, competition between employees, blind spots (unknown unknowns), lag between an important event or trend and the information about it reaching the decision-maker, and many other “soft” social factors affect the quality of decisions and their execution. This bleak picture is familiar to many corporate workers. The notion of an inefficient, highly bureaucratic and often absurd corporate reality has made its way to popular culture with Dilbert comic strips and TV series such as The Office.

Another challenge is the sheer cost of maintaining the command-and-control structure; management personnel are essentially information-pushers that aren’t directly engaged in creating value for the company. Their existence is a consequence of choosing a particular model of governance and has become a long-lasting semi-autonomous burden. Once the management personnel is in place, it will inevitably create a sub-structure within an organization that is self-serving and self-preserving, often at the cost of the whole. There are strong incentives, as well as possibilities, to enlarge the management structure while avoiding responsibility for bad decisions. Indeed these two processes are interconnected: as the company becomes bigger and more complex it is easier to spread and dilute responsibility for the unintended consequences of one’s miscalculations. The notorious lack of accountability of the management makes the cost of bad decisions only higher, and, as the power of an organization grows, these costs are very often borne not by the company and its employees but by the society at large. This issue will be discussed in more detail in the section 6i of the whitepaper (Hidden Costs and Integrative Design / Beyond the Market)

2. Introduction

b) Decentralized Autonomous Organizations

Let us now look again from above at the landscape of human-made organizations. There is something interesting happening – one can notice a growing number of circles with dots that are not organized in a pyramid-like top-down manner but horizontally. There are not many of them but they are getting bigger, and more effective in organizing their governance processes without the need for multi-level management personnel. These Decentralized Autonomous Organizations are run by their members and governed by rules encoded as a computer program. In a DAO, algorithms encoded in a blockchain make it possible to implement incentive and reputational schemes that increase the likelihood of contributions from the members while minimizing the risk of activities to the detriment of the organization. DAOs are decentralized in a sense that there is no separate governing authority. Decisions are made by all those willing to participate, and this is strengthened by the tokenomics of the system. The implementation of the decisions is usually done by small specialized teams delegated for specific tasks by the community of users. The DAOs smart contracts enable not only financial transactions but any kind of digital interaction to be securely recorded on a blockchain ledger. In principle, once a DAO is up and running, with established rules, there is no need for human management since all the interactions within a DAO are regulated and enforced by computer code. This is why these organizations are called autonomous – they are, in ideal form, free from human governance. In reality however, DAOs need to evolve and this evolution is driven by members who are able to alter their organization's DNA – the code – at any point. They typically engage in the decision-making process through voting on selected proposals. Every member of a DAO owns a certain amount of governance tokens and the number of tokens in possession usually determines voting power. Contributions from members like proposals, bug fixes and voting, can be rewarded with more governance tokens or other incentives. This way every member is encouraged to use his or her knowledge for both individual and collective benefit. Perhaps this is the key to DAOs success – the extent to which it is able to pool and utilize different users' expertise towards organizational goals while keeping information flow as free as possible determines the quality of decisions made and their implementation. Assuming that members' interests are congruent with the interests of the organization, as each member is also a stakeholder, there are no incentives to conceal or distort information that is crucial for making the right decisions. On the contrary, members are motivated, directly and indirectly, to share important data and insights with others and are equipped with a platform (a public forum) to facilitate this constant information flow. An important benefit is the low-cost of sustaining the decision-making infrastructure – instead of high-paid and numerous management positions in a hierarchical organization, the DAOs governance is based on a horizontal community of members contributing their know-how and time through a web-based interface. The cost of engaging in the governance process (time/attention) is borne by active members, while the benefit is distributed among all token holders. This is why it is important for DAOs to implement a way to encourage and appreciate valuable activity through financial and non-financial rewards. Within a DAO this is made simple by smart contracts that embody the organization's rules in the form of an automatically executed computer code.

The most striking difference between a dominant top-down organization and a DAO is that the latter can successfully, and without an elaborate system of control and penalties, align its goals with the goals of its members-owners. They are motivated simultaneously by direct incentives for contributions and the long-term increase of value of the organization (and, as a consequence, the tokens owned) which result from good governance. A group of highly motivated, competent individuals pooling their resources and knowledge to realize a common goal, underpinned by technology that records digital interactions and encourages uninterrupted information flow for the granular, high-quality decision making that benefit the members and the organization as a whole.

2. Introduction

c) Direct Democracy

Every community, regardless of its size, location and purposes, needs a viable governance framework. The most basic one, often spontaneously adopted by informal groups, is direct democracy, a system of rule in which all (or most) members of a community decide on every political initiative directly, without representatives or other intermediaries. A common historical example is that of ancient Athens where every citizen who owned land (which excluded all women and slaves) was entitled with the right to participate in an assembly called ekklesia, which had a final say on all proposed legislation. The Athenian assembly usually counted approx. 6000-8000 citizens (that is less than one fourth of the total population), gathered several times a month and voted by a show of hands, counting of stones or broken pottery (in the case of banishing a certain member of the society). It can be argued that Athenian democracy was in fact representative since only a fraction of citizens could participate in the open-air deliberation at a time due to a limited capacity of the agora. Moreover, the meeting agenda was set by the council of 500 citizens selected randomly from willing citizens. Assembly was thus limited in number and to a large extent dependent on agenda-setting by the council although suggestions from the wider demos were allowed to be added to the agenda as well (Landemore, 2020).

Out of modern states only Switzerland adopted a system that features elements of both representative and a functioning direct democracy; dozens of referendal questions, including those submitted through citizens' initiatives, are answered every year by the public on federal, regional and municipal levels. Direct democracy in its pure form survived in just two Swiss cantons, where citizens still gather in town squares to decide collectively on local affairs. There are many reasons why this system, admittedly the most democratic in principle as it allows every member of the society to have an equal say in all political matters, has not gained widespread popularity. Direct democracy, while possible to adopt in small groups, becomes problematic as community grows and increases in complexity – the number of decisions to be made grows exponentially as does the scale of operations to the point of information and work overload. Learning about issues, participating in discussions and voting become prohibitively time-consuming for most members. It would not be reasonable to remunerate every citizen for this work if it was their main activity; a society made of professional politicians with no one to perform productive work is a rather dismal scenario. Large-scale direct democracy systems therefore face the dilemmas of decreased participation and representation. Both widespread participation and high levels of competence are crucial for a well-functioning direct democracy. Good decisions require debates which are opportunities to learn facts as well as exercises in adopting other peoples' perspectives. While establishing a completely horizontal digital agora for thousands of people is technically possible (and quite simple given recent technological developments), making it functional as a high-quality deliberation tool presents a major challenge. As the crowd grows, the voice of an individual becomes muted. The impact of a single user on policy is extremely limited in comparison to time spent on the decision making process. The classic tragedy of the commons often ensues – engaging in a time-consuming democratic process is less rewarding than staying passive and benefiting from other people's work.

Even if direct democracy was feasible, it is far from certain that it would be desirable. The principle of equality – ensuring that all members of the population on whose behalf decisions are taken have an equal chance of having their views taken into account – takes advantage of differences in knowledge, interest and abilities among the community members. The aggregation of thousands of opinions in a way that translates into collective wisdom rather than a chaotic hotchpotch of ideas may nevertheless be problematic[1] (Ford, 2002).

2. Introduction

d) Representative Democracy

In order to eliminate the flaws of a large-scale direct democracy, some form of representative structure has been introduced in most modern states. In a system commonly called representative democracy, which most people consider a default form of peoples' rule, a relatively small number of politicians (in proportion to the whole population) are elected by citizens to make decisions on their behalf. This kind of system relieves the lion's share of the population from engaging in day-to-day decision making, instead relying on a group of professional politicians who are supposed to act in the interest of their constituencies. While representative rule is considered a much more efficient decision-making model for a complex society, it comes with its own disadvantages which are now clearly apparent to the general public. The symptoms of what is widely recognized as a crisis of democracy are abundant. In OECD countries where voting is not mandatory, electoral participation rarely exceeds 70% (OECD, 2016) and polls show that only 7% of the United States citizens trusted the US Congress as an institution in 2021. One of the most obvious reasons for a low voter turnout is that the impact of a single vote cast in typical parliamentary elections is negligible. Studies show that an individual vote very seldom changes the outcome of an election. From the economic perspective which assumes perfect rationality and self-interest of a voter, the cost of participating in an election is higher than the benefits (a phenomenon known as Downs' paradox)[2]. The reasons for voters' apathy lie much deeper, however, and may be more related to the alienation of parliamentary politics from the public at large. Corruption and low transparency of modern politics, it's vulnerability to the influence of entrenched elites who have economic power and high incentive in shaping policy. The crux of the problem lies in the electoral mechanisms of

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[1] Which is not to say that it is impossible provided that certain conditions are met – for a more in-depth analysis of the collective intelligence concept see chapter The Wisdom of (diverse) crowds.

[2] Mackie (2012), instead of the dominant "pivotal" approach, in which it is irrational for an individual to vote unless he or she is pivotal to the outcome of the election, proposes a "contributory model" of voting, which states that citizens directly value the public good.

representative democracy that face a familiar dilemma of representativeness and effectiveness. A governing structure optimized for accurate electoral representation could become ineffective due to the large number of parties and representatives, resulting in the constant threat of gridlock and frequent power changes. A structure which encourages effectiveness, stability and cohesiveness of policy, employing measures that reduce the diversity of elected officials may face a greater risk of being taken over by a powerful minority. Another concern about traditional representative democracy is that even if representatives are competent about all relevant policy issues (which is a wild assumption), voters may have difficulty determining which representatives most closely share their values. Political campaigns tend to focus on polarizing, contentious issues in order to attract the attention of the voters, so matching candidates' views with one’s own is not an easy task. Moreover, all citizens in an electoral district ultimately have the same representative, regardless of how distant their individual views are from the elected official. Another layer of distortion of the political outcome stems from the fact that representatives are not obliged to vote in accordance with their declared program and bear no responsibility for breaking their promises (other than a distant perspective of losing another election). In most cases changing a representative that failed to deliver on his or her promises is difficult or impossible. For deeper analysis of the failure of representative rule to deliver outcomes supported by the majority of the public, see chapter Defining Democracy.

2. Introduction

e) Liquid Democracy

First envisioned in 1884 by Lewis Carrol (the author of the novel Alice in Wonderland) in his pamphlet The Principles of Parliamentary Representation, liquid democracy has since been experimented with primarily by online communities, showing much promise in advancing the age-old concept of democracy by placing it firmly within the technological landscape of the XXI century.

Liquid democracy can be seen as a middle ground between participation-oriented direct democracy and burden-minimizing representative democracy. It is a form of voluntary direct democracy in a sense that participants have a voice in all decisions, but voters can opt out by way of delegating their voting power to someone else if they choose to do so due to lack of time, interest, or expertise on a particular matter. The core difference between liquid democracy and representative democracy lies in the practicalities of the delegation of power. The metaphor of liquid helps understand the principle of the fluidity and divisibility of voting rights granted by delegators in liquid democracy. Contrary to the electoral model, there are no predefined jurisdictions or term lengths; delegates can be recalled at any time; delegates' votes can be overridden; the voting power can be divided and allocated to different delegates based on topic or specific issue; a chain of delegations is possible, with delegated votes being re-delegated further which is referred to as metadelegation. As a result, a 'liquid parliament' can be extremely flexible, as it potentially changes composition every time a new policy area is debated (Landemore, 2020); in fact, there may be a number of such assemblies debating at the same time.

This kind of liquid representation is aimed at maximizing the utilization of participants' expertise while limiting the amount of time devoted to decision making. Authority is granted only temporarily to persons considered specialists, instead of full-time politicians who exercise their power in all decisions. This creates ground for meritocratic governance. Participants in a liquid democracy type of governance system are expected (1) to decide whether their interests are better served by direct voting or by means of a delegate, if the latter is true, to (2) competently select an appropriate expert and (3) to decide when to exercise the immediate recall option (Blum, Zuber, 2016). Arguments from empirical studies strongly suggest that it is indeed possible. When the selection of experts becomes a collective endeavor, like in known digital knowledge systems, the community of users support the rational selection of experts through rankings and assessments. Moreover, a sufficiently diverse community in a liquid democracy system can make better decisions, even if the selection of experts is imperfect; under certain conditions, a collective of randomly selected decision makers outweighs that of the most competent decision makers working individually[3].

Empirical studies of voter competences in direct democratic decision-making show that even poorly informed people make meaningful choices thanks to heuristics. Then there's also a time factor: increased opportunities to participate in decision-making leads to increased knowledge and competences of citizens, as shown by a survey of cantons in Switzerland (Blum, Zuber, 2016).

Two crucial variables which may decide on the dynamics of a particular liquid democracy model is the number of delegates and the number of votes per delegate. Proponents of liquid democracy (e.g. Ford, 2002) suggest that voters should have

[3] This question is elaborated in the chapter "Collective wisdom in diverse groups".

direct relationships with delegates, who ideally represent tens or at most a few hundred voters. Large numbers of delegates, none of whom enjoy concentrated power, removes the threat of the system being taken over by oligarchy or salient public figures. Highly distributed and fluid voting power may result in policy inconsistencies (as different policies are voted on by different subsets of the community). There's also an issue of organizing a meaningful deliberation process for thousands of voters and delegates. The solution proposed for the governance system of Cryptopolis addresses these questions in multiple ways

First, every Cryptopolis user can propose an initiative for improving any aspect of the system. Proposals will be structured in a standardized way for the sake of clarity; each will feature a question (what is the subject of voting?), a short description detailing the goal of the initiative, a description of how to achieve this goal, a budget (if it is needed for implementation), videos or graphics to help visualize the idea, a timeline of the implementation stages associated with the release of budget tranches and an additional crowdsourcing tool for managing the project in a specialized working group. Of these features, only the question and the description would be mandatory. Once an initiative is put forth by a user, it is reviewed and categorized by a group of elected moderators into a topic and an area; topics can then be divided further into subtopics. Participants can then delegate their vote to a person of choice, granting him_her voting rights for all initiatives, a selected topic, or a more general area. In all cases they can withdraw their delegation and override the vote cast by a delegate during the voting cycle.

A crucial aspect of any type of quality democratic governance is the process of deliberation – the thoughtful weighing of options before a decision is made. In an online community like Cryptopolis creating discussion forums for each proposal is a default and sensible choice. All delegates as well as regular participants will have a voice in discussions but the visibility of comments will be determined by users' ratings. The weight of ratings will, in turn, be proportional to a participants' voting power. In order to keep the discussion clean and focused, a signaling option for inappropriate comments will be made available to users; the flagged comments will be delivered for review to human moderators.

3. Functionality

a) Interlink of Direct & Delegated Voting

Cryptopolis' voting mechanism is based on the principles of liquid democracy.

Every Cryptopolis user can **propose** an initiative for improving any aspect of the system. This is expounded on in the section on proposals.

All participants can then **delegate** their vote to a person of choice, granting him/her voting rights for all initiatives, a selected topic, or a more general area. In all cases they can withdraw their delegation and override the vote cast by a delegate during the duration of the voting cycle. Delegation can be also chosen for an unlimited period.

Every user is also encouraged to take part in discussion.

3. Functionality

b) Choosing Representation by Topic

When starting proposal creators can choose which topic their initiative fits best, moderators then need to approve the topic or can suggest moving the proposal to a different topic category, such suggestions should be accepted by users.

Categorizing the proposal into a comprehensible tree structure is an important first step for the efficiency of the delegation process.

Users can delegate all decisions through topics and subtopics.

For example, let's say that a user wants to delegate 'science' to User1, 'tokenomics' to User2 and 'culture' to User3, 'culture' is further divided into sub categories like 'film' 'music' and 'visual art'. Let's say that the user is very passionate about music, in such a case they can decide directly on the subject of music and delegate the rest of the subtopics to User3 or alternately they can delegate every subtopic to a different representative.

Delegation can be admitted for a single voting instance or for a longer period of time.

This mechanism promotes specialists in topics and not “omnipotent” politicians.

3. Functionality

b) Proposals-Based Self-Correcting System

In Cryptopolis every aspect of the system can be changed, even the most crucial ones, like voting power, information flow, blockchain code, transaction fee and moderators can be chosen or released. This is another layer of its “liquidity”.

3. Functionality

c) Proposals

Proposals will be structured in a standardized way for the sake of clarity; each will feature a question (what is the subject of voting?), a short description detailing the goal of the initiative and means to achieve it, a budget (if it is needed for implementation), videos or graphics to help visualize the idea, a timeline of the implementation stages associated with the release of budget tranches and an additional crowdsourcing tool for managing the project in a specialized working group.

Of these features, only the question and the description will be mandatory.

3. Functionality

d) Discussion

Quality democratic governance stems from the process of deliberation – the thoughtful weighing of options before a decision is made. Cryptopolis as an online community creates discussion forums for each proposal by default. All delegates as well as regular participants will have a voice in discussions but the visibility of comments will be determined by users’ ratings. The weight of ratings will, in turn, be proportional to a participants’ voting power. In order to keep the discussion clean and focused, a signaling option for inappropriate comments will be made available to users; the flagged comments will be delivered for review to human moderators.

3. Functionality

e) Moderators

Finding mistakes is heavily undervalued work. There is no Nobel prize for being the second person to discover something. There is no Nobel prize for fact-checking.

Once an initiative is put forth by a user, it is **reviewed** by a group of elected moderators.

In the decision-making process fact-checking and structurizing discussion are key components. It might also be very difficult work that demands multidisciplinary knowledge. In many cases more advanced than creating a proposition for a solution.

For those reasons we have decided to combine **Artificial Intelligence**'s ability to make swift and detailed research with human oversight and financial motivations for users.

At the beginning of the process users that get familiar with the projects and take part in discussion about it can give “red flags” where they think something is misleading, at the same time A.I. with a focus on language is searching independently. Red flags from users will be compounded with those made by A.I. and the final results will be given to human moderators, which will need to evaluate the aggregated data.

Moderators will be chosen and dismissed by the community through voting at any time (conviction voting, see below, may be used in this process).

Users that mark the bugs and moderators reviewing the marked material will be gratified in pangea token. This issue will be discussed in more detail in the section 4b of the whitepaper (Improving Functionality & Value for users)

3. Functionality

f) Voting & Types of Voting

Transparency

In democracy an important balance to achieve is between **transparency** and **anonymity**.

- Transparency is necessary for users to believe in the fairness of the voting process and the system's underlying principles.
- Anonymity is important in preventing corruption, bribery in exchange for votes and ensuring the safety of sensitive financial data (since voting is linked with the amount of tokens).

Votes which are cast directly by users are anonymous, as well as the ones they delegate to representatives.

When a representative receives votes, the amount they have received is visible, however the users who have delegated their votes to the representative remain anonymous. When the delegate casts their total vote, the users remain anonymous and the number of votes delegated to the representative stays visible.

A study of the decision making platform (LiquidFeedback) used by the german Pirate Party (2010-2013 with ~14k users, ~500k votes, ~15k delegated votes) has shown that:

The proportion of votes cast directly for yes is negatively correlated with the number of votes cast. This effect is much less visible among delegates. What's more, the greater the voting power (more incoming delegated votes), the greater the tendency to support initiatives and vote in accordance with the will of the majority of users.

This mechanism shows that delegates, despite their greater voting power, take into account the will of other users, making the system more democratic.

This is one of the reasons why the process of voting will be visible live. Users and representatives will have the opportunity to adjust their votes, and will be more motivated to manifest their decision or view on the matter at hand.

Time

The amount of time open for voting may be subject to change. We are currently proposing a 2 week timeframe. However it's possible that different subjects might need different timeframes - some investment possibilities might have a more pressing timeline, and conversely some fundamental decisions might need more time for in depth analysis and deliberations.

Right to change votes

Users can change their vote throughout the entire duration of the voting period. Thanks to the deliberation process many new angles and facts are given the chance to appear.

Alternative Mechanisms of Voting

- Multiple - Choice Voting
  - Instead of a binary system allowing people to vote yes or no, it is possible to choose a few alternatives, from which the users specify which suits them best.
- Simplified Cumulative Voting
  - Introducing the option of voting on a scale of 1 - 100% (can be expressed with a slider). This way voters can more precisely express their preference for a specific project. Thanks to this, the initiatives developers receive a more exact feedback loop.
- Lazy Consensus
  - In a lazy consensus, it is assumed that the absence of objections indicates agreement. A proposal is approved if no one objects within the specified timeframe. Otherwise the proposal is put to a vote.

A key issue in a lazy consensus is that people find it easier to agree to a proposal without doing anything than to object (which requires activity).

This has two effects: first, people are less likely to object for the sake of objecting, and second, the amount of time spent on unnecessary discussions is reduced. At the same time, however, it requires vigilance on the part of each member.

This type of voting can be used in teams that work on specific projects, that are small and have basic level of trust towards each other.

Conviction Voting

Voters declare their preferences as opposed to casting votes during a session limited by a time framework. Everyone can change their preference at any point in time, but the longer they maintain a preference for the same proposal the stronger their vote becomes. Once a threshold of votes (accumulating over time) is reached, the proposal is accepted.

Continuous voting is an example of biomimetism in systems design. This example is analogous to the mechanism by which neurons in the brain work - an action's potential builds up over time until a threshold potential is reached, beyond this threshold the neuron is stimulated.

This type of voting can be applied to key elements of the system (e.g. constitutional).

3. Functionality

g) Voting Power

The formula for translating voting power is designed to protect the system from sybil attacks as well as maximize the value that can arise from the wisdom of a diverse crowd.

First off, let us notice that both of these presented scenarios are far from perfect:

1. One token - one vote. On the positive side, users that have high stakes have the most votes, so the risk of voting against the benefit of the system is low, because that would mean sabotaging their own interests. However, users with lower stakes would have less motivation, so the system would not have the advantages that come from the diverse crowds wisdom (see chapter 6f). Nor would it be much different from a classical top-down organization.
2. One person - one token. The advantage of such a solution is high democratization. That being so it is susceptible to a sybil attack - where a log of agents create wallets with minimum volume and vote in unison against the system. Also it minimizes the incentive to hold tokens.

For these reasons we propose a more nuanced formula that includes:

Amount of Pangea Tokens

To prevent manipulating votes through the creation of a large number of accounts with small amounts of tokens, the weight of the specific vote is proportional to the number of tokens the voter has.

We assume that the greater the number of tokens, the greater motivation the voter has to vote for the good of the system. However, above a certain number of tokens, the weight of the vote will increase disproportionately in order to maintain a high level of democratization in the decision process.

Reputation

Reputation plays a key role. It helps to evaluate users who act against the development of the system, and in such cases reduces their voting weight, as well as allows them to rate specialists.

Experience

As a user gains voting experience (the number of votes cast) their voting power will increase.

A study of the decision making platform (LiquidFeedback) used by the german Pirate Party (2010-2013 with ~14k users, ~500k votes, ~15k delegated votes) has shown that:

There is a noticeable tendency to vote yes” 0.71 (in other words: the likelihood of voting in favor of an initiative is significantly higher than the likelihood of voting against an initiative).

A similar tendency has been observed in rating systems used by online platforms (Amazon, IMDB), which may indicate a general inclination to express positive opinions and a reluctance to express dissent.

The proportion of votes cast (directly) for yes is negatively correlated with the number of votes cast.

We conclude that as the number of decisions made increases, self education increases as does the number of critical voices.

Proof of Identity

Users that are verified as humans and linked to a single account gain higher ratings from the system. This is explained in greater depth in the chapter: system architecture/ Identity provider (IDP).

3. Functionality

h) DAO That Creates DAO

As more and more work becomes remote, we use even more digital tools to manage tasks.

Cryptopolis's ambitious goal is to create software that combines decision making DAO, and project management tools with communication features that can help in creation, funding and management of different projects. Not only for Crypotolis it-self or Crytopolis based startups but also for a wider range of initiatives.

This feature intended for research groups, NGO-s and private companies will be based on the same principles described in this document. Creating and maintaining such dao will require Pangea tokens - in this way users of pangea can benefit from other initiatives and the costs of maintenance can be covered.

4. Tokenomics

a) Transaction Fee

Every transaction in both the traditional financial world and in the crypto world has a cost.

Banks often choose to minimize the cost of transfers within a country, however international transfers are expensive (and often painfully slow). Creating free internal wire transfer is also not without costs. Usually banks cover such costs with proceeds from other products. On other hand, fees for cryptocurrency transactions can vary greatly. In general costs are substantially higher in Proof of Work systems, for instance bitcoin being probably the most costly; in times of high demand the price can go up to over 20 dollars per single transaction. In contrast, proof of stake systems can go as cheap as the equivalent of 0.00025 $ per transaction.

Usually, the cost of such a transaction is mainly part of the consensus architecture. In our case we are adopting a new generation blockchain, therefore the technical cost of a transaction is on a minimal level.

Our proposition is a treasury system where most of the transaction fees will be collected. In a sense, it's similar to a country's tax redistribution system.

To start off, we propose that the transaction fee will be at the level of 0.5 % of each transaction. Setting this metric right is fundamental to the success of the whole network. If too high, users will not be motivated to move funds and use Pangea tokens, or they will migrate to wrapped Pangea tokens on other chains. On the other end of the spectrum if the fee will be too small - it will slow down the growth of the network.

At first, the transaction fee is split into two parts: one which covers the technical maintenance of the network, and the second which goes to the treasury. At this point the split happens automatically, so the network is not at risk of shutting down.

All the proceeds that exceed the maintenance fee will be subject to voting in the Cryptopolis DAO.

From this point onward, all the team can do is propose new solutions for growing the network and value of the Pangea token (details on the proposal-based system 3.g).

We strongly believe in the wisdom of the crowd (further reading in chapter 4a), that a community thanks to the diversity of ideas will be able to make the best decisions.

We propose the division of projects and funds into two main categories.

1. Improving Functionality
2. Backing & Stabilizing the Value

4. Tokenomics

b) Improving Functionality & Value for users

A part of the budget is orientated to **grow** the Cryptopolis DAO, software and network.

In a DAO users are essential, therefore an important part of the system is the tokenomy that benefits active users.

The first and foremost reward for users is an appreciation of value in their token holdings. Since participants of the system are token holders, it is in their interest to navigate the system in a way that is to the best of their knowledge beneficial for a healthy and growing economy.

Nevertheless, we believe that incentives for participation in the DAO are equally important.

Our organization aims to engage as many active users as possible. That's why we are proposing rewards for voting, creating new projects, and bug detecting. such a solution provides different kinds of benefits. Through this process, users with a smaller amount of tokens and a high amount of engagement can benefit from such rewards and build their portfolio through work.

Reward for Voting

In a sense the Cryptopolis network is a human computer. Voting is the conclusion of a synthetic process at the junction of a single user's knowledge and the review of a proposal, therefore such work should be rewarded.

Users will benefit equally from negative and positive votes, so economics does not interfere with judgment.

Specialists who accumulated votes will benefit from extra voting, so their work and expertise are appreciated.

Rewards for Projects Creators

Creating a project in Cryptopolis should be a responsible act. The community will benefit the most from many high-quality projects, not a sea of poorly-thought-through ideas. That's why we came up with gamified economics.

Creating a proposal will have a cost, for example 1 Pangea token. Project creators whose proposals will be accepted will be rewarded (for example 10 Pangea tokens). Of course in a project where there is a budget, a creator can place remuneration for them and their team.

Reward for Bug Detecting

Many initiatives can benefit from early bug detection. Cryptopolis funds can also benefit in case some important project was created in a misleading or fundamentally flawed way and it was detected before funding. That's why rewarding users for pointing out an inaccuracy in a project or discussion is indispensable.

Different mistakes carry different burdens. For this reason the economics of rewarding bug detection should be carefully crafted and subject to further research.

Investment Fund

In this section, we grouped proposals for software-focused solutions, not all of them will require a budget.

They can include:

- Changing parameters in chains or rules
    - Transaction fees, smart contract structure, architecture, scaling solutions
- Rules of participation in DAO

    - like - voting power, the reward system, structuring debates, structuring data
- Crowdfunding
    - new layers, platforms, or startups - that brothers Cryptopolis ecosystem.

Some of them could be managed during the process of creation and after, through separate DAO's based on Cryptopolis. Found can be released in stages of the process, after approvals (or use lazy consensus - see chapter 3g).

4. Tokenomics

c) Community - Driven Backing

Users can create real-world organizations that for example buy and store gold and link them with the Pangea value. Although today's legal environment seems still difficult in this area, it's not impossible as newer and simpler solutions are emerging.

Since these organizations will be decentralized and diversified the risk of relying on a single entity is minimalized.

There is almost no limit to the types of assets that can back Pangea.

For example rare minerals, stocks or companies, alternative energy contracts or enterprises, valuable pieces of art, collectibles, cryptocurrencies, and stablecoins. We have a special place in our hearts for land investments, viewing them as a great opportunity - (you can read more in chapter 3q).

The value of such diversified backing could be automatically calculated and expressed in the diagram. The total value of backing assets is comparable to asset-based valuation in business. It brings the bottom valuation of Cryptopolis organization on which stabilizing assets will have minimal value.

The network is designed in such a way that from every transaction part of the fee goes to stabilizing the currency (Cryptopolis users have the power to decide to change this or modify it in the voting process). For this reason the network’s growth has a stabilizing effect on the valuation, making it more difficult for the value of the network to drop to zero (like it is in the case of most cryptocurrencies).

In the worst case scenario when market capitalization goes below stabilizing value users can decide to liquidate assets to defend the price of Pangea.

Of course, the most likely scenario is that the valuation of the network will be significantly larger than the assets.

However small, we believe that decentralized backing can bring new usability for Cryptocurrency. Especially during crypto winter - when cryptocurrencies can drop significantly. This form of backing can give users assurance that the currency is still usable, therefore can be used with more confidence as a desired method of payment.

Furthermore, we believe that the wisdom of the crowd (see chapter 4a.) combined with advanced DAO like Cryptopolis can achieve much better investment strategies than huge funds.

4. Tokenomics

d) Pangea - A Decentralized Supercontinent

From the almost unlimited list of possible assets in our opinion land has a very special place. In this section we further expand on the reasoning behind this.

- There is a finite amount of land on Earth. The small exception to this is the possibility of producing artificial islands, however, as is evident from the example of the Dubai Palm Islands, this kind of endeavor is an enormous struggle to build one within bounds of economical common sense (and we are not even discussing the reality of the ecological impact). For this reason land is the ultimate scarce asset.
- Due to climate change, there are fewer and fewer habitable areas. Rising sea levels, as well as the increase in extreme temperatures, will render many areas previously habitable unlivable thus reducing the amount of space humans can survive in.
- Land is often the first necessary stage from which most elements in the chain of assets can originate. Food relies on land, as do minerals, and many kinds of materials are mined or produced on land - usually, land owners have the right to those assets. It's hard to imagine any kind of production without access to land. Many businesses need land to work, and last but not least people need land to live on.

- Earth is the best planet for humans to live and thrive on. There is no better place in the universe accessible for us through either current or predictable technology. Planets, reachable for humanity by means of envisionable space travel, have extremely difficult environments to sustain life on. Without crucial elements found on earth they are uninhabitable. Possible time spans needed to bring them to an inhabitable condition and possibly function as independent systems are very long and even in such cases, they will not be as pleasant to live on as Earth.

Let us get back to the earth then. If the Cryptopolis community decides to buy land (for example in a city or near an urban area) users can propose projects on how to manage this space. For example, they can vote for a project that proposes to create a cafe, which would bring local members of Cryptopolis together as well as other customers. After the expenses are covered the profits can be shared between the users involved in running the project and the Crytpolis network (since it was funded through Cryptopolis). In such cases, Crytopolis benefits in both ways from this project. First, thanks to backing the currency with land and infrastructure, and second with an additional revenue stream that goes back to the pool.

In case the cafe won't be deemed successful by the users, either through profitability issues or because a line of thinking about such a project might change, Cryptopolis users can vote to close or change such a project. Of course not all projects need to be profitable independently, in many cases, they can bring value to the community that's more important than short-term profit.

We intentionally came up with a simple business model as an example, but we're convinced that the proposed structure with time can develop to manage more complex solutions.

If that model would be successfully adapted, with time and with a larger investment pool, the Cryptopolis network could manage more and more Land which would take it to another level of possibilities. We strongly encourage users to think about this growth strategy in terms of systems thinking (5b) and ecological sustainability (5g).

5. System Architecture

In this chapter we explain the core ideas behind the architecture of the system. If technical language is not your preferred way of adopting ideas, and you want to learn more about the vision and philosophy behind this project you can skip on to chapter 6.

1. General Concepts and Elements

a. Object-Oriented Ruleset (OOR chain)

The Object-Oriented Ruleset chain is where the Cryptopolis system stores all of its data (Code, Users, DAOs, Proposals, Votes, Public Keys, etc). Each OOR Object has an ordinal value, a unique identifier (OID) that is made by hashing the OID of the previous object (ordinal value – 1) and the current object ordinal value. This secures the chain from any form of tampering and loss of integrity. A complete replica of the OOR chain is shared by all of the cryptopolis clients, which will be discussed later. The OOR synchronization is done using the P2P layer, ensuring that all clients have the most up to date and valid version of the chain. Each client can validate the chain using the OIDs and threshold signature scheme.

b. Chain Application (Cryptopolis Core)

The application is the core of the system and it is fully decentralized. Each component of the application is an independent microservice that can call other microservices. Code for each microservice is treated as a block of the OOR chain, so there is a limit in the size of code that a single microservice cannot exceed. The microservices can be written in any code that compiles to wasm. There is an initial set of microservices required for the application to work, but they can later be replaced with new versions. There can also be brand new microservices that extend the application functionality.

All changes to the application code (creating, updating or deleting microservices) are subject to yes-or-no voting, just like for any other proposals in the cryptopolis system. Voting can consist of one phase (pre-approval) which means that the change is being voted and then being uploaded to the chain or two phases (pre and post-approval) which means that the change needs to be approved also after it's being uploaded, otherwise it'll be reverted. Two phase approach is better for safety since it lowers the chances of the faulty code breaking any functionality of the application. For both approaches, the fundamental safety requirement is providing the uncompiled code for public review while submitting the proposal (request for change) and also providing test evidence in the form of both manual (functional) and automatic test results (unit testing). Testing can be done in the local (sandbox) environment which will be discussed later.

Initial application functionality is as following:

- Creating DAOs. Each DAO can have it's own decision pool and budget) through GUI;
- Creating proposals. Proposals can be global (for the entire system) or local (for DAOs);
- Conducting voting, handling voting delegations and calculating a particular user's voting power. There are a few types of voting: basic (binary yes or no), multiple-choice voting, simplified cumulative voting and lazy consensus. Their details are described in the functionality section. The application stores algorithms and generates a user interface for each type of voting. It also calculates time to close voting and handles any changes (users are allowed to change their votes during a certain timeframe). In a similar way, it also stores logic for voting delegations.
- Storing encrypted Pangea wallets (and providing their addresses via API) for DAOs and proposals (decentralized budgets);
- Handling various meta functions such as reviewing proposals and grouping proposals into topics by moderators, calculating the reputation or experience of a particular user, gratification for users/moderators;
- Providing a forum for discussing proposals, where each user's comment can be rated by other users (and being reported to the moderators if necessary);
- Providing an API endpoint for interacting with the OOR in a secure way;
- Providing an API endpoint for calculating fee for Pangea transactions and getting the address to send the fee;
- Interacting with the external API.

The application sends HTTP requests to the external API from the AI engine provider. It sends the descriptions of proposals and comments to the AI engine for doing automatic verification of their sources and logic. In return, the application receives scoring which can then be used to flag the content, which is then reviewed by human moderators.

c. Identity Provider (Cryptopolis IDP)

Identity providers are independent applications that provide identity (in the form of logging in and password resets for existing users and registration for new users) to the core application. They are externally hosted and managed, and the main application chooses to trust them or not by including or removing their public key in the OOR (each IDP must have a keypair for signing requests to the application).

This trust process occurs in the form of a regular liquid-democracy proposal voting from the app itself. The implementation of the specific proof-of-referral or KYC mechanism is left to the IDP developers due to their relatively dynamic nature that makes it unsuitable to handle entry-level authentication inside the main application. It's the same for implementing any additional security mechanisms such as 2FA or passwordless authentication.

In practice, after registration through IDP the data of the user is sent to the main application via API and then stored on the OOR chain (the application checks whether the registration request was signed by an IDP private key). After the user is created in the OOR, he or she can log in (or reset password) using any IDP trusted by the main app.

d. Client Nodes (Cryptopolis Client)

In order to participate in hosting the cryptopolis chain application, one needs to download the cryptopolis client application. The client application is fully open-source (github hosted) and consists of an executor and a validator. The executor part executes code for the microservices while the validator is able to validate whether the new blocks that were received from other nodes are valid or not. Validation includes basic validation (checking the signature, hash verification against OID) and more advanced validation (against the application logic, such as checking whether the particular request was properly authorized).

Client nodes also have basic failsafes embedded such as the possibility to revert any changes to the chain application if there are any errors, or if the community won't provide final approval for the recently deployed code changes (the so-called two-phase deployment as discussed earlier). All client nodes send heartbeats to the always-on nodes every predefined number of seconds in order for the always-on nodes to know that they are still online.

All of the clients have a full replica of the OOR chain. Each client also has a share of the private key corresponding to the chain application public key. Using the threshold signature scheme, if a sufficient number of client nodes agree, they can use their own key share to jointly sign a message. This removes the need for proof of stake or proof of work validation, allowing the chain application to run at web-speed.

Clients, in order to find each other for the first time, need to connect to the always-on nodes in order to receive a list of possible nodes. After that, they remain connected to each other. This implementation is based on the Kademlia protocol, with always-on nodes used for bootstrapping. Client nodes are gratified with the pangea tokens for utilizing their computational power. P2P logic is used to replicate the chain so that all nodes have the most up to date version of it and also for the validation purposes (consensus). Only a response that has been validated by a defined number of nodes can be sent back to the user. If the validation fails, the node which provided a fake response gets banned out of the network and loses all rewards.

e. Always-on Nodes (Local Load Balancers)

Always-on nodes in the cryptopolis system serve the following purposes:

- They provide HTTP access to the system acting as HTTP servers (nginx) with load balancing features that forward the HTTP requests to the geographically nearest executors (client nodes) and then respond to the requests with executed content. Always-on nodes also provide integrity verification of the content, caching, rate limiting (protection against DDoS attacks), etc.
- Always-on nodes also maintain a list (including geolocation and wallet addresses) of the client nodes that connected to them recently for the initial peer discovery purposes (bootstrapping) and load balancing purposes;
- They can also verify whether the response has been validated by a large enough number of client nodes by checking its signature against the chain application public key.

All of the always-on nodes are linked to the DNS server of a top-level domain (TLD) for cryptopolis. The user is directed by the DNS using the traffic steering mechanism (geographic proximity) to point to the nearest always-on node, which then uses its internal logic to redirect the request further to the client nodes. The traffic inside the system (between client and always-on nodes) is encrypted internally using TLS, and at the always-on nodes layer the TLS is terminated in order to use the external TLS certificate for TLD.

Initially, there will be one top level domain (cryptopolis.community), but this can later be changed in order to eliminate any single points of failure.

The always-on nodes have two types of storage:

- Private storage for information (IP, geolocation, wallet address, etc) about client nodes that connected to it in a certain time window;
- Public (shared) storage for statistics on web traffic that was handled by always-on nodes and client nodes. This storage is also used for the distribution of distribution (Pangea tokens).

The validation and gratification mechanism for always-on nodes is similar to the one utilized by the client nodes (based on the threshold signature scheme). Both client and always-on nodes are gratified during randomly defined intervals. If the validation fails, the node is banned and any previous rewards are lost.

2. HTTP Request Flow

a. The HTTP request sent by the user is received by the DNS server for TLD;

b. The DNS server forwards the request to the geographically nearest always-on node using the Steering/GeoIP;

c. Always-on node receives the request, performs some basic checks for rate limiting, caching etc. If the request is “new” (no cache entry) and valid, it strips any unnecessary headers and finds the geographically nearest client node, sends the request (with its own address so that the nodes know where to send the response and for later rewards distribution) and gives it some time to process the request. If the response does not come in a predefined time window, then the always-on node returns the HTTP 504 error code and removes the node from its list;

d. The client node executes the request and shares the response with a predefined (required by a threshold signature scheme) number of other client nodes to validate it. If all nodes agree that the response is valid, the client node sends it back to the always-on node. If the response consists of updating the OOR chain, the chain itself is also updated;

e. Always-on node terminates the internal TLS, uses the external TLS certificate (for TLD) and sends the request back to the user.

3. Local Environment

For development purposes, there is a portable version of the cryptopolis system consisting of an embedded HTTP server (nginx) combined with a single, offline client node. Same as with other elements of the system, its code is open source and can be viewed/modified/forked using github.

This local sandboxing environment allows the developers to run the cryptopolis core application on localhost (127.0.0.1) and test any changes with an easy option to revert them. The portable version has an ability to clone the real chain to stay up to date with the production environment while skipping any non-relevant data (such as user data), maintaining a small subset of dummy test accounts, proposals, DAOs etc. for functional testing.

4. API Endpoints of the Chain Application

Access	HTTP method	Endpoint	Sends	Receives	Description
Restricted (token contract only)	GET	fee	Amount (decimal) Sender (hash) Receiver (hash)	Fee (decimal) Addr (hash)	Endpoint used by Pangea token smart contract to calculate transaction fee and get the address to send the fee
Public			Name (string) Target (string, optional) Status (integer 0-2, optional)	OOR Object (JSON)	Getshe most recent object of the given name and, optionally, of the given target and/or of the given status

			Owning DAO ID (OIDl)		and/or of the given owning DAO ID
Private (localhost only)	POST	object	Owning DAO ID (OID) OOR Object (JSON) Owning DAO signature (JSON)	Status (success or failure) Error codes (if any)	Create new OOR object (status of the new object is always 1 – active)
Private (localhost only)			OOR Object (JSON) Owning DAO signature (JSON)	Status (success or failure) Error codes (if any)	Update OOR object
Private (localhost only)	PUT	approve	Owning DAO ID (OID) OIDs Owning DAO signature (JSON)	Status (success or failure) Error codes (if any)	Convenience method (same result can be obtained using the PUT object method but with more complexity, so it’s less human-friendly) used to approve multiple OIDs (endpoint used in proposals to approve one or more objects)

Restricted (request must match one of the IDP URLs)			ID (integer) Salt (random string) AuthToken (string made from encrypting UID and Salt by the ID app private key)	Chain UID (hash) Status (success or failure) Error codes (if any)	Creates a new user on the chain
Restricted (request must match one of the IDP URLs)			UID (integer) Salt (random string) AuthToken (string made from encrypting UID and Salt by the ID app private key OOR Object of the user (JSON)	Status (success or failure) Error codes (if any)	Updates the user on the chain
Restricted (chain web app contract only)			Owning DAO ID (OID) Salt (random string) Owning DAO signature (JSON)	Balance (decimal)	API method to check the DAO wallet balance

Restricted (chain web app contract only)			Amount (decimal) Destination (address) Owning DAO ID (OID) Salt (random string) Owning DAO signature (JSON)	Status (success or failure) Error codes (if any)	API method to transfer funds from the DAO wallet
Restricted (chain web app contract only)	POST	wallet	Owning DAO ID (OID) Salt (random string) Owning DAO signature (JSON)	Status (success or failure) Error codes (if any) Address (if success)	Create a new DAO wallet

OOR structure and initial (sample) object

Count	The order of the object on the chain
OID	Unique identifier that is made from hashing the OID of the previous object (count – 1) and the current count

Owning DAO ID	OID of the DAO that owns this object
Name	Unique name (it's different from the ID – ID can be used only once, but the name can be used by more than one object, for example - object User1 can have ID 1 (initial) and 2 (updated), but when you query the GET object endpoint asking for User2, you'll always get the User1 object with ID 2 since it's the most recent one.
Status	Status: 0 – archived, 1 – active, 2 - approved
Timestamp	Automatically-assigned timestamp
Description	Human-readable description
Class	Object class. List of available classes is to be done by querying the initial class object (Init)
Target	Target for a decision, eg. which endpoint to query during object initialization and by which method. Can be null if the object is not a decision or the decision is not linked to any automation
Content	Object content (can be JSON) with maximum 24 KB of size

Initial object

Count	1
OID	<random seed>
Owning DAO ID	N/A
Name	Init
Status	1
Description	Object classes registry
Class	INI
Target	N/A
Content	INI – Object classes registry USR – User DAO - Decentralized autonomous organization PRO - Proposal VOT - Vote IDP – IDP public key and other details like URL COD – Code (compressed, uncompiled code for web app)

	STO – Storage (generic storage for web app of things like reputation, comments, ratings, delegation of voting power, etc)

6. Broad Context

a) What is Systems Thinking

Living successfully in a world of systems requires more of us than our ability to calculate. It requires our full humanity—our rationality, our ability to sort out truth from falsehood, our intuition, our compassion, our vision, and our morality.

Donella Meadows, Thinking in Systems. A Primer (2008)

Most people would probably be willing to acknowledge that a piecemeal approach to solve complex problems is ineffective. Nevertheless, adopting an alternative, holistic view of how things work requires a fundamental change of epistemic tools and a whole new understanding of reality. Systems thinking provides a comprehensive framework that enables one to appreciate the notion often summed up in the stock-phrase ‘the whole is more than the sum of its parts’. What it means, in essence, is that the properties of any dynamic system cannot be reduced to those of its elements; in other words, the building blocks are less important than the way they are organized. A structure of the system, understood as a whole, gives rise to patterns of behavior. Therefore, in order to understand the root causes of any phenomena arising in a living system, one needs to look holistically at a web of relationships and processes that govern it rather than analyze isolated elements. What is perhaps the most striking realization for an adept in systems thinking is that the system, to a large extent, causes its own behavior (Meadows, 2008). This has profound consequences not only for understanding a problem at hand, but also for the quality of generated solutions. Systems thinking helps to understand that removing or replacing a problematic element (eg. a corrupt politician, a powerful drug dealer, a new flu virus) does not yield a solution when the problem is rooted in the internal logic of the system (the structure of incentives in politics, the systemic causes for the existence of an illegal drug market, immunity level of an organism susceptible to infection). It enables one to ask better questions and be more creative and daring about system redesign (Goodman, 2018).

Systems thinking requires a radical shift of perspective: from objects to relationships, from quantities to qualities, from structures to processes, (Capra and Luisi, 2014). What used to be seen as an object, a separate part, is itself a network of relationships, nested in a larger network: organisms are parts of ecosystems, organs are parts of organisms, tissues are parts of organs, cells are parts of tissues, molecules are parts of cells, atoms are parts of molecules – down to subatomic particles, which too, as quantum mechanics reveals, are probabilistic patterns of relationships rather than solid building blocks of matter. The relationships, as opposed to objects, cannot be quantitatively measured; they can only be qualitatively mapped. Another shift involves understanding that a structure is the result of an underlying process. For example, a cell in a living organism is replaced according to an elaborate sequence of biochemical processes. Thus a cell, or any structure, can be permanently changed only by altering the process that leads to its emergence. Generally, a system stays in equilibrium even with complete substitution of its components, provided that its interconnections, processes and purposes remain intact. This serves the primary function of almost every existing dynamic system, namely its self-perpetuation. Additionally, resilient systems are very often adaptive, able to reshape themselves in response to signals from the environment. This capacity of a system to improve its own structure, to make it more refined, complex and heterogeneous is called self-organization; a phenomenon that is often unpredictable and, at first glance, disorderly, yet leads to the emergence of novel solutions.

Systems theory aspires to map and explain patterns of behavior at different levels of scale in a unified way as it is increasingly recognized that all systems – physical, biological or social – share a set of common properties. This makes the systems approach profoundly multidisciplinary, ultimately leading to the integration of all scientific disciplines. This unity of all science, now looming over the horizon with the development of systems theory, ultimately leads to more coherent, and accurate, models of the world.

6. Broad Context

b) Historical Context of Systemic Thinking Development

The origins of systems thinking can be traced back to Aristotle and his systematic overview of all the branches of knowledge of his time. A multidisciplinary philosopher par excellence, Aristotle was equally interested in the study of matter and its fundamental building blocks, as well as the study of form, which involves mapping of patterns and relationships. His vast intellectual legacy formed foundations for modern science, including the first attempts to formulate a comprehensive systems theory in the first decades of the twentieth century.

The emergence of systems view can be seen as a response to the complexities and multi-faceted challenges that steadily arose as a result of applying the analytical apparatus of science to solve large-scale problems generated by rapid industrial development. Applying technological solutions to narrowly defined issues lead to unintended consequences, requiring more techno-fixes, which in turn generated new problems in a seemingly endless spiral. In the words of Gerald Weinberg (1975), 'science and engineering have been unable to keep pace with the second order effects produced by their first order victories'.

Scientists of the modern era, cultivating their specialized knowledge in isolated fields of knowledge, were ill-equipped to handle crises of hitherto unimaginable scope and complexity such as pollution, resource depletion or chronic diseases. In this context, the insights of Alexander Bogdanov, a Russian physician, science-fiction writer and philosopher stand out as pioneering and timely. In his work Tektology: Universal Organization Science, published in Russia in 1922 (and translated to English only in 1980!), Bogdanov anticipated many ideas later developed into general systems theory and cybernetics. His ambition was to formulate universal principles of organization observable in living and non-living systems. In Bogdanov's own words, 'all things are organizational' and the aim of tektology was no less than 'the systematization of organized experience' which can be accomplished by studying 'the totality of connections among systemic elements', or in other words, patterns of organization. According to Bogdanov the dynamics of the system can be framed in terms of two fundamental mechanisms: formation and regulation. The formation dynamics involves establishing connections between what he called complexes which results in a higher-level order. Any organized entity can be rapidly transformed as a result of crisis, understood as a sudden breakdown of the established systemic balance, leading to a new, qualitatively different state. Bogdanov's understanding of crisis as a catastrophic transformation laid the groundwork for complexity theory with its key concept of bifurcation (Capra and Luisi, 2014).

Meanwhile, Western organismic biologists came to the conclusion that the whole of an organism is driving its embryological development, behavior, reproduction, and physiology. Their ideas helped adopt a more systemic lens in biology – in lieu of anatomy, parts, structure, the notions of connectedness, relationships and patterns came to the foreground. In the 1940s, Austrian biologist Ludwig von Bertalanffy synthesized these ideas into general systems theory, a paradigm based on the recognition that all systems have general characteristics independent of the scientific domains (Skyttner, 2005).

6. Broad Context

c) The Rise of Cybernetics

> *The thought of every age is reflected in its technology . . . If the seventeenth and early eighteenth centuries were the age of clocks, and the later eighteenth and nineteenth centuries constituted the age of steam engines, the present time is the age of communication and control.*
>
> *Norbert Wiener, Cybernetics (1948)*

The post-war period was remarkably fertile for the blossoming of systems thinking approaches. The U.S. military was particularly involved (and generous) in the pursuit of developing science that would aid technical innovation and decision-making in the complex, highly competitive landscape of the Cold War. One of the results of these explorations, facilitated by the famous Macy conferences which gathered scientists representing various fields, was Norbert Wiener's seminal work Cybernetics or Control and Communication in the Animal and the Machine, published in 1948. The word 'cybernetics' was formed from the Greek kybernetes ('steersman'), which gives a hint on the new discipline's main question: how to control complex systems through information in order to steer them in the desirable direction.

Cybernetics became an interdisciplinary intellectual movement, involving mathematicians, neuroscientists, social scientists, and engineers, all studying patterns of communication in closed systems. It embraced universal principles relevant for physical and living systems, both of which, as cyberneticists observed, were governed by cyclical rather than linear processes (Skyttner, 2005). In any dynamic network, information, understood as relevant data that influences the system, follows a cyclical path. This leads to the core cybernetics concept of feedback loop which can be understood as a circular arrangement of causally connected elements. In a feedback loop, the first node is affected by the last, resulting in self-regulation of the entire system, as the initial impulse travels around the network (Capra and Luisi, 2014). The result is a recurrent pattern of behavior. Even more importantly, the feedback loop mechanism enables equilibrium – information about the environment is communicated through the system with the purpose of maintaining balance of the whole, or in other words, resisting entropy. In living beings, the same condition of keeping physiological variables within limits conducive to sustaining life is called homeostasis. Cyberneticists model not only humans but all living systems as self-perpetuating patterns of relationships. As Wiener himself noted in his later work (1950), "the pattern maintained by homeostasis is the touchstone of our personal identity. Our tissues change as we live: the food we eat and the air we breathe become flesh of our flesh and bone of our bone… We are but whirlpools in a river of ever-flowing water. We are (...) patterns that perpetuate themselves."

The field of cybernetics reached maturity when concepts regarding information, feedback, and control were generalized from practical applications in engineering to living organisms, language, mental processes, as well as social systems.

The human brain seen through a cybernetics lens, is an enormously complex and intricate system of neural networks nested within larger networks. Cyberneticists strived to express neural mechanisms in mathematical language to ultimately create a precise science of the mind. Indeed, contemporary neuroscience originates in these pioneering attempts to model the brain as a hyper-complex cybernetic machine.

The concept of feedback loop applies to social sciences as well. Metaphors like the famous 'invisible hand', steering the free market towards balance according to Adam Smith, or a system of 'checks and balances' introduced by the U.S. constitution to protect against tyranny point to the notion of circular casuality with a balancing effect. (Capra and Luisi, 2014). It can be generalized that social systems are in fact systems of communication that generate feedback loops through which they tend to regulate and organize themselves. The consequences of an error spread through the communication network along feedback loops, finally returning to the source and enabling corrective measures.

Along with groundbreaking concepts such as "algorithm" and "computation" developed independently by British mathematician and logician Alan Turing, cyberneticists' ideas were pivotal in the development of computer science and later artificial intelligence.

6. Broad Context

d) Network Society

Social networks often manifest in ways that extend beyond the network. They create material infrastructures – such as roads, houses, or heating systems, or they develop communication tools such as language, literature, the telephone or the internet. Social networks also come into dialogue with nature, especially visible in agriculture.

All of these creations arise from and with meanings, the significance of which cannot be understood in isolation and always exist within a context. Nothing has meaning on its own. Perhaps to structure this interrelated web of meanings we have a tendency to create systems of power.

“The exercise of power, the submission of some to the will of others, is inevitable in modern society; nothing whatever is accomplished without it. . . . Power can be socially malign; it is also socially essential “ John Kenneth Galbraith (1984)

When such a network becomes more dominant in a landscape of other networks its power becomes usually more structured, a great example is the transition from tribe community to national governments. Formal institutions perform the function of a decision-making facility. Unfortunately such institutionalized systems often become dehumanized, independent entities.

Following the internet revolution, Social Networks emerged in new forms as internet platforms. Sociologist Manuel Castells (2000a) speaks of society in the early twenty-first century being characterized by a social structure that he calls the “network society.”

Often, internet-based social networks have an anti-establishment spirit which gives them the initial momentum to grow. However with rapid growth chaos emerges, and the need to create a structure similar to those old fashioned government-like institutions. Today's tech giants are great examples of this process.

We believe that a DAO-based structure will add “liquidity” to the manner of governing the network thanks to swift mechanisms that will prevent the centralization of power as well as its petrification in an unwillingness to reform the organization from fear of losing position.

6. Broad Context

e) Money as a System and as Tool for Decision Making

Today's societies use money to structure power flow. Money similarly to other social networks probably originated as a grassroots communication layer to exchanging goods and services.

Jedrzej Malko argues that money did not evolve as a simplification of the barter economy. Claiming that the theory that originated with Adam Smith is a "great founding myth of the discipline of economics".

"No example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money," wrote Cambridge anthropology professor Caroline Humphrey in a 1985 paper. "All available ethnography suggests that there never has been such a thing."

Finding the roots of money is very difficult, mainly because it is such an ancient technology. However when we start to imagine pre-governmental economies it becomes more possible that money evolved as a function closely related to action and speech. Today putting money on a decision is a form of sealing it. Very often it's a moment that emphasizes an idea (speech) as mature enough to take action on. Part of Cryptopolis' aim is to experiment on interconnection for those 3 elements.

6. Broad Context

f) The Wisdom of (Diverse) Crowds

The many, who are not as individuals excellent men, nevertheless can, when they have come together, be better than the few best people, not individually but collectively, just as feasts to which many contribute are better than feasts provided at one person's expense.

Aristotle, *Politics III* (ca. 350 B.C.E)

The discussion around democracy is too often mired in claims that are ideological rather than practical and down-to-earth. The important question is: are there any tangible advantages of governance systems that give voice to all its members relative to those that place power among a fraction of their population, for example a panel of carefully selected experts? The answer is complex but there are many reasons to choose democracy over minority rule, one being the former gives higher epistemic return i.e. provides answers of a higher quality than any other aggregation system.

Aristotle, quoted at the beginning of this chapter, observed that the mechanism accounting for the superiority of a collective over any of its members is the pooling of information and refining of arguments, the key goal of deliberation, which was ingrained in the Athenian polis governance model. Inclusive deliberation – that is deliberation which involves all the members of the group – is one of the key mechanisms that gives democracy an epistemic advantage over other systems. The ideal of deliberation is characterized by its emphasis on arguments. Many modern examples, however, point to other manifestations of a phenomenon known as collective wisdom – the excellent problem-solving and decision-making capacity observed in groups under certain conditions – even in the absence of salient deliberation. Understood this way, deliberation is supposed to enlarge the pool of information and ideas, assess the quality of arguments and, finally, lead to a decision on the best solution (Landemore and Elster, 2012). “The Wisdom of Crowds'' (2005), is Francis Galton’s naturalistic study conducted at a regional fair, where eight hundred contestants wrote down their guess about the weight of an ox (after it had been slaughtered and dressed), and the average figure fell within one pound of the right answer. Another example is that of a lost submarine found by pooling the likelihood estimates of several different explanations of what might have been the reason for the submarine’s failure, provided by a group of mathematicians, submarine specialists and the salvaged crew. Their independent answers served as a basis for the model which estimated the location of the lost boat with outstanding accuracy, even though no one in the group knew the exact circumstances of the event. And yet, the group as a whole came up with the right answer just by combining scraps of incomplete information reflected in contradictory scenarios. How is this possible? The truth is we don’t know exactly. As many other emergent phenomena, collective wisdom is notoriously difficult to explain. There are, though, several theoretical accounts that can provide at least a partial answer to this question, as well as help delineate some of the conditions conducive to collective wisdom. On a general level, what facilitates the emergence of the phenomenon of a global collective wisdom is the existence of a horizontal network through which information is transmitted and distributed (rather than centralized information control and dissemination). In a decentralized network power does not reside in one central location; instead, decisions are made by individuals based on their own local knowledge rather than by an omniscient planner. The development of the internet made this kind of network global in scope enabling smart solutions to emerge from the bottom up, among groups of interconnected people. The collective wisdom reflected in Google or Amazon rating systems, for instance, stems from translating individual actions into informational cues for others, much in a way the chemical signals left on the soil by ants direct other ants' decisions about where to move next, a phenomenon called stigmergy (Origgi, 2012). These apparently non-deliberative procedures in fact rely heavily on decentralized and distributed deliberation, one which takes place among clusters of participants rather than one that involves all members of the group (Landemore and Elster, 2012).

One of the established explanations for the remarkably high performance of groups, relative to individuals, even those who are considered experts, is called the "miracle of aggregation"; in simplest terms, it states that mistakes around the right answer cancel each other out symmetrically when answers are aggregated. Interestingly, the miracle of aggregation comes in different versions, each of which reflect different assumptions about the composition of the group and distribution of the correct information (signal) and mistakes (noise). An elitist interpretation of the miracle of aggregation views collective intelligence as the statistical phenomenon by which a few informed people in a group (i.e. experts) provide the right answer while non-expert's answers are randomly distributed around the correct answer and thus cancel each other out. A more democratic understanding of the theory also states that the random distribution of errors around the right answer is such that the collective judgment is fairly accurate, the only difference is that not just a small group of experts but everyone has an opinion that is roughly correct. Finally, a distributed interpretation of the miracle of aggregation assumes that pieces of information leading to the right answer are dispersed among many people; because of this, random opinions with a varying lack of knowledge will cancel each other out, leading to the right prediction in the aggregate. In the two latter cases, what is critical for collective wisdom to occur is not the individual competence but rather the size and the diversity of the group; having people with different opinions will result in harvesting wildly differing answers with a roughly symmetrical distribution of errors (Landemore and Elster, 2012).

The importance of cognitive diversity is at the core of Lu Hong's and Scott Page's (2004) "Diversity Trumps Ability Theorem", which states that the group of randomly selected individuals outperforms a team of high-performing experts when the problem is hard, the participants are smart, and the group is large. Therefore what matters most in problem solving is not the pool of knowledge generated by specialists, but in fact cognitive diversity, or in other words, the existence of different interpretive and predictive models used by individuals in a group to navigate the world. But what precisely is cognitive diversity? Put simply, cognitive diversity is the variability in the ways people approach a problem. More specifically, it is about multiple ways of representing reality, categorizing phenomena, arriving at solutions and inferring cause and effect (Page, 2007). It is not the same as diversity of values or goals, which in fact could be harmful to the collective's effort to solve a problem. However counterintuitive it may sound, a group of cognitively diverse people performs better than a group of very smart people who think alike. As a group goes through a process of deliberation or other form of argument refinement, very smart yet cognitively homogenous people tend to stick to the local common optimum, while members of a more cognitively diverse group have the opportunity of guiding each other toward the global optimum, which aggregates different approaches to the problem. More generally, diversity makes it easier for a group to make judgements based on facts, rather than on influence of authority, or group allegiance. Homogeneous groups often fall victim to what the psychologist Irving Janis (1972) called "groupthink", which may even be exacerbated by deliberation; they may be very efficient in performing their tasks but often fail in investigating alternatives or proposing novel solutions.

Cognitive diversity assures the existence of negative correlations among people's predictive models, which tends to systematically lower the collective error. If one group member makes a mistake, another is more likely to make an accurate judgment and vice versa. As a result, the accuracy of the group's prediction is systematically better than the average accuracy of its members, and the degree by which the group outperforms an average member increases as the group becomes more cognitively diverse. The simplest way to ensure greater cognitive diversity is to increase the number of people involved. In a sense, more is smarter, however in practice, the benefits of adding another group member declines gradually, while the probability of having participants with similar world models increases with the group size. Once groups reach hundreds or thousands of individuals, the deliberation process becomes difficult to manage. This is why some measure of delegation is in place. Representatives reflect on a smaller scale the voters' cognitive diversity, which in the case of liquid democracy, is preserved over time thanks to constant flux in the pool of delegates.

It is important to note that, contrary to the miracle of aggregation theory, which presupposes that participants receive an infinity of independent signals that they process in order to make a prediction, "Diversity Trumps Ability Theorem" formulated by Lu Hong and Scott Page (2004) assumes that people make decisions on the basis of a limited and dependent range of cues and information sources. The independence assumption is applied not to people's cues or judgments but rather to the cognitive processes leading to those judgments (Landemore, 2012). Also independence means a non-coercive environment in which these processes and judgements themselves, while not isolated, are relatively free from direct influence of others (Surowiecki, 2005).

To the extent that cognitive diversity is more likely to exist in a larger rather than a smaller group, democracy is more conducive to collective wisdom than the rule of minority, even if this minority is made of the best and brightest in the community. It is better for the collective to include a different and less accurate model of the world than to add one more copy of any existing model, even if that model is more accurate. The reason to include everyone in the decision-making process is not because it is difficult to identify highly competent individuals. The reason is that the highly diverse collective often knows better (Landemore, 2012).

6. Broad Context

g) Defining Democracy

The concept of democracy is a convoluted one, mired with misunderstandings and pervasive myths. This chapter is aimed at untangling the idea of popular rule and broadening the perspective of what democracy in the third millennium might look like. According to a definition by Robert Dahl (1989), democracy is a governance system in which "all the members are equally entitled to participate in the association's decision about its policies". Even a sketchy analysis leads to a conclusion that the minimal conditions proposed by Dahl are hardly met by the ubiquitous system commonly called representative or parliamentary democracy.

The representative system, which originated in the late eighteenth century in France and the newly founded United States, was initially intended as anything but democratic. Rooted in liberal-republican ideas, it was primarily concerned with protecting individual rights against the tyranny of majority or oppressive government power rather than empowering citizens to engage in self-rule. The founders of the U.S. had little regard for what they viewed as chaotic mob rule. James Madison made no question about it when he wrote in the Federalist Papers that the American Republic would be characterized by "the total exclusion of the people in its collective capacity from any share in [the government]" (Hamilton, Madison, Jay, 2003). Oppressive majorities, in Madison's vision, should be limited by the elected elites, whose task was to filter and refine the disorganized judgments of the people. The ruling class would be in turn constrained by the separation of powers and a system of checks and balances. Election process was thus designed to serve as a filter, aimed at maximizing the average competence of the representatives, not the economic and social diversity of the privileged group of rulers. This new regime was, in fact, based on the idea of people's consent to power rather than people's exercise of power (Landemore, 2020).

Federalists were diplomatic enough not to describe the tension between the system they envisaged and popular rule as elected oligarchy versus democracy, but rather as representative versus direct rule, the representation principle being justified by the fact that not all citizens could rule at once, therefore they had to delegate power to an elite supposedly made up of the brightest and most competent of them.

That was not the only proposal on the table though. A rival group branded as Anti-Federalists believed that representation should mirror the population to produce a miniature portrait of the citizenry. Their argument was that only representatives with characteristics and experience reflecting those of common people could properly speak for the population as a whole. They were much less concerned with the competence of individual representatives. It is striking how their intuitions correspond with recent scientifically backed insights on the importance of cognitive diversity in groups tasked with generating solutions (Hong and Page, 2004). The notion that diversity of the collective weights more than individual competence, being counter-intuitive, and not supported by theoretical framework or empirical evidence more than two centuries ago (even the simple, and crucial, idea of a "random sample" has not yet been conceived back then), was eventually overcome by the common sense argument of representation as a refining filter. The rest is history.

Perhaps the exclusion of ordinary citizens from spaces where real power is exercised should not be seen as a removable flaw of the currently dominating representative system, but rather as a design feature – an intended result of elections which introduce systematic discrimination in access to the decision making process. As long as political parties mediate between individual citizens and the institutions of the state by aggregating judgements and solutions into policy proposals, the possibility of meaningful deliberation is also quite limited. Citizens are expected to settle with the bundles of policies provided by the existing parties and voice their will of being governed by professional politicians by participating in the ritual of elections which are conducive to fierce and ruthless competition rather than open-minded deliberation. As noted by Blum and Zuber (2016), the party democracy also creates systemic inequality in the degree people's voices are represented: some voters may find most of their interests reflected by a specific policy bundle, others may only be able to identify with any political party program whatsoever. As the gap between government policy and popular sentiment grows wider the public opinion finds expression in petitions, street demonstrations or general strikes, often giving rise to social movements that have some degree of symbolic power but can influence actual decision-making only indirectly (apart from rarely used popular referendum initiatives). Social movements which proliferated in recent decades – alterglobalists, Arab Spring, Black Lives Matter, Me Too, among many others – emerged in opposition to the representative institutions, which largely ignored or even exacerbated the underlying issues (globalization, systemic racism, rape culture).

Meanwhile, levels of political rights and civil liberties have been steadily eroded from their historic highs around 2005. Ranks show that significantly more states have declined in freedom than have improved in recent years. In many countries, the system of representative rule is going through a downward spiral that typically involves increasing state surveillance and censorship of the internet, decay in the rule of law, limits imposed on NGOs, the unchecked spread of corruption and crony capitalism (Diamond, 2016). Even in countries where all the formal features of representative rule are found – fair elections, free speech, independent courts etc. – there is a sense of hollowness of these institutions. In many countries deemed democratic the distance between majoritarian preferences and policies grows along with a sense of alienation of ordinary citizens from the system which seems to be controlled by global economic elites (Crouch, 2004). These concerns have strong merit indeed – research shows that there is no correlation (in the United States) between preferences of the majority and policy outcomes once one controls for the preferences of the richest 10 percent (Gilens and Page, 2014), which qualifies the U.S. as a de facto plutocracy.

What are the features of a system that deserves to be called a democracy? Drawing from historical examples, one can observe that the pivotal element is a public gathering in which issues are discussed and decisions are made. It applies to citizens of ancient Athens (who coined the term democracy) with their agora meetings during which laws were made based on an agenda set by a lottocratic council, as well as to the Icelandic Viking's annual parliament, open-air assemblies of the Swiss confederacy called Landsgemeinde, Puritan's town hall meetings in the New England, or Native American tribes talking things through and making decisions around the fire. Societies all around the world independently adopted practices that allowed widespread participation of cognitively diverse citizens in policy making and thus enabled collective wisdom to naturally emerge.

It is worth noting that democracy does not preclude representation, and representation does not necessarily mean classical elections. The important question is how open the system is for ordinary citizens. There's also a practical issue: how to make it maximally accessible without jeopardizing the effectiveness of the decision making process. Hélène Landemore in her book Open Democracy (2020) offers five principles as a basis for a genuinely democratic system: universal participation rights, deliberation, majority rule, transparency, and democratic representation, the last of which stands out as a fascinating area of experimentation with possibilities of random selection, self-election and, finally, liquid representation[4].

The so-called "crisis of democracy" might indeed be a symptom of rising democratic expectations which are hardly met within the current paradigm. Electoral representation is now endorsed mostly by the Western elites, leaving the general public more disillusioned than ever before. On a positive note, perhaps we are witnessing an era of democratic revival – a recent OECD report (2020) grasps a wave of increased participation through deliberative experiments that has been mounting over the last ten years. Obviously, citizen panels, while valuable as deliberation tools, are no substitute for established, permanent democratic institutions with a clear power mandate. A more ambitious vision, compatible with the age of high technology and global interconnectedness, would feature a democratic system that expands horizontally to the economic sphere and vertically to the international level (Landemore, 2020), while also leaving ground for de-territorialized entities akin to Cryptopolis.

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[4] Nota bene: Cryptopolis governance system features all of the Landemore's Open Democracy principles, with unrestrained, liquid delegation chosen as a default representation mechanism.

6. Broad Context

h) Ecological Sustainability - An Economy of Partnership

Between social networks, money technology, and a systemic vision there is one more highly important dimension - an ecological one, since no organism can exist in isolation.

Animals depend on plants as an energy source as well as exchange CO and CO_2 in codependent breathing cycles. Mushrooms and microorganisms regulate the entire system, from breaking down deceased organisms to redistributing nutrients through root networks. This is a radical oversimplification of the web of life which makes it possible for humans to exist.

Understanding this codependence is crucial. It might be possible for humanity to live with fewer trees, but can it survive without any? Where is the threshold? As with other complex network problems, it might be impossible to arrive at a definitive statement. Even so, it is not inconceivable that humanity might get dangerously close to this point, especially given the speed of industrialization and the appropriation of nature.

It can be argued that the economic system which undisputedly gave us a lot of technological and social growth is no longer suitable for human and natural coexistence. Today the tension between ecology and the economy seems to be hopeless.

In this chapter, we could endlessly give examples of how dramatic the ecological situation is, however, we would like to focus on a solution to this great challenge of our time which might need a radically different perspective - a shift from an economy of competition to one of partnership.

In our opinion solutions can be found in:

- Firstly a systemic understanding of the principles of ecology – viewing the ecosystem through a wide lens encompassing the human network as well, as opposed to isolating a single problem, can shed more light on the codependent nature that underpins the balance of phenomena.
- Secondly, extending our view on the creation of value beyond it being designated for a single human, family, company or nation into a wider vision of

value for humanity. More on that can be found in the chapter “Hidden costs and integrative design / Beyond the market”

6. Broad Context

i) Hidden Costs and Integrative Design / Beyond the Market

Systems, scientific and philosophic, come and go. Each method of limited understanding is at length exhausted. In its prime each system is a triumphant success; in its decay it is an obstructive nuisance. The transitions to new fruitfulness of understanding are achieved by recurrence to the utmost depth of intuition for the refreshment of imagination.

Alfred North Whitehead, Adventures of Ideas (1933)

Modern economy is at odds with the environmental and social systems on which it depends. Rampant pollution of air and water, resource exhaustion, looming mass extinction, and runaway climate change can be seen as extreme examples of market failure in the sense that the market mechanisms have generally failed to account for these systemic effects of profit-driven business activities (Stern, 2006). In the mainstream (neoclassical) economics these effects are called negative externalities and are defined as costs to a third party that arise as a result of other party activity. In other words, an externality is a difference between the private cost of an action (which is reflected in the market price of a good or a service) and the social and environmental costs (which are not included in the price). From this perspective, hidden costs are a failure in optimal resource allocation. Framing damages borne by society and nature in economic terms points to solutions that are strictly within the market paradigm. One proposed way of reducing externalities is imposing taxes on polluters to disincentivize damaging activities as well as to raise funds that the state can later use to reduce or compensate for the harm caused by the pollution.

This so-called ‘polluter pays’ principle faces serious practical and theoretical limitations. First of all, it requires estimating damages in terms of monetary values which is not always feasible and depends on assumptions which do not lie within the market-oriented paradigm but rather in the realm of philosophy and ethics. What is the price tag for polluting a river with heavy metals that takes generations to clean up? How to compensate people living in 2100 for climate catastrophes caused by three hundred years of highly distributed anthropogenic CO_2 emissions? Are we willing to accept the massive plastic pollution of the Earth's oceans as a price for the abundance of short-lived consumer goods?

The value of environmental and human well-being, the direction and pace of development and other such questions can be answered only by relying on ethical principles which are embedded within particular cultures and as such require society-wide deliberations. The objectives of a business enterprise are quantifiable, in a sense that they can be expressed in terms of the maximization of profits, but this is not the case with the objectives and means of environmental planning. In a market economy, societal preferences – questions of what is desirable, possible and necessary – are not taken seriously but seen as problematic; they need to be answered explicitly and continuously.

Another source of difficulty with the 'polluter pays' principle is that the charges imposed by the government may be easily shifted to consumers, disproportionately affecting people with limited financial resources, especially if the market structure is monopolistic or oligopolistic. In this case any incentive to diminish pollution is eliminated (Kapp and Berger, 2015). Karl William Kapp and other ecological economists point to an even more fundamental issue with applying market mechanisms to deal with social and environmental costs: nowadays the practice of shifting costs on nature and workers is in fact a basis for making profit. Alternative measures, like setting objectives through planning based on democratic decision-making rather than market logic, are rejected precisely because they would require a radical departure from the ideology of the market as the primary regulator of human activities.

Externalities, rather than being internalized, need careful analysis in order to reveal and understand their causes, complex, systemic effects, circular interdependencies and cumulative or synergistic character. Neo-classical economics may be useful as a guide for maximizing utility but it is inappropriate for the more essential task of minimizing human suffering or satisfying basic human needs. What is needed to this end? A useful starting point would be a comprehensive evaluation of the current state of the environment on a global, regional and local scale, identification of current and predicted pressures on the environment as well as mapping resource constraints. Next step would be creating an inventory of the most desirable existing and new emerging solutions which could be then applied to making better informed decisions on the choice of technologies best suited to deal with the identified challenges in an environmentally responsible manner. This information along with the integrative design framework, developed by Amory Lovins as a tool to decrease ecological impact of industrial structures, could be applied to specific business models, public policies, investment options and institutional arrangements. Integrative design encourages using systems thinking by identifying relationships between various components, or subsystems, and then optimizing the entire system for multiple benefits rather than optimizing individual components for a single benefit. Next, a deliberation process involving experts from different disciplines and the general public to ensure high cognitive diversity would allow for making near-optimal decisions on the choice of systemic solutions.

How is this discussion relevant to Cryptopolis? It is possible, and desirable, to employ the integrative design framework in order to estimate, and minimize, environmental impact of investment decisions within Cryptopolis. Here is where economic and ecological perspectives merge. If the primary goal of Cryptopolis investment is sustaining the value of the Pangea token in the long term, and the long-term value of any asset depends on its ecological and social sustainability, then sound investment decisions must take ecological criteria seriously.

6. Broad context

j) Open-Source Civilization

Innovation needs time and money. Patents and copyrights ensure that creators are compensated for their investments. The first patents were recognized in Ancient Greece in the Greek city of Sybaris. Today they are closely related to governmental institutions and legal disputes take place in various national courts. Patteting for innovation on an international scale becomes so expensive and time consuming that it can slow down implementation dramatically.

On the other end of the spectrum is the open-source movement which is transparent, free and fast. Many of the backbones of the operating systems (computer and mobile) as well as the foundations of the internet infrastructure are based on open source software.

Arguably the biggest advantages are speed and accessibility. The disadvantages might be low or no income for creators.

There may be a huge opportunity for a solution that combines the speed and access to innovation intrinsic to open source systems with the financial benefits of patenting.

In the case of a DAO such as Cryptopolis, transparency is crucial - it allows users to participate, evaluate and improve on ideas. There are many indications that this type of high speed human computer might act more efficiently than a standard top-down organization, even if they had access to the same data. Some key components can be constructed similarly to NFT tokens, where using such components gives a fee to the creator. Possibly an algorithm can even evaluate in real time how much this component is used.

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