Tools for Emancipatory Societies

Abstract

In this text, I'm laying out possible alternative future societies based on the core values of freedom and solidarity, starting from rather abstract requirements to more concrete details on economic and social organization. This includes decentralized modes of planning controlled by the needs of the people. I will also show which information technology tools can be used to support (not control or dominate) free and solidary societies. Finally, I will use methods of simulation to underpin the feasibility of the presented ideas.

Shortcomings of the Current Socio-Economic System

There are many shortcomings of the currently most dominant socio-economic system, the nation-state-based neoliberal capitalism. This paragraph lists the most important failures of this system. The most obvious failure of capitalism is its inability to effectively counteract the climate crisis. Even though experts from various fields demand urgent action to drastically reduce emissions, political decisions are still mostly based on (national) economic interests.

Another failure of the current system is the injustices it creates as well as the discrimination it is based on. Racism and misogyny are not only part of the history of capitalism but inherent to its system: in institutions and mindsets. Also, the discrimination of minorities based on e.g. religion, sexual orientation, neurodivergence, or body type is a common pattern in capitalism. Discrimination is one but not the only reason for social injustices and unequal resource distribution both on a local and global level. The alleged lack of willingness to achieve is often used to justify the injustices when it is based on inhuman systemic issues (see e.g. Nguyen's (2020) work).

The third shortcoming of neoliberal capitalism I'm going to mention here is its psychological effects. It has been shown by Zeira (2021) and others that the ideology of individual responsibility, the permanent need to perform, and competition lead to isolation and existential fears (job loss, financial insecurity) and result in increased rates of depression and suicide. Societies should not optimize the well-being of economies, but the well-being of the people.

Also, recent and historic financial or pandemic crises showed that the idea of self-regulating markets is just a myth. The market often had to be rescued with tax money to prevent it from crashing. The government had to interfere to make sure, the most important services and goods could still be provided.

Requirements for Utopian Societies

Note: I use "utopian" as Bloch did in the sense of a concrete, feasible outline of a society and not as a description of a non-existing paradise island.

Any future society which is worth living in should aim at fixing the above-mentioned shortcomings of the current system. As Sorg (2022) wrote it's not enough to take over companies like Amazon. Instead, *transformative movements will need to push for the construction of alternative socio-technical infrastructures*. In this section, I'll outline five abstract requirements for societies based on the well-being of the people. The following sections will then get into more concrete ideas, measures, and tools.

The first two requirements are freedom and solidarity. Freedom means the absence of coercion, oppression, and discrimination. Freedom is the ability to fulfill one's own needs, i.e., to develop and live a good life. Everyone should have the freedom to do what they want, as long as they don't limit the freedom of others. Solidarity means not putting one's own needs above those of others (future generations included). Freedom without solidarity results in privilege and injustice. Freedom without solidarity restricts the freedom of excluded groups or individuals. Therefore, freedom and solidarity must be in balance when it comes to the freedom of all.

The third requirement for outlines of utopian societies is to discuss how the care sector will be organized. If a utopian draft is only about the production of countable units (e.g. tons of steel) or if it is assumed that unpopular activities would somehow be done, then the care sector has not been considered. Is it implicitly assumed that women will continue to do this mostly invisible work on the side? Regardless of feminist motivations, any utopia must answer the question of distributing care work and unpopular activities without coercion if it is to pass the freedom and solidarity requirements.

The fourth requirement and acid test for utopias is the question of whether they also work in crises. Climate catastrophes and violent takeovers of power by authoritarian regimes can be played out as thought experiments. Crises have often shown that the capitalist system fails at the local level and must be rescued at the national or global level through massive intervention by states. Despite all this, capitalism keeps adapting to changing conditions and is seen by many as the best option - even in times of crisis. The utopia under examination must therefore face the question of whether it would be the better option even in times of crisis.

The fifth and last requirement is for societies to be non-dogmatic. The utopia needs to allow for diversity and inclusion of minority groups. Diversity refers to lifestyles, preferences, worldviews, and origins. Dogmatic views do not necessarily have to be explicit. They can also consist of unstated and unquestioned assumptions. An example is the acceptance of the inequality between the global North and South without looking at the history of colonialism. "No dogma" does not mean, however, that any worldview is to be fully accepted. When it restricts the freedom of others and thus becomes dogma itself, a limit is needed.

Viable Systems

In addition to the above five requirements for free and solidary societies, they need to be adaptable to changing environments, stable in case of disruptions, and functional - in short, they need to be viable. Note: When using the words "system", "society", "level", or "hierarchy" in the following, I don't refer to institutionalized power structures or structures of domination but to structures and patterns of humans interaction, structures which can be determined by the people and which have the only purpose of facilitating interaction between people.

Beer (1972) developed the Viable System Model (VSM) based on the theory of Second Order Cybernetics as well as his empirical research on organizations when consulting in companies. The VSM is not a model or a blueprint for how to build an organization or a society but it is a debugging tool that can be used to analyze organizations.

Cybernetics is about understanding complex systems and finding ways to abstract from the complexity with the help of self-regulating systems. Cybernetics is not about control in the

authoritarian sense but about control in the sense of self-regulating and self-organizing, i.e. anti-authoritarian systems.

Beer explains why only decentralized organizations can cope with complex environments: Applying the laws of cybernetics, he concludes that the complexity inherent in organizations or societies needs to be dealt with in some way or another. The top-down way is to attenuate the complexity very radically, losing a lot of information, so that a central leader can process the remaining information and make decisions based on that. This leads to domination, instability, and chaos for the entities of the system. The cybernetic way of dealing with complexity, and this is the one that Beer proposed, is to decentralize as much as possible. That way the complexity is absorbed by or encoded in the units of the system which can then self-regulate as best as possible. Only relevant information will be shared with other units in a way that everyone can still have an overview of the system as a whole and give feedback when needed.

At the lowest level of the VSM, are units called System 1. Each unit has a specific task and is self-regulating. System 1s operate by looking at information from the environment that is relevant to their task, performing this task, and influencing the environment in their way, always adapting to changed information from the environment. A System 1 unit in itself can be considered a viable system at another level. I.E. the VSM is a recursive concept that can be applied to various levels of detail, e.g. at the level of a branch of industry, at the level of a company, and at the level of a team within that company. A System 1 unit is autonomous as long as it works within the constraints set by the needs of the whole system.

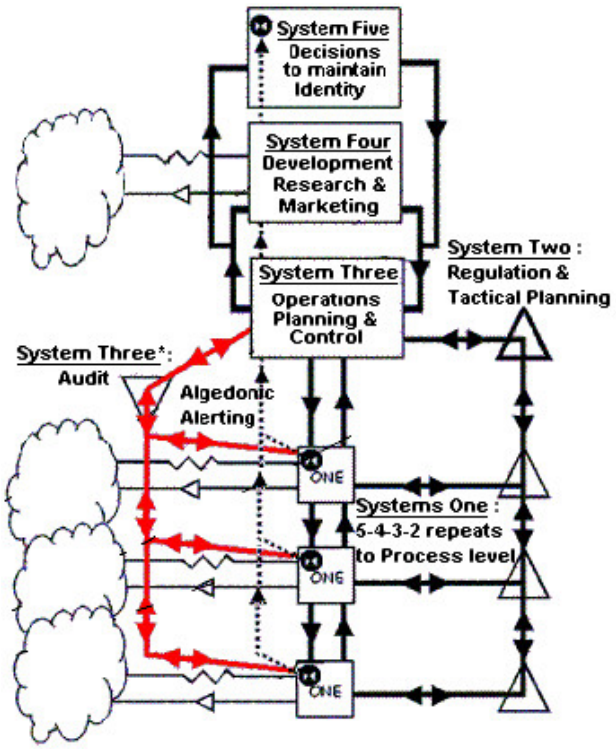

Figure 1: Illustration from Beer's work about the VSM

System 2 is responsible for the communication between System 1 units. It ensures that System 1s don't have conflicting goals and thus don't create overshooting or oscillating effects in the environment by trying to counter-act on what the other unit was doing.

System 3 defines the decision space in which systems 1 and 2 can operate autonomously. It is responsible for giving feedback (cybernetics use the term algedonic feedback) to systems 1 and 2 if they are operating outside of the expectations. It also serves as an interface to systems 4 and 5, by providing them with all the important information from systems 1 and 2.

System 4 is responsible for keeping an overview of the environment and the operations of systems 1-3. Based on that information, it is developing a strategy for the whole system and communicating that to system 3.

System 5 can be seen as the brain in the nervous system. It is responsible for long-term strategic thinking and the vision and purpose of the whole viable system.

Beer did not think of System 3, 4, and 5 as managers who are imposing their will on the workers in the lower ranks, but rather as a requirement or role in a viable organization that has to be fulfilled. The roles of Systems 3-5 could be fulfilled by a group of people, as a rotating task, or in any other way.

As decentrality and self-organization are central topics of anarchist theory, the VSM can be a useful tool to analyze anarchist forms of organization. Swann (2021) came to the same conclusion, emphasizing, that the Systems 1-5 are not structures of dominance but a functional hierarchy. This means that the responsibilities of systems 3-5 are necessary and should be performed by multiple and changing people, which can and should also be part of systems 1-2 at other times. According to Swann, most anarchists would also agree that the constraints on autonomous parts defined by Beer should be applied to anarchist organizations or systems: 1. The organization must operate in coordination with other autonomous organizations. 2. It must operate within the intentions of the whole organization. 3. It must face the possibility of being excluded from the organization as a whole.

The recursive levels of the VSM are also functional hierarchies with the purpose of absorbing complexity and not structures of dominance. In the context of free and solidary societies, these levels should not be thought of as a rigid pattern of local, regional, continental, and planetary levels but as a dynamic federation of interconnected systems.

Decentralization and Complex Societies

Decentralization and anarchism are often criticized for not being able to handle highly technologized modern societies. We rely on infrastructures like water pipelines, electricity grids, internet hubs, and public transport. Currently, many of those have central points of failure. Damages to their functionality can have devastating effects on many people within days. Many of these systems rely on standardization like frequencies, protocols, or transport container measurements.

Systems like that could not be organized by isolated low-tech self-sufficient countryside communities as promoted by anarcho-primitivism. While this might be a cliché understanding of the goals of anarchists, it's not what most anarchists strive for. Decentralization does not mean isolation or rejection of modern technology.

To make it more plausible how decentralized societies could work, we need to understand how they would handle complex systems like modern technology, supply chains, limited resources, a variety of cultures and needs, and additional challenges related to the climate crisis.

As Beer has shown, decentral systems are best suited to handle complexity, especially if the goal is not to force badly informed decisions on people. By absorbing complexity as much as possible at lower levels, the needs of the people can best be met as decisions are made at the source of the information. Also, higher levels, which are then freed from unnecessary complexity, can concentrate on those aspects that require coordination between multiple subsystems. The goal is to move information collection and decision-making to the lowest possible level while still adhering to limits set at the planetary level, related to measures to reduce the impact of climate change, standardization, knowledge sharing, freedom, and solidarity.

To give some more concrete examples: Child care can be organized at a very local level. Hospitals should be organized at a more regional level to cover the needs of the people and still be resource efficient. Food production can be handled partly at local, regional, and even planetary levels, depending on the food preferences and available resources. Allowed greenhouse gas emissions should be handled at a planetary level to stay within the planetary boundaries.

Tools to Support Free and Solidary Societies

The previous sections already hinted at some of the technical requirements needed for modern decentralized systems. I will get into more detail about the four categories of requirements in this section, showing how the requirement relates to the VSM, how it was met in the historical example of CyberSyn as written down by Beer (1973), and how it could be met today.

Variations of these tools will be needed at all recursive levels of the VSM. All of these tools have the sole purpose of supporting people in creating and maintaining free and solidary societies. Tools should never control what people want or do. Also, the societies and meta-society I'm describing below can be supported by but do not require technology. Thus, it's still possible for people who prefer to avoid technology to live in isolated communities or to connect in minimalistic ways.

The first category is tools supporting the collection of relevant information, the distribution of relevant information as well as the distribution of resources. This is the core of cybernetic systems as they are based on communication and feedback. It is needed by all systems of the VSM, but mostly by systems 1 and 2, the systems responsible for actually getting things done and coordination between the instances which get things done. They handle the input information from the environment (e.g. the needs of the people and available resources) to coordinate the work with other systems and constraints. The advantage of decentrality is that information is collected at the lowest possible level, thus preventing central surveillance and keeping the unaggregated data in local communities. Only anonymized summaries might be needed at higher levels. Additionally, communication channels for algedonic feedback using the same tools are needed for system 3.

In CyberSyn, this category was covered by CyberNet, a network of telex machines that were used to send ten key process indicators (KPI) from each production site to the only available computer in Chile. The workers in the factories decided what should be considered important. Today, we can use the internet to communicate important metrics. As some industries already use digitalized processes, data like available resources, consumed energy, and the amount of produced goods can easily be forwarded. However, just because we could, does not mean we have to report all data from all living and working spaces. What kind of data is useful can mostly be defined by the local communities. E.g. some communities might decide to track the energy consumption of every building to make sure they stay within limits allotted to them (based on the planetary decision about emissions), while others might just measure the total consumption of the community. We can think of these tools as special-purpose social networks, maybe as federated instances with a common protocol (similar to the fediverse). The protocol will allow us to post resource-, product-, service-, and time-availabilities as well as requirements, together with options to explain the numbers and discuss alternatives.

The second category of tools supports the analysis of the collected data to detect outliers and for short-term forecasting. This mostly supports system 3 by making sure systems 1 and 2 stay within limits previously decided on. If outliers are detected, system 3 can give feedback to systems 1 and 2 and suggest measures to counteract, especially if the data indicates that not counteracting could lead

to a crisis. Short-term forecasting (e.g. of production and consumption data) can also be used as input data for decision-making in systems 4 and 5.

In CyberSyn, they used the only mainframe they had for entering the process data they received and for analyzing the data with CyberStride, a software suite developed by the teams around Beer. One part of it was CyberFilter, a set of statistical tools for time series analysis. They also used Bayesian Statistics for short-time forecasting. Today, handling huge amounts of data is no longer a problem. There are various advanced data science and machine-learning-based algorithms which efficiently filter out cyclic patterns (seasonality), detect outliers and trends, and perform short-term forecasting (e.g. TODS by Lai (2020) et al. for outlier detection and Facebook's Prophet by Taylor (2017) et al. for forecasting).

Additionally, I would add optimization tools (e.g. linear programming as developed by Kantorovich) to this category. The purpose would be to suggest multiple options on how to optimize resource distribution and usage to best fit the needs within given constraints. The people within this subsystem could then decide which of these suggestions they want to follow or just discard all of the suggestions. In contrast to the central planning applications of optimization proposed by Cockshott (1993) et al. and others, I'm suggesting to use of optimization as an optional tool for multi-level decentralized planning, creating non-coercive suggestions as a decision support tool.

The third category of tools supporting free and solidary societies is simulations and other tools which model a system and can be used to run experiments. Simulations can be used as a basis for decision-making e.g. in system 4. They can be used to compare the impact of various measures, that are in discussion of being introduced, to gain more knowledge before actually implementing the measures in society. Simulations can also be used for long-term development predictions. E.g. simulations of ecosystems can be used to predict the impact of producing a new product A vs a new product B. Simulations of travel and transport behavior can be used to compare the impact of building a new railroad in area A vs area B. Simulations of food consumption can be used to compare the impact of introducing various new products.

In CyberSyn, they were planning and starting to use CHECO, a simulator of the Chilean Economy based on the DYNAMO compiler for long-term forecasting based on various scenarios. This was hardly started when the system was overthrown on September 11th, 1973, by a CIA-backed military coup. Today, we have frameworks for agent-based modeling (ABM) to efficiently create intuitive simulations. Additionally, reinforcement learning (RL) is seen as a more powerful alternative to simulations. I will get into details and examples of ABM and RL in the last part of this article.

The fourth and last category of tools are those related to decision-making. They can be used at various systems within the VSM, mostly in systems 4 and 5 at all levels in the recursive setup. The purpose is to use the aggregated information from the environment (only for System 4) and System 3 in a structured way, amend it with additional information, knowledge, and experience, then reason about various options, exchange opinions, and concerns, and finally reach a consensus and make a decision.

In CyberSyn the OpsRoom was built with the idea to present the aggregated information and discuss. In project CyberFolk they also envisioned a tool called Algedonic Meter which should have been able to collect real-time feedback on current political matters from the people using a good-to-bad scale. Today, there are still security concerns related to electronic voting systems. In future societies, there might be fewer reasons to manipulate votes and fewer reasons for the necessity of

accurate votes as the exchange of arguments and the respect for opinions and concerns from minority groups are more important than vote counts. There are existing tools for discussion and decision-making like Kialo and Loomio. Again, this decision-making is not happening in a central place but as decentralized as possible.

Many of the state-of-the-art data collections and tools are currently under the control of huge companies like Meta, Amazon, and Google. There are many reasons, why these powerful tools need to be in the hands of the people.

Free and Solidary Societies

Previous sections already hinted at the characteristics, requirements, and tools for free and solidary societies. In this section, I'll get into more detail about how such a society could work. Freedom and solidarity are the necessary conditions of anarchism. My ideas are close to those of anarcho-communism. As anarchism and also anarcho-communism are a spectrum of diverse ideas, my work can't be seen as a representation of anarchism.

Here are the more concrete foundations of anarcho-communist societies: decisions are made by those who are impacted by them. If possible, the group of affected people should be kept small. Consensus is the preferred decision-making method unless the people agree on other methods. Decisions are free agreements that can be changed when needed. The production is adjusted to the needs of the people while staying within the ecological bounds. Everyone gets what they need, independent of their work contribution. Houses, factories, products, resources, ... don't be long to anyone. They are used by those who need them. There is no money and no bartering.

Everyone can work on what they want. If there is unpopular work that too few people want to pick up, like care work, this work has to be made more popular or rotated (or the affected people need to find another creative solution on how to distribute this work). There are no prisons, no courts, and no police, only conflict-handling supporters. Conflict resolution is a well-known daily habit and there are many trained mediators to support when needed. Everything from personal conflicts to conflicts about not adhering to agreements, to scarce resource distribution conflicts can be handled with these methods. Transparency and efficient distribution of important information is valued. There are no states, nations, or borders, only networked regions and communities and freedom of movement. In previous descriptions of anarcho-communism, there were depictions of deeply nested federated regions. With today's technology, flatter nesting and even regionally overlapping structures should be possible. Also, the old idea of the imperative mandate, which resulted in indirect, impersonal communication, could now be replaced by transparent barrier-free online decision-making on all levels. Thus, everyone affected by and interested in a decision can directly contribute using the communication tools.

Information Sharing and Decision Making

To get into further detail, everyone should be in one consumption council. Each consumption council defines what and how much they plan to consume (both products and services) in the next period. Depending on the product/service group the period length can vary, i.e. their information tool might prompt them for estimates multiple times a year. This does not have to be detailed or complicated. Short-term forecasting tools as described above they can be used for a rough estimate. Only in the case that the consumption council is expecting drastically changed consumption

patterns due to changed a number of members, changed consumption patterns, or changed limits due to new agreements, they should adapt their estimate. Consumption councils are federated to create aggregated numbers for regions.

Additionally, most people will be part of one or multiple work collectives, responsible for producing goods and or providing services. Work collectives will communicate via the information tool what and how much they will be producing in the next period and which and how many resources they need for that. Work collectives can also be federated to create aggregated numbers.

Coordination committees (existing at all levels in the VSM) try to consolidate the needs and production capacities so that 1. the needs are met and 2. the system says within the limits which were agreed upon. The coordination committee can use the optimization tools described above to make multiple suggestions on how to fulfill the needs. It will then initiate a few iterations of feedback from consumption councils and work collectives. In times of scarcity, consumption councils might have to define their most important needs. Work collectives might have to decide to put in a few more hours of work. The coordination committee might suggest switching to more resource-efficient production methods or it might ask some workers to temporarily support another work facility that could provide more of a scarce product or service if more workers were available.

Coordination committees will support people, councils, and collectives to solve interest conflicts and come up with suggestions. Their work is transparent so that everyone can understand how they came up with suggestions and give feedback. Coordination committees don't have the authority to decide on a plan, they just facilitate the decision-making, using the tools described before. People working in coordination committees should rotate if possible. This is collective coordination.

From a VSM point of view, consumption councils, and work collectives are System 1s. System 2 should mostly be covered by the information systems plus maybe one additional work-collective sanity checking for conflicts between system 1s and supporting the conflict resolution.

System 3 is the set of agreements to which everyone involved in the whole system (1-5) contributed, including the agreement to stick to the work and consumption plans that were previously facilitated by the coordination committee. System 3 also includes one or multiple work collectives with the task of clearly communicating the agreements to those affected by them, noticing issues with the agreements, giving feedback if the agreements are not fulfilled, and supporting conflict resolution related to behavior not matching the agreements. Another system 3 work collective has the task of consolidating the need/work-capacity information collected from consumption councils and work collectives. People working in System 3 should be rotated. They are not enforcing agreements or punishing, they are merely facilitating conflict resolution. If that fails, they can transparently scandalize issues.

System 4 is the coordination committee. It uses information from the environment (e.g. changed agreements from other systems outside this system that affect this system, e.g. related to the availability of scarce resources) as well as the consolidated information from system 3 to come up with plan suggestions. Everyone affected by those plans then joins system 4 until a new plan is agreed upon. System 5 consists of yearly or quarterly meetings of everyone affected (prepared via online discussions in the information systems), in which perspectives of the local or regional needs, consumption, and production are discussed and agreements formulated.

As there are no laws and no law enforcement, only free agreements, conflicts, and advanced methods of conflict resolution, critics might say that the system could be abused or even destroyed

by "bad actors". With decentralized and distributed power structures there are way fewer possibilities for using structures to cause harm. Also, as there is no property there is no reason for theft. People not adhering to the agreements are not a problem as long as no one in the community complains about it. If someone is not ok with it, this is treated as a conflict. In the case that a conflict can't be resolved, the issue is scandalized via the information tool. If there is still no solution, the community might decide to separate in some way, to solve the issue. People causing harm in multiple communities might end up having problems finding a community in which they are welcome. As Camillo Berneri once put it: *Anarchism is based upon no compulsion to work, but no duty towards those who do not want to work.* I don't agree to kick people who don't want to work out of solidarity networks, but I agree that separation from people who repeatedly cause harm and are not open to conflict resolution is important to avoid self-exploitation.

Economy: Needs-Based, Decentralized Planning

Some people argue that economic planning restricts freedom. I see decentralized planning as a necessity to balance freedom and solidarity. Being able to plan that individual needs are met, that societies have the security of supply, and that future generations will have enough resources remaining, is one aspect of freedom. Being able to plan your life is a huge benefit over capitalism in which risks (e.g. Covid, job security, ...) are often externalized to "private life".

The previous section already explained how decentralized plans are created and how they are based on the needs of the people as well as short-term forecast data. There is no central authority defining the needs of the people but the needs are defined bottom-up thus enabling diverse ways of living and diverse ways of handling care work. While some communities might decide to treat care work like any other work and plan the required hours, other communities might decide to split the responsibilities of caring within extended chosen families and not count them as work as they consider this more respectful towards those who are cared for.

Due to planetary ecological boundaries, the effects of the climate catastrophe, and the planetary infrastructure systems, some planning needs to be done at the planetary level. As described before, this should as limited as possible. I will further illustrate how a planetary plan is created and how it impacts regional or local plans, using the example of the planning of greenhouse gas emissions. A planetary coordination committee composed of people from various regions, climate scientists, ecologists, farmers, and other interested and affected people present their suggestions in the information tool. They discuss and decide on the amount of allowed emissions and required emission sinks for the next five years. (The longer planning period is due to the fact that industries need to base their plans on this.)

By default, the amount distributed to the regions is proportionate to the number of people living there. The regions may argue and decide on a different distribution method. E.g. areas of the global south might need more allowed emissions to meet the needs of the people, due to the previous exploitation of these regions during capitalism, colonialism, and climate crisis. Then, each region knows their amount of allowed emissions and required sinks and can either further distribute the amounts to more local communities or decide on measures how to implement the limitation, e.g. by running optimization tools on various scenarios. This will again be done in coordination committees involving all those affected by the decisions.

As there is no property, resources, products, and services are not distributed based on the decision of those who did the work but based on the plan everyone agreed upon. They are not distributed

based on in-group friendships but based on need. Plans are not static: Changing needs can dynamically be communicated via the information tool and distribution and production can dynamically adapt.

Panarchy

The ideas of decentrality and diversity of ways of living and economic systems have a long tradition in anarchist thinking (e.g. synthetic anarchism, the international federation of anarchists, or bolo'bolo). As an anarchist and also as a white person, I should not try to present a system which the pretension of being the right system for everyone. Some people might prefer to be ruled or to live in competitive economies.

Panarchy is a political philosophy that emphasizes an individual's right to choose their political and economical system without changing their physical location. Nettlau (1909) explained panarchy like this: *What is involved is merely a simple declaration at the local Office for Political Membership and without having to part with one's dressing gown and slippers, one may transfer from the republic to the monarchy, from parliamentarianism to autocracy, from oligarchy to democracy or even to the anarchy of Mr. Proudhon, according to one's own discretion.*

Panarchy solves the "too big to fail"-problem by running multiple systems in parallel in the same region. The idea of panarchy is however also popular in market-liberal or so-called anarcho-capitalist circles as it takes the idea of competition without any restrictions to the level of political systems. Panarchy could lead to increased ableism and uneven distribution of care work, if those currently requiring less care would switch to competitive systems and switch back to cooperative systems once they are older and again require more care.

A system based on panarchy is a meta-system that should define how the various systems interact with each other and how core values like freedom and solidarity can be maintained across all systems. This includes questions regarding the distribution of resources between the systems. While ideas of anarchism are often confronted with the question of how they will handle so-called "bad actors", meta-systems of panarchy will have to be resilient to "bad systems". From the VSM point of view, this is the same problem at another level. Decentralized systems tend to be more resilient to "bad actors" than centralized ones. In the last part of this text, I will discuss methods of testing resilience.

A planetary panarchist meta-system might need a minimal agreement for coexisting societies so that neither the planet nor certain societies are exploited or destroyed. The following is a suggestion for such a minimal planetary agreement: 1. The planet must remain permanently habitable for the living beings of all continents. 2. Every person is free to decide how and where they want to live, as long as this does not restrict the freedom of others. 3. The basic needs of every person must be fulfilled. 4. All structures of concern are transparent. 5. There are no (national) borders and no warlike activities. 6. Planetary and regional justice (measured in satisfaction, with the minimum being raised) is aspired.

Comparison to Previously Proposed Economic Systems

In this section I'll concentrate on the main differences between the proposed way of economic and social planning and other, popular approaches, thus highlighting the important features.

The main difference to Commonism as described by Sutterlütti (2018) et al. is who has the power to decide how to distribute. In Commonism, the commons (i.e. the work collectives) decide who they want to cooperate with. The danger of this approach is forming in-groups and forgetting about unpopular or marginalized groups. There is also no guarantee that important needs will be met (unless you managed to create a good network of cooperating commons). This concept might work for humans with good communication skills and no need for care-for. Also, work councils deciding with whom to cooperate gives councils working on critical infrastructure a dangerously high accumulation of power. Commonism values the freedom of individual decision-making over solidarity. In contrast, the approach presented here focuses on the needs of everyone within the planetary limits by deciding about production and distribution in coordination committees. Products of work should not be considered the property of those who produce them but the property of the community. This is a different mental model, which results in different behavior. Another problem of the original commonism approach was that they did not have a concept of how to address the climate crisis with planetary measures.

Parecon and many other economic concepts stick to the idea of measuring and incentivizing work by paying something like tokens per hour or depending on the "effort". They claim to need this as a tool to either calculate the quantity of needed goods (market clearing price) or to make sure unpopular work is done. I consider this unnecessary, over-simplified, and ableist. I have shown above that there are tools to forecast and estimate future needs within given limits. Reducing work or products and services to a single number (prices, tokens) is a black-box-simplification that does not show, other factors like ecological impact, scarce resource usage, worker happiness, long-term-quality, or other trade-offs made for this product/service. A transparent decentralized planning procedure can give those interested in the details the option to understand why some goods are scarce and others are not. Introducing tokens for work is also ableist as it requires defining what is considered (acceptable) work and what is not. It makes a separate, stigmatizing social-benefit system for those who can't work (long or fast enough) necessary. Also, measuring care work in hours can be problematic.

While Saros (2014) does not suggest tokens as an incentive for work, he still uses them as a tool for production planning and the distribution of goods and as an incentive for good planning. This too has the downside of over-simplification. Additionally, tokens always come with the danger of creating markets. Saros' idea of registering needs at the level of individuals seems too cumbersome and isolating and has the potential for surveillance.

Democratic planning approaches which are based on majority voting, are in danger of discriminating against or at least ignoring minorities. Intersectionality studies have shown that discriminated groups are often under-represented in institutions of power. Thus, majority voting within these institutions will have a bias towards those in power. Also, elections can be manipulated by people with ill intent. For these reasons, anarchists favor decentralized decision-making, hearing all perspectives, and consensus decisions when possible.

Economic Models to support the Viability

Above, I mentioned modeling of systems (e.g. with simulations) as one tool to support the decision-making in System 4. In this section, I will discuss the pros and cons of using various modeling-based methods to test the viability and resilience of free, solidary, and decentral systems.

Models are always simplifications of reality with the danger of missing relevant aspects. Thus, models need to be treated with skepticism and care. Explanatory models can be used to test a hypothesis on causation. However, association and correlation do not imply causation. Modeling has ethical implications. Especially tools based on artificial intelligence (AI), which use huge amounts of unstructured input data, are prone to biased behavior. Fairness, accountability, and transparency are important values to strive for in modeling.

While models can't be used as proof that societies based on these ideas would work, they can still add support, transparency, and trust to the possibility of emancipatory societies. Thus, the modeling should be explanatory and interpretable. In addition, these methods can be used to compare the possible impact of various measures within a given system. The validity of models can be tested by comparing the effect of a change in the model with the effect of the same change in real economies. Models can help to solve the "too big to fail"-problem by running various experiments on data models instead of real societies. Providing easy-to-use economic modeling and simulation frameworks, is one way of democratizing decision-making.

Pluralist Economic Models

Heterodox economics promote various economic modeling approaches, taking inspiration from other fields like statistics and physics. With diverse theories in the tool belt, the chances of making well-founded decisions are increased. The goal is to create models which match empirical data and common sense and allow causal inference. Heterodox economics criticize neoclassical models for the assumptions of uniform, rational agents and the market equilibrium theory.

More realistic models use heterogeneous actors with varied qualities depending on the matter of investigation. The assumption of rational behavior based on some factor (utility function) that agents need to optimize, is a simplification of reality. I would however argue, that in free and solidary societies, people's behavior will be more likely to match modeled rational behavior for two reasons: 1. Information will be freely available and not distorted by profit interests. This will allow better decision-making. 2. There will be less coercion by power structures and financial necessities.

A critical aspect of models is the definition of the utility function, as its choice has ethical implications. Originally, moral philosophers like Bentham and Mill introduced it as a measure of happiness. In neoclassical economics, it was defined as a consumer's preference ordering over a choice set. Heterodox models often go back to the original definition of individual happiness (e.g. the amount of money earned minus the amount of labor done). I would argue that we should experiment with utility functions based on the happiness of communities or even the whole population and the ecological system as the well-being of others has an impact on everyone's mental health. Also, the concept of individual happiness should be questioned as a false assumption of neo-liberal thinking.

Critics of the market equilibrium theory say that equilibriums don't match the reality of non-local markets. Colander (2008) et al. argue that living systems rarely are in equilibrium although the dynamically changing behavior of agents might create results close to equilibrium. They suggest using agent-based models (ABM, i.e. simulations in which heterogeneous, interconnected agents interact with the environment and each other). ABM allows the creation of intuitive models which don't assume equilibriums but might show multiple emerging equilibriums based on the behavior of agents.

Axelrod (2005) sees simulation as a third way of doing science besides induction and deduction: *Like deduction, it starts with a set of explicit assumptions. But unlike deduction, it does not prove theorems. Instead, a simulation generates data that can be analyzed inductively. Unlike typical induction, however, the simulated data comes from a rigorously specified set of rules rather than direct measurement of the real world. While induction can be used to find patterns in data, and deduction can be used to find consequences of assumptions, simulation modeling can be used as an aid intuition.*

Parker (2020) showed that simulation can generate higher-order evidence (evidence that there exists other evidence for a hypothesis about the world) and new knowledge (at least for those who don't fully understand the implications of the model). Parker considers evidence from simulation reliable *in a domain of application if, and to the extent that, the majority of results that it would produce in that domain are true*.

Reinforcement Learning (RL) is one field of artificial intelligence (AI) that can be used in the same way as ABM to model economies to study the effects of specific measures. It has the same limitations of the epistemic value of the results as described above for ABMs, i.e. the results can be used to validate assumption but not as proof. The advantage of RL over ABM is that the model does not need to hardcode the rules of agent behavior, thus avoiding wrong assumptions. In RL the agents explore the solution spaces and thus come up with the behavior which maximizes the utility function in the long run. This is especially important for complex multi-agent scenarios in which coding the rules of interaction between the agents would be too difficult and too unintuitive. The idea is that complex systems can't be designed, they need to evolve. The use of RL requires only observational data (to test the results) and no detailed prior knowledge about the domain of the simulation. The disadvantage of RL is that it requires way more computational resources compared to ABM.

Zeng (2020) et al. presented the "AI economist", a multi-agent RL (MARL) to learn more about optimal taxation in capitalistic economies. The underlying model uses a two-step economy in which agents collect stone and wood, trade those resources, and then build and sell houses. Two-step economies are more realistic, as they include effects of interdependent behavior changes, e.g. changed behaviors of builders can have an impact on gatherers. The agents have diverse collecting and building skills. The agents try to optimize their utility (increases with post-tax income, decreases with labor). As the goal of the AI economist is to figure out optimal taxation, they use two level RL: the first level are the described agents and the second level is a social planner trying to optimize social welfare as a utility function defined as productivity (pre-tax income of all agents) times equality (similar incomes across all agents). As the behavior of the social planner depends on the behavior of the other agents, they first train the other agents until their behavior is stable before starting the social planner exploration on top of that. Zeng et al. noticed that the emergent agent behavior features specialization depending on their diverse capabilities (some agents specialize in collecting resources while others concentrate on building houses) as well as tax gaming (avoiding high tax brackets for some periods by increasing income in other periods). These two features which align with economic intuition support the validity of the model.

Two more notable examples of diverse tools for economic models: As part of the field of econophysics, Chakraborti (2002) created a model, which was later called yard-sale model, explaining why the rich get richer in capitalism. The model was tested by comparing the effect of redistribution via taxes to those in real economies. Korth (2002) cited experiments from Axelrod

(1984) with the repeated prisoner's dilemma, based on models inspired by game theory, to show that cooperative strategies are superior to strategies based on exploitation. This supports the idea that actors don't have to be "good people" acting based on ethical values, as the agents were computers. In this article, cooperation is understood as mutual support or "tit for tat" to avoid (self-)exploitation.

Modeling Experiments

In this section, I describe my initial experiments, modeling economies[1]. I started with a copy of the ABM Sugarscape, which is often used as a model for wealth distribution. The agents are ants that walk around to collect and eat sugar. Some areas have higher concentrations of sugar than others. The sugar regrows after being eaten. The agents are heterogeneous: Some need more sugar to survive than others and some have a larger search and motion radius than others (called vision in the experiments). In the basic setup, the ants collect more sugar than they need. The more ants are added, the higher the death rate. Low-vision ants have a higher chance of dying.

In the first variation, I added internet for the ants: free information for all of them so that they know in which direction to move to find more sugar. While this led to more living ants, it also increased the separation between the low- and high-vision agents: Of all dead ants, the percentage of low-vision ants further increased compared to the percentage of high-vision ants. This is intuitively clear as those agents who can move further in each simulation step can reach areas, in which there is currently a lot of sugar faster.

In the next experiment, I added the concept of solidarity: Ants would only add sugar to their own reservoir until they have up to three times the amount of sugar they need per simulation step. Additional sugar is added to a common distribution center. Ants that did not manage to find enough sugar can take what they need for the current simulation step from the distribution center. The simulation is assuming no transportation cost for giving to or taking from the distribution center. In this version, way more ants survive compared to the previous versions. Only when adding more ants than sugar can be collected, the first ants start to die. The death rate of low-vision ants is closer to that of the high-vision ants and there is no uneven distribution of sugar among the agents (see figure 2).

In the last experiment, I added a variable percentage of individualist ants to the previous scenario. The individualist ants ignore the solidarity system and just collect their own sugar. This can be interpreted either as a model of the impact of so-called "bad actors" or as a model of panarchy, where two economies exist in the same location. In this simulation, the individualists were the first to die. Even when the number of ants increased so that some of the solidary economy ants started dying, there was still a higher chance of individualists dying. This shows, that the individualists did not have a huge impact on the solidarity economy (see figure 3).

1Details of the experiments: https://github.com/rakvat/ant_sim

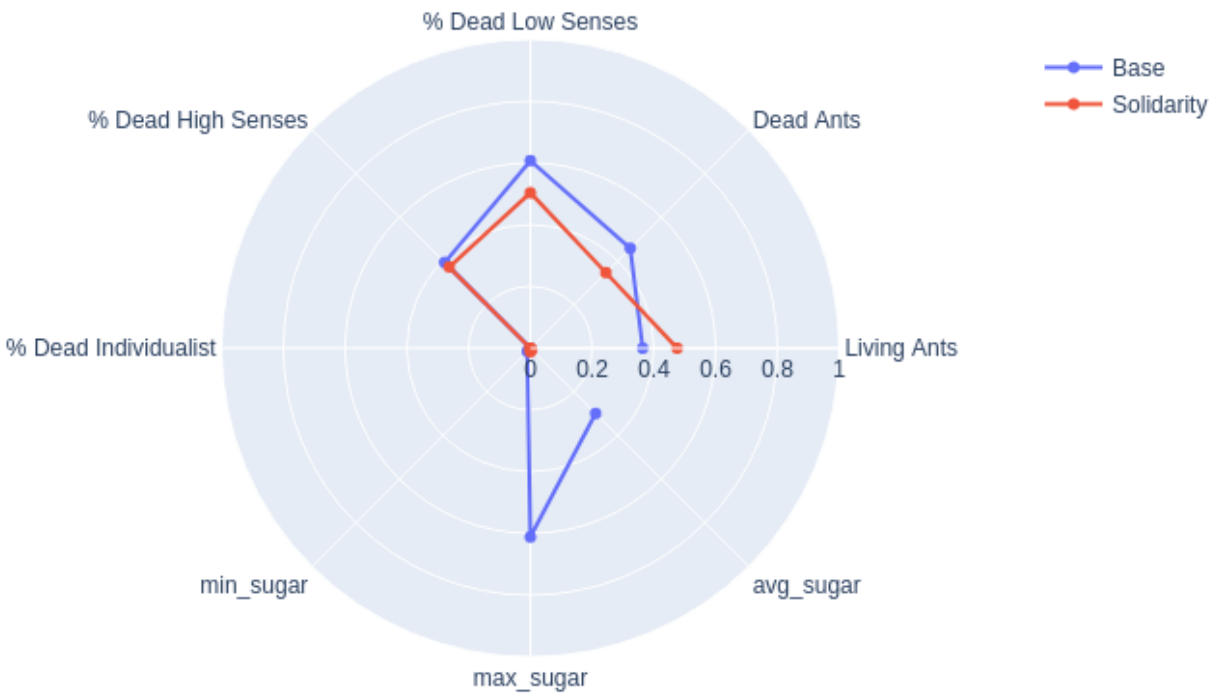

Figure 2: Results of the simulation with the solidarity concept compared to the base case

Figure 3: Results of the simulation with individualists

I did not include any detailed numbers about the results of the experiments, as this is not empirical research. Simulations have suggestive value and thus, qualitative changes in the results are more valuable than exact numbers.

Further Research

These experiments are just a starting point or proof of concept which might add support to the feasibility of economies based on freedom and solidarity. Additional and more detailed models could be developed to make anarchist societies more intuitive. E.g. ideas of decentralization and other patterns of organization like those suggested by the VSM could be explored further via simulations. It would also be interesting to simulate various scenarios of panarchy to figure out if and under which circumstances economies would destroy other economies in the same or neighboring areas, e.g. if a capitalist economy could exist next to an anarcho-communist economy or if capitalism would not be able to exist without the possibility to always assimilate more. I'm also planning to experiment using the method of reinforcement learning to further reduce the number of assumptions that are baked into the models and to experiment with non-individualist notions of utility.

Conclusion

In this article, I presented abstract requirements for future societies based on ethical values. I derived concrete organizational foundations for economic and social planning which are in line with these values. Using the Viable System Model as a debugging tool, I categorized necessary technical tools for those societies — tools that are already available and in our hands to make such societies a reality. Lastly, I showed how the method of simulation can be used to support the feasibility of

societies and economies. In times of climate crisis, we need to discuss, evaluate, and start building alternative economic systems and societies which value freedom and solidarity over authoritarian tendencies.

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