

Hierarchy beyond top-down control: the architecture of self-organised social systems

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Abstract—Diverse social system architectures are needed to address the inter-related social and environmental challenges that societies face across scales. The iron law of oligarchy states that all societies eventually become hierarchical, with top-down control, as they grow in size and complexity. We contribute to existing research arguing that this is not an inevitability. To do this, we analyse social systems that organise non-hierarchically (Self-Organised Social Systems (SOSS)). SOSS have a multi-scale architecture with respect to information abstraction, which is not tied to a hierarchical control structure, and allows for scalability. Through primary and secondary data collection, we analyse the structure and function of SOSS in the past and present, including neighbourhood collectives, activist and co-living groups (primary data, via interviews); and anarchist collectives in the Spanish Revolution, the Zapatistas, and the Occupy and 15M movements, among others (secondary data, from literature). We identify *federations* and *networks* as two initial types of SOSS that can scale in size and complexity. Key features include: (i) maintaining power at the lowest level; (ii) the quasi-autonomy of lower-level groups; (iii) sharing of skills, information and knowledge; (iv) adaptability across scales; (v) stability and uncertainty reduction; (vi) resilience. Future work will focus on questions of timing, scalar stress, and adaptability, to better understand how and why SOSS architectures succeed, fail, and can be implemented.

Index Terms—feedback hierarchy, self-organisation, social system, adaptability, scalability, information

I. INTRODUCTION

As social systems grow in size and complexity, their internal organisation often becomes hierarchical, featuring a tree-like structure with top-down authority and control. This evolution towards hierarchy is often considered to be inevitable, necessary, or both [1][2] [3]. Necessity of hierarchy is justified on the grounds of *scalar stress*, i.e., the relationship between a group’s consensus delay and its size [4]. As scalar stress increases with group size, top-down authority is seen as necessary to ensure the effectiveness of decision-making. Yet, as noted by Zefferman [5], hierarchies may also generate information bottle-necks, as those who hold power use their authority to control information flows. The inevitability of hierarchy is also referred to as “the iron law of oligarchy” [1], which states that any large social organisation, no matter how democratically organised at first, will eventually become an oligarchy, where power becomes concentrated in the hands of a few. Diefenbach [6] re-framed the iron law of oligarchy as a *threat*, arguing that while strong tendencies towards oligarchic hierarchies may exist, they are not inevitable. Appropriate

counter-measures and innovative self-organisation may allow creating and maintaining alternative social arrangements.

Graeber & Wengrow [7] also refute the inevitability of hierarchy, building a counter-narrative from an archaeological and anthropological perspective. They provide examples of societies throughout history that have organised non-hierarchically, from pre-historic Ukrainian “mega-sites”, to the Mexican city of Teotihuacan. Instead of framing one or the other as inevitable, Boockhin described the non-hierarchical vs. hierarchical organisations of societies as the Athens vs. Roman model of democracy – the first is participatory-communal, and the second centralist-statist [8]. While the Roman model is dominant, the Athens model has appeared as a counter-current at different points throughout history [8].

This position paper presents initial findings of an on-going project, with two main objectives. First, we investigate how non-hierarchical social systems function, focusing in particular on their scalability. Second, we aim to identify the key prerequisites, constraints and weaknesses of non-hierarchical social systems, to contribute to a better understanding of their successful implementation. Diversifying the way social systems organise can help in addressing the wide range of interrelated, local and global, social and environmental challenges faced by modern societies. We do not argue that lack of top-down control is inherently good or bad, but aim to contribute to an informed debate about the strengths and weaknesses of different social system architectures. We present here initial considerations related to the first project phase.

We refer to the systems of interest to our study as *self-organised social systems (SOSS)* (although admittedly all social systems are self-organised in some sense). We define SOSS as systems of people who organise towards shared goal(s), while avoiding top-down authority or control. SOSS include groups of different sizes and complexities, such as activist groups, social cooperatives, co-living groups, and ad-hoc collectives mobilising for a short-term goal (e.g., a group of people organising to stop an eviction). This definition is in line with Simon’s view of human organisations as systems of interdependent activity towards common objectives [9]. In particular, we consider SOSS from an information perspective, as multi-scale feedback systems [10]. Information from the groups’ fundamental units is abstracted into higher coordination layers, which provide a broader and more stable view to

group members, while maintaining power and control at the bottom. Hence, a hierarchical (multi-scale) architecture can be built for information management and coordination purposes, allowing SOSS to scale, without requiring hierarchy in the sense of top-down authority or control [11]. By viewing hierarchies as systems of information abstraction and feedback, we argue that large-scale systems may function efficiently without requiring power centralisation. To make this point, we analyse past and present SOSS of different scales.

We collected SOSS details via direct observation and semi-structured interviews (primary data); and from academic and grey literature (secondary data). Interviews allow focusing on the fundamental processes of interactions among group members and assembly dynamics, while structural features of SOSS are more easily found through available resources. Eight semi-structured interviews were conducted with SOSS across the Barcelona and Paris region, featuring diverse goals and sizes – e.g., a neighbourhood collective managing an urban garden project, a nation-wide activist group working on housing rights, and a collective living on farmland to protect agricultural fields. Groups were selected based on the authors’ networks and relations. For secondary data, we focused on large-scale SOSS in the past and present, selecting examples based on the availability of information in academic and grey literature. These are: the Paris Commune, the Zapatistas, the Autonomous Administration of North and East Syria (AANES), the 15M movement, the Occupy movement, assemblies in Greek poleis, the Gilets Jaunes, Extinction Rebellion, and Food not Bombs. We do not focus on these SOSS as case studies, but rather as illustrations to explain our main ideas. The collection of primary and secondary data will be expanded as the project continues.

The rest of this paper has a hybrid format. Section II introduces the theoretical framework of feedback hierarchies. This provides the unifying lens for presenting our results, which distill and synthesise insights from the literature, and combine them with examples from the analysed SOSS (including interviewed groups, and systems analysed from secondary data). Section III describes SOSS as feedback hierarchies, and Section IV summarises some of their main characteristics. For the interviewed SOSS, we do not disclose confidential details of their inner workings, but describe relevant features of their behaviour, keeping the names of the less institutionalised groups anonymous.

II. THEORETICAL FRAMEWORK: FEEDBACK HIERARCHIES

Complex systems tend to be organised hierarchically [12]. Hierarchy, however, does not necessarily imply top-down control [13]. To model this, in previous work we introduced the Multi-Scale Abstraction Feedbacks (MSAF) design pattern. MSAF systems feature multiple scales, or information abstraction levels, interconnected via feedback loops [10]. For our purposes, we define information as “an observable difference or change in an object that propagates and triggers change in an observer” [14]. Then, scale represents “the granularity of

observation of a targeted object”. Hence, information abstraction is the process of information loss when moving from a lower scale (with higher granularity) to a higher scale (with lower granularity). Information reification is the opposite, and takes place when abstracted information flows back down to lower levels (with higher granularity). From this perspective, a feedback hierarchy can be defined as a system where multiple levels of information abstraction exist, and affect one another through feedback. Both abstracted and reified information flows can lead to modifications in the receiving observer, and hence be considered as ‘control’ signals. However, MSAF does not inherently impose control authority of higher scales over lower ones; nor vice-versa. Consider a simple example of foraging ants in a colony. Ants lay pheromone trails, which collect and abstract information (i.e., pheromones) provided by each ant. The trail is an aggregate of the individual ants’ pheromone information, and affects their behaviour. This system can be described as a two-level feedback hierarchy, where the pheromone trail is an *exogenous macro-entity*, abstracting information from ants (the system’s micro-entities), and providing feedback back to the ants through that abstracted information. In addition to the exogenous case, two other types of abstraction-driven feedback exist, depending on where the abstracted information is located (i.e., how the macro-entity is distributed): *micro-distributed*, and *composite* hierarchies. In micro-distributed hierarchies, the abstracted information is distributed across the micro-entities (not exogenous to them). Examples include culture or values shared by a group, existing as ideas and interpretations within each individual, and guiding their behaviour. In composite hierarchies, the higher levels are composed of lower ones and provide structural feedback to them. E.g., trees form forest patches, which determine where new trees grow. Macro-entities – whether exogenous, micro-distributed or composite – act as *slow variables*, changing as they accumulate information from lower levels, and providing abstracted information to guide them [15]. Hybrid hierarchies, combining macro-entity types, are also possible.

III. SOSS AS FEEDBACK HIERARCHIES

Feedback hierarchies can be used to model and structure SOSS. Our initial study brought to the fore two types of feedback hierarchies that ensure SOSS scalability: federations and networks (Figure 1). In both cases, the lowest level is populated by quasi-autonomous groups – i.e., groups who act autonomously within given bounds [16], in line with Simon’s near-decomposability concept [12], which views systems as recursive sets of sub-systems. A variety of bounds, more or less restrictive, allows for a wide range of autonomy levels. In the federate case, groups organise around shared goals through a delegation system (i.e., exogenous coordination), ensuring that control remains at the lowest level. The figure shows only three levels, but there can be more. Information can be gradually abstracted through meso-levels or it can all originate from the lowest level, with different coordination layers defined in terms of their span (e.g., assemblies of delegates covering entire territories, vs. regions). In the network case, the slow variable

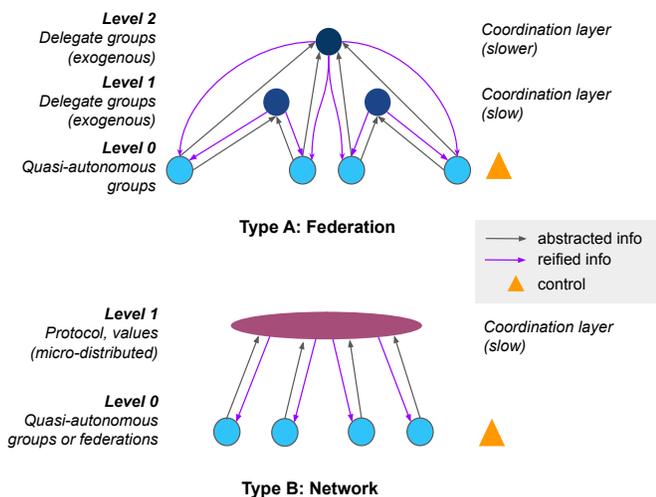


Fig. 1. Feedback hierarchies: federations and networks

at the macro-scale is a protocol, norm or value shared by all groups and members (i.e., micro-distributed coordination). In both cases, higher levels operate more slowly than lower ones – e.g., delegations coordinating national strategies for different branches of an activist group meet less frequently than the local assemblies of that group. While making this distinction, it is important to note that SOSS are often a mix of both types (e.g., networks of federations).

A. Federations

As observed in the studied federations, groups at the bottom level organise autonomously, usually through assemblies. Then, delegates from each group meet to coordinate across groups. Importantly, while delegation can span across several levels, the final decision power stays at the bottom. This is also known as social (or upward) control [6]. The purpose of the higher levels is mainly to organise, coordinate and propose strategic lines to the lower levels. For such delegate democracy to avoid top-down control, delegates must be recallable, and have a clear mandate. Lower level groups, in turn, have autonomy within predefined guidelines, which may change.

From an information perspective, delegates are exogenous entities (macro) who provide abstracted information about their groups (micro) to coordination assemblies. Inversely, delegates bring information from the higher levels back to their groups, leading to inter-scale feedback. Shared values and norms may either be exogenous (written and stored externally) or micro-distributed (maintained internally by each member).

Our definition of federations includes both short-term and long-term goals, allowing for temporary and loose federations to form. E.g., the Gilets Jaunes movement spread throughout France in autonomous groups, but representatives from each group met in an “Assembly of Assemblies” to decide on shared strategic guidelines [17]. Other federations include AANES, the Zapatistas, the councils of the Paris Commune, the Spanish activist group PAH (a housing rights group), which organises

through municipal, local, and regional assemblies, and France Nature Environment, split into regional and local branches.

Groups of neighbourhood collectives can also meet to form a temporary federation for a specific goal – e.g., the discussion of shared concerns against real estate speculation, which happens in neighbourhoods across Barcelona and the Paris region. Larger-scale ad-hoc federations may also occur – e.g., inter-union discussions for selecting a common protest date, in France. Many small and medium-sized activist groups (of 10-50 people) act as federations of working groups, which have autonomy over decisions taken within their mandate, and then meet to take group-level decisions. Usually, whether the federation is small or big, loose or tight, lower-level meetings are more frequent than higher-level ones. Such federations, when formalised (e.g. AANES), reflect the principles of libertarian municipalism [18] and democratic confederalism [19].

In terms of scaling, the quasi-autonomy of lower levels in federations is essential, as well as the fact that decision-making powers are kept at those levels. Scalar stress is reduced by keeping assemblies at a manageable size, without requiring power centralisation.

B. Networks

In networks, quasi-autonomous groups replicate or organise independently with little or no explicit coordination. Implicit coordination occurs as all groups strive towards a similar goal, by sharing compatible values or guidelines – the macro-entity here may be micro-distributed, e.g., informal norms; or exogenous, e.g., a manifesto. Similar to federations, networks may also have short- and long-term goals. Network examples include the spread of the 15M movement across squares in Spain; the Occupy movement in the US; or the Food Not Bombs and Extinction Rebellion groups across countries.

Often, each group may then feature an internal federation-style organisation (e.g., the different working groups of Extinction Rebellion), forming a network of federations. More informal network groups include, e.g., anarchist solidarity networks across the world, united by a shared culture; and networks of resistance with specific goals, e.g., the international supporters network of the Zapatista movement. In terms of scaling, networks have low coordination costs, as groups are almost entirely autonomous, and held together by shared goals (though these may change over time). They work well for specific purposes, when most of the coordination happens at the lowest levels. Low coordination costs among groups who have a shared vision allow for such networks to spread rapidly and to reach large sizes – e.g., the Occupy movement spread to more than 100 cities in the US and 1,500 encampments globally [20]. This network structure may remain stable over time if the group’s goals are clear and relatively simple. Else, they may switch to a federation-style system when requiring more inter-group coordination, or collapse if they fail to adapt. In general, boundaries between networks and federations are fuzzy, and groups may fluctuate between the two systems, or form hybrid structures.

IV. KEY FEATURES OF SOSS

A. *Decision-making at the lowest level*

In SOSS, control is maintained at the lowest level (Fig. 1). Hence, self-organisation is crucial at this level, even within deep hierarchies with many coordination layers – lower levels are not “less complex” than higher ones [21]. E.g., in AANES, the commune is the most powerful political unit [22]: “ (...) the higher the council, the lesser its power in democratic confederalism” (p.102). For the analysed cases, lowest levels tend to operate through consensus (everyone agrees) or consent (no one disagrees), although majority votes may also occur. Generally, consensus is used for important, strategic decisions, while majority votes for smaller decisions – e.g., the date of the next assembly. This constrains the assembly size, as consensus becomes difficult for groups that are larger than 40-50 people. To address this, many larger groups include a core component that uses consensus for key decisions; and a peripheral component that uses voting for less essential actions, supporting the group. Else, consensus may still be used in principle in large groups (with assemblies of 50+ people), but often the dynamics here are unequal, with an informal core component of the group leading the discussion. Consensus decision-making ensures that everyone feels involved with the decision and allows for new, creative options to appear. While taking longer than a majority vote, consensus also reduces monitoring efforts, as people work for goals they have agreed on [23]. Yet, consensus is not perfect – often, it may lead to informal hierarchical structures, where group members with higher social status gain and capitalise upon extra power. E.g., the long assemblies that took place during the Occupy movement led to “the manipulation of the better organized”, or “consensus by fatigue”, where long assembly times allowed for individuals to push for their personal agenda [24] [25]. As assembly participation cannot be forced, for larger systems (e.g., Zapatista communities, or AANES) only a part of the population attends the assemblies. Still, participation tends to be higher than in representative democratic systems [22].

B. *Structure & stability*

Whether explicit or not, groups always have some form of structure in the way they operate. Formalising structure, so that it can be questioned, avoids the “tyranny of structurelessness” [24]. Still, this structure does not need to be associated with power centralisation. E.g., having a fixed set of roles that rotate regularly provides group stability, without tying that stability to specific people fulfilling those roles. This also avoids excessive specialisation, a structural condition that “undercuts the likelihood of developing and maintaining a collectivist-democratic form of organization” [26] [6].

A shared culture (which can be micro-distributed, or exogenous) provides stability to SOSS – both networks and federations. AANES’ constitution defines its guiding principles, including democratic confederalism. The 15M movement developed within a shared culture of autonomy, feminism, and hacker ethics [27]. Its assemblies were also bound by a

methodological proposal aimed to ensure transparency, building on the principles of horizontality, inclusion, respect and collective thought [27]. In smaller groups, decision-making protocols often ensure stability (e.g., consensus principle). Stable elements within the group can lower the costs of coordination and communication, allowing the group to invest their time and energy in other decisions (e.g., having a fixed assembly meeting time and place, and clear role-rotation protocols). For less institutionalised SOSS, stability may be ensured via the (partial) continuity of their members. While member fossilisation may lead to power centralisation, some continuity provides group memory and persistence. However, internally stable SOSS may still “fail” when faced with an adverse environment actively fighting against them (e.g. the Paris Commune, or anarchist collectives in the Spanish Revolution).

C. *Mechanisms against power centralisation*

Most SOSS are aware of the tendency towards top-down control, and set up mechanisms to counteract it. Information centralisation often leads to power centralisation [24]. To avoid this, information is not centralised and abstracted onto specific individuals, but onto roles, mechanisms, shared values, or public documents, accessible to group members (detaching key information from key individuals).

In federated SOSS, there are many ways to avoid power accumulation by delegates. E.g., in the Paris Commune, maximum salaries were set for officials. In the Zapatista communities, political delegates follow the principle of “leading by obeying”, and can be revoked whenever the community sees fit. This is in line with the principles of polyarchy, i.e., control *of* leaders, rather than control *by* leaders [28]. Similar mechanisms also hold for networks. In the 15M movement, rotating spokespersons communicated with the media, instead of representatives. Clear mandates are also essential, both in smaller SOSS, organised into working groups, and in larger federations, with delegates following mandates decided from lower-level assemblies. Federation-style systems can also work alongside systems with centralised control, and dilute the power of those systems. E.g., in AANES, the communes exist alongside the State and political parties, but diminish their power by making them redundant [22].

D. *Adaptability & sustainability*

Adaptable SOSS can alter their internal organisation in response to short- and long-term change. As lower levels are quasi-autonomous, in most SOSS new working groups are created ad-hoc when needed (or put on hold when no longer needed). In smaller SOSS, fluctuations in group members may be beneficial, allowing people with new ideas to join, and those who no longer identify with the group to leave. Still, excessive fluctuation can reflect a lack of clear shared goals, internal group coherence or motivation, and lead to collapse. Over time, groups may adapt between more or less structured architectures, depending on their needs and action complexity. Adaptive SOSS may also shift between distributed and centralised control – i.e., from a SOSS to

a classic hierarchical system. This may be needed in times of emergency. Reducing a society’s hierarchisation does not necessarily reduce its social complexity [29]. However, back-and-forth transitions between SOSS and hierarchical structures remain under-studied.

Other adaptability shifts include changing voting mechanisms depending on different factors (e.g. number of voters, urgency of decisions), with many groups switching between consensus, consent, and voting. SOSS adaptability is also closely tied to the sustainability of their embedding environment. As environmental challenges unfold across different scales, a multi-scale federation can ensure that environmental problems are dealt with at the relevant scale (what is also known as polycentric governance [30]). However, lack of wider coordination and agreement among groups can lead to failure in addressing large-scale environmental challenges.

E. The role of information

In network-like structures, information ecosystems that are accessible to different groups are essential for growth and stabilisation. For the 15M movement, coordination was enabled via social media platforms, facilitating networking among members [27]. The way knowledge was aggregated and distributed was central to participatory democracy in Greek poleis [31], which relied on building common knowledge (a slow variable), and on open access to that common knowledge. As “information is power” [24], information sharing (including knowledge and skills) may offer a way to prevent oligarchy formation [26]. While everything may not be shareable within limited time-frames, what matters is access to information (even with some delays). The quasi-autonomy of working groups and commissions within SOSS mirrors some form of specialisation, but those specialised skills are distributed among groups of people, and rotated when necessary.

F. Timing

Top-down decisions may often be faster than ones taken in a decentralised way, especially if consensus is used in the latter. This is particularly important in emergency situations. To address this, adaptable SOSS may switch to centralised authority in emergency cases, while setting up mechanisms to ensure that the authority is limited and revocable. If a system switches to a top-down control structure when facing an emergency, as often seems to be the case (see [4]), it would be useful to understand how that group can switch back to a decentralised organisation, and to estimate the costs and constraints of such back-and-forth adaptation. Hybrid organisations may also exist, combining SOSS with top-down control for different societal sectors. E.g., in the Zapatista community, while the inner workings of the army are hierarchical, the actions of the army itself are controlled by the assemblies (i.e., the army does not have autonomy to do what they want). While warfare situations constitute an emergency, it is also important to distinguish between different types of timescales and emergencies. Climate change, for example, is an urgent issue, but not one where solutions are chosen and implemented

on the time-scale of minutes. For this, a slower deliberative process (within limits) may lead to more effective solutions, and to ones that are better implemented – although if decisions taken in assembly settings are too slow, people may reduce their participation (this happened with both the Occupy and 15M assemblies).

G. Summary of key features

- **Power at the lowest level.** To avoid the threat of oligarchy [6], SOSS set in place special-purpose mechanisms, e.g., role rotation and strict mandate and delegation systems. This comes at a cost, especially when faced with external threats, as role rotation may lead to slow behaviour, loss of competitiveness and reactivity.
- **Sharing of skills and information.** Distribution of skills, knowledge, information and power allows for individuals to feel ownership over decisions; and for the group to be less dependent on key figures. Power relations may persist informally and structure may help to avoid oligarchisation.
- **Quasi-autonomy of the lowest level.** Scalar stress is reduced by splitting large groups into small, quasi-autonomous components. Feedback across layers allows for the coordination of these quasi-autonomous groups.
- **Stability & uncertainty reduction.** Slow variables (such as shared values) provide stability to the group, and a fixed structure reduces uncertainty, allowing for SOSS to invest their time and energy into complex decisions.
- **Adaptability.** Adaptability is required at different scales. Assembly-style deliberative processes may be ineffective at times, getting stuck when consensus cannot be reached. In these cases, groups can formally or informally switch to softer consensus forms, e.g., consent. Over time, groups may shift from being more or less structured depending on the complexity of their needs. At slower timescales, groups may switch between SOSS and hierarchies.
- **Resilience.** For smaller groups (e.g., neighborhood collectives working for specific goals) a SOSS architecture may be beneficial in the long-term, as they specialise in a chosen domain and do not necessarily face competition with other groups. At the larger scale, SOSS tend to fail when faced with adverse environments, as dominant systems employ their accumulated power to fight alternative configurations (e.g. Paris Commune, anarchist collectives during the Spanish Revolution).

V. CONCLUSION

Processes of social transformation are not inevitable, but conditional [6]. By refuting the iron law of oligarchy, this research project aims to explore how and why non-hierarchical configurations (SOSS) may succeed or fail. Initial results, extracted from primary and secondary data, pointed to key features of SOSS – e.g. the quasi-autonomy of groups; individual power reduction via rotation and mandates; and the separation of power, hierarchy and information. We identified

federations and networks as two initial types of SOSS that allow for scalability without centralising power. In both types, scalar stress is reduced by splitting the decision-making nodes into quasi-autonomous groups of manageable sizes, while slow variables (exogenous or micro-distributed macro-entities) ensure group coordination and stability. However, keeping control at the bottom changes the timing dynamics with respect to a classic top-down authority, as decisions taken by the coordination layer must be passed through the lower levels. Future work will further explore this dynamic, expanding the case study database to model and evaluate SOSS and the timing dynamics of their feedback cycles.

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