

Essay

The Promise of Collective Intelligence: Communicative–Inferential Coordination Across Collective Systems

Sven-Volker Rehm

Abstract. In this essay, I propose a systems-theoretical and inferential perspective on collective intelligence. Drawing on cybernetics, systems theory, and recent research on AI-supported collective reasoning, I argue that collective intelligence depends on the conditions under which communication, interpretation, and coordination become possible across hierarchical levels. Consequently, the article discusses the conceptualization of collective intelligence as communicative-inferential coordination across collective systems. It further examines how AI-based infrastructures increasingly shape these boundary conditions and discusses the resulting epistemic, organizational, and ethical challenges for collective adaptation and societal communication and coordination.

Keywords. *Collective intelligence, collective adaptation, inferential coordination, systems theory, cybernetics, artificial intelligence, sociotechnical systems, societal communication*

From Collective Performance to Collective Adaptation

Collective intelligence is often associated with the idea that groups can outperform individuals—by aggregating opinions, distributing tasks, or merging diverse perspectives. While these interpretations capture important aspects, they remain limited. They frame collective intelligence primarily as a problem of ‘smart’ performance: how to make groups more efficient, scalable, or aware of common goals.

In this essay, I propose a different starting point. I approach collective intelligence through the question of how collective systems become capable of *adapting collectively*: of perceiving changes, interpreting signals, coordinating responses, and reorganizing themselves over time. This understanding shifts the focus from individual cognition or aggregated judgment to the conditions under which coordination, reasoning, learning, and transformation become possible in collective systems, and especially in open social systems.

This perspective resonates with recent work that reframes collective intelligence as a problem of *collective adaptation* rather than ‘optimization,’ emphasizing responsiveness under changing conditions (Galesic et al., 2023). Here, the core question becomes how groups can remain responsive under changing environmental and boundary conditions, how they can collectively develop sophisticated lines of reasoning despite incomplete knowledge, and revise their purposes as circumstances evolve. This view denotes intelligence as a collective, emergent achievement of ongoing interaction and introduces an *architectural notion* of intelligence beyond understanding it as a property of individual agents.

At the same time, recent advances in artificial intelligence—particularly in natural language processing—have begun to transform the conditions under which such interaction takes place. Tasks such as collecting, structuring, interpreting and synthesizing large volumes of discursive

material can now be partially automated. This can expand both the *scale* at which collective processes can be organized and the *depth* at which they can be analyzed (Malone, 2018; De Cremer & Kasparov, 2021).

This does not imply that AI replaces human judgment. Rather, the architecture within which judgment is formed and coordinated is gradually changing. AI systems can support collective memory, attention, and reasoning, enabling new forms of interaction that were previously infeasible (Woolley & Gupta, 2024; Riedl & De Cremer 2025). By reshaping technological infrastructures, however, AI systems also introduce new dependencies and design challenges, as they change the communicative conditions under which information is selected and interpreted and collective action is developed (Woolley, 2025).

From this perspective, collective intelligence becomes a feature of the communicative-conceptual, organizational, and technological *arrangements* through which communication, interpretation, and coordination are made possible. In the following, I discuss these arrangements further, addressing coordination through digital platforms and at the societal level, the role of inference and hierarchy, transformations in the conditions of coordination, and associated design challenges.

From Operational Efficiency to Sustainable Coordination

If collective intelligence is understood as collective adaptation, a crucial distinction emerges between systems that *work* under controlled conditions and those that *remain viable* in open, evolving environments.

A growing number of experiments show that coordination of collectives at scale can be achieved under specific conditions. Using digital platforms, distributed groups of participants—sometimes numbering in the hundreds—can be organized through iterative or real-time feedback mechanisms to produce coherent outcomes. Such approaches have been applied to forecasting tasks, large-scale opinion formation, and the coordination of distributed work, and are discussed, among other contexts, in Malone’s (2018) concept of *Superminds*.

These experiments show that collective performance can be organized systematically and that meaningful coordination can emerge without centralized control. However, their functioning and performance often rely on a decisive condition: interaction is typically *pre-structured*. Participants operate within predefined interfaces, constrained response formats, and carefully designed feedback loops.

This also reveals a limitation. Systems optimized for efficiency, ease-of-use and performance in well-defined, relatively stable settings may become fragile when conditions change—when purposes shift, contexts change, or competing interpretations become apparent. What appears as robust coordination often depends on specific structural conditions—and may break down once these conditions change.

This tension points to a broader issue. Collective intelligence is often approached through a form of *technological solutionism*: the assumption that complex social dynamics can be improved primarily through accessible interfaces, larger datasets, or advanced algorithms that channel information (Morozov, 2013). Such an approach can underestimate the open-ended, historically contingent, and normatively charged nature of social systems.

A more demanding perspective recognizes coordination in such systems as a communicative and interpretive accomplishment. It involves the ongoing negotiation of meaning, relevance, goals, actions and interventions under conditions that cannot be fully specified in advance.

Designing for collective intelligence therefore extends beyond enabling participation or optimizing interaction; it requires an understanding of how coordination can remain sustainable over time while *allowing its underlying conditions to be reflected upon and revised*.

This distinction between operational efficiency and sustainable, adaptive approaches to coordination will be central for the argument that follows.

Collective Intelligence, Societal Change, and the Limits of Simplistic Thinking

Taking the collective adaptation perspective, the ‘promise’ of collective intelligence extends into the broader domain of societal coordination. Many of the processes that structure social order and economic change have long been described through powerful concepts and metaphors—Adam Smith’s *invisible hand* and Schumpeter’s *creative destruction* being among the most prominent. These metaphors capture the important insight that coordination can emerge without centralized control or intention. At the same time, as I will argue below, they cannot simply be translated into engineered mechanisms.

It is still tempting, in light of contemporary technological capabilities, to assume that such emergent processes could now be deliberately reproduced or even improved. If coordination *can* emerge spontaneously, why should it not be designed? If large-scale participation can be organized technically, why should collective outcomes not be steered more effectively?

This line of thinking, however, risks overlooking a fundamental distinction. The phenomena described by these metaphors are not engineered mechanisms in the conventional sense; rather, the metaphors offer retrospective accounts of emergent order arising under historically contingent institutional and communicative conditions. To treat them as blueprints for design is to misunderstand their nature.

Recent experiments in collective intelligence, including those described by Malone, illustrate both the possibilities and the limits of this ambition. As noted earlier, these systems demonstrate that coordination of distributed collectives can be achieved when interaction is carefully structured. Participants can be guided through interfaces that aggregate inputs, provide feedback, and channel attention toward shared outcomes. Under such conditions, collective processes can indeed become remarkably effective. However, while such systems may scaffold coordination, *they cannot reproduce the historically contingent conditions from which broader patterns of societal coordination emerge*.

What makes these systems work is the pre-definition and constraining of possible contributions, the framing of relevant signals, and the orchestration of interaction through designed feedback loops. These constraints can support efficient coordination within fixed boundaries and goals, yet they may also *limit the adaptation* of both coordination methods and the communication they structure.

A different picture emerges when one turns to domains in which coordination unfolds primarily through communication and interpretation—for instance, the formation of public opinion in democratic societies. Here, social order emerges through large-scale processes of communication, interpretation, and mutual adjustment unfolding across a distributed and heterogeneous public. In systems-theoretical terms, public opinion takes shape through recursive processes of selection and stabilization within communication itself (Luhmann, 1987; Luhmann & Baecker, 2005).

In such settings, coordination depends on the continuous collective reproduction of shared references, expectations, and distinctions, within acknowledged but evolving lines of reasoning. Digital platforms, public media, and increasingly AI-supported tools intervene in these processes through a spectrum of stimuli and modes of mediation that influence what becomes visible, what is considered relevant, and what appears plausible (Gillespie et al., 2014; Kitchin, 2017; Tessler et al., 2024; Jungherr & Rauchfleisch, 2025). Under these conditions, collective processes can shift rapidly or gradually, sometimes in unintended or even destructive directions. Unlike normative models of deliberation that orient communication toward consensus, this perspective emphasizes that coordination may emerge under conditions of persistent plurality and contestation (Habermas, 1982).

The challenge, then, lies less in reproducing coordination through technical means than in *understanding how the conditions that enable adaptive coordination are themselves being transformed*. Understood in this way, collective intelligence offers little prospect of controlling societal dynamics; its significance lies instead in drawing attention to the changing conditions under which communicative processes unfold.

A concrete, and in some respects cautionary, illustration of these dynamics is provided by recent urban governance initiatives experimenting with digitally supported citizen deliberation. Cities such as Barcelona and Taipei have introduced platforms that allow citizens to propose, discuss, and prioritize policy ideas at scale (see Borge et al., 2023; Tseng, 2023; Barandiaran et al., 2024). While these systems are often presented as tools for participation, their effects are more subtle, extending beyond participation itself (Husted & Plesner, 2017; Gudiño et al., 2024). The design of interfaces, the structuring of contributions, and the visibility of certain proposals over others shape how issues are framed, which arguments gain traction, and how consensus—or conflict—emerges. In some cases, these platforms have enabled new forms of collective problem-solving; in others, they have revealed how communicative processes can become skewed or fragmented (Bächtiger & Dryzek, 2024). Reports and critical analyses have pointed to issues such as unequal participation, agenda-setting effects, and the influence of platform design on deliberative outcomes. What becomes visible in such settings is the delicate interplay between technological structuring and the open-ended dynamics of public communication, extending far beyond a mere increase in participation.

Communication, Inference, and Hierarchy in Collective Systems

At this point, it becomes necessary to return to a more fundamental question: what is it, precisely, that is coordinated in processes of collective intelligence?

A classical cybernetic answer would, firstly, point to communication. Following Norbert Wiener, coordination depends on the circulation of messages that enable systems to regulate themselves through feedback (Wiener, 1948). General systems theory further suggests that, under certain conditions, such processes can contribute to structural adaptation, variation, and the emergence of new structural patterns (Bertalanffy, 1969; Prigogine & Nicolis, 1985).

Yet this perspective—indispensable though it may be—remains incomplete. In language-based social systems, messages—in and of themselves—do not explain coordination (Pask, 1970). A message can be transmitted without being understood, received without being acted upon, or interpreted in ways that diverge from its intended meaning. The effectiveness of communication depends not only on transmission but also on the conditions under which messages acquire meaning. As Bateson argued, communication is subject to a “*hierarchy of*

orders of recursiveness” (Bateson, 1979, p. 188). According to Stafford Beer, communication in organizational contexts generates coordinated action—that is, the functioning of the organization—through *recurring patterns of coordination* (Beer, 1972).

Communication thus extends beyond the mere exchange of predefined information. It unfolds as an ongoing process in which participants anticipate, interpret, and relate one another’s contributions, responding accordingly (Pask, 1970). In this sense, communication enables coordination by reinforcing—or disappointing—expectations, opening space for argumentation and reasoning based on distinctions, and thereby shaping the scope for action or non-action.

This is where an *inferential perspective* becomes relevant. Communication unfolds within a web of implicit commitments, entitlements and expectations that determine how contributions are taken up (Brandom, 1998). Actors engage in processes of mutual interpretation in which the meaning of a contribution depends on how it is situated within a broader context of what is already assumed, expected, or contested; its interpretation may depend on who has voiced it; and acknowledgement of its conceptual content depends on the recipient’s own stance and reasoning. In this sense, coordination can emerge through the *stabilization of inferential relations*—through sufficiently shared understandings of what counts as relevant, valid, or actionable (Brandom, 1998). Related recent work suggests that rhetoric, as an expression of reasoning, can help bridge divides by identifying shared values or goals across ideological boundaries (Drori et al., 2025, p. 18).

Hierarchies play a more subtle role in this process than is often assumed (see e.g., Leonard & Levin, 2022). Beyond functioning as instruments of control or authority, hierarchies can provide structural conditions under which recursive inferential relations scale across social systems. By organizing communication across levels, hierarchies can create relatively stable contexts within which expectations are formed, revised, and maintained (Mesarović et al., 1970). They shape who is entitled to say what, whose contributions carry weight, and how responses become coordinated. At the same time, this communicative process may gradually reproduce, transform, or destabilize the very structures on which it relies.

Through ongoing communication, new concepts, distinctions, and roles can emerge. What begins as a tentative interpretation may, over time, stabilize into a shared understanding; what is initially a local coordination may become institutionalized as an organizational function. Once established, such functions can exert a form of downward influence—or downward causation—by shaping how actors perceive situations, what they consider relevant, and how they orient their actions (Flack, 2017).

In this way, social systems continuously reorganize themselves through communicative processes that are simultaneously structured and open-ended. New ideas can evolve incrementally through recursive interaction with existing concepts—finding resonance with them or coming into conflict—and thereby gradually reshape the landscape of possible coordination.

Seen from this perspective, collective intelligence appears as **communicative–inferential coordination** unfolding across hierarchical levels and types of hierarchy. It takes shape through the dynamic interplay of actors, technologies, and structures within processes in which meaning is continuously generated, stabilized, and shifting again. Over time, these dynamics can contribute recursively to the coarse-graining and institutionalization of novel structural units while simultaneously enabling the adaptation and reconfiguration of existing arrangements.

Technological Transitions and the Changing Conditions of Coordination

Norbert Wiener, reflecting on the transition from the first to the second industrial revolution, describes a seemingly technical but deeply consequential shift in the organization of production (Wiener, 1950, pp. 171ff.). In early industrial systems, mechanical energy generated by a central steam engine had to be distributed through elaborate systems of shafts, belts, and couplings. The structure of production was therefore tightly constrained by the physical architecture of energy transmission. Coordination was, quite literally, built into the machine.

The introduction of electrical power substantially altered this setup. Energy could now be supplied locally, at each point of operation, without the need for mechanical coupling. What had previously relied on carefully engineered transmission systems could now be achieved through more flexible arrangements for supplying power locally. This shift not only boosted efficiency but also opened up entirely new possibilities for *organizational design*. Production processes could be restructured, decoupled, and spatially distributed in ways that had not previously been possible.

What initially appears as a technical innovation reveals itself, upon closer inspection, as a *transformation in the conditions of coordination*. Attention shifts from transmitting a fixed form of energy through predefined structures toward organizing systems in which locally available inputs can be combined and coordinated in different ways.

A comparable transition may now be unfolding in the domain of information processing. Tasks that once required extensive organizational structures—collecting information, interpreting it, and coordinating responses—can increasingly be supported by infrastructures that make informational resources locally accessible and configurable. AI systems, particularly those based on natural language processing, make it possible to engage with large bodies of language-based and discursive information in ways that were previously prohibitively costly or slow.

And yet, there is an important distinction. Unlike electrical infrastructures, which distribute energy without themselves determining its use, AI-based systems do not merely expand the scope and scale of action; they can also shape the conditions under which communication takes place. On the one hand, they structure how information is presented; on the other, they generate formulations that may prompt different inferences in recipients. They can thereby influence which interpretations become salient and which responses appear plausible, contributing to the *formation of inferential relationships* from which coordination emerges (see also Riedl & De Cremer, 2025).

This transition is still in its early stages. While experimental systems demonstrate what is technically possible, robust and well-understood implementations that deliberately and responsibly account for these inferential effects remain comparatively rare. What is becoming visible, however, is that the design of such infrastructures will increasingly shape *how open, adaptable, and reflexive collective processes can remain*.

The Design Challenge of Collective Intelligence

If collective intelligence is understood as communicative–inferential coordination in collective systems, with particular attention to open social systems, and if the conditions of such coordination are increasingly shaped by technological infrastructures, then the question of design moves to the center. Today's technology enables enhanced performance, expanded participation, and the acceleration of decision-making processes. However, questions remain

regarding the *preservation of inferential openness*—specifically, the conditions under which collective processes remain capable of generating, revising, and contesting interpretations.

Current developments in AI-supported deliberation and collective reasoning illustrate both the potential and the risks of this situation (Fishkin et al., 2025). On the one hand, such systems can enhance the visibility of arguments, support large-scale participation, and make complex issues more accessible. On the other hand, they may also narrow interpretive spaces, privilege certain framings over others, or guide collective outcomes in ways that are difficult to detect.

This ambivalence reflects a deeper tension: The same mechanisms that make coordination more efficient—structuring inputs, guiding attention, stabilizing interpretations—may also limit the diversity and flexibility on which adaptive capacity depends. Collective intelligence systems therefore face a tension: they must enable coordination without prematurely closing the space of possible interpretations.

This brings us back to the classic cybernetic insight that control systems are conceived in relation to goals or purposes. They operate by maintaining or approaching particular states and responding to deviations from them. Wiener was already aware that such systems, whether mechanical or social in nature, can be used in ways that are not only beneficial but also problematic or even harmful (Wiener, 1950).

In the context of collective intelligence, this raises a fundamental question: Who defines the purposes guiding collective processes, and how are those purposes legitimized? This question becomes increasingly important as AI-based systems play a growing role in shaping communication. Beyond merely ensuring system functionality, we must also ask whose interpretations these systems favor, whose contributions they amplify, and whose possibilities they constrain. Since these systems can influence how meaning is formed and how actions are taken on that basis, their design raises epistemic and ethical questions.

The promise of collective intelligence, then, lies in enabling social systems to *remain capable of meaningful adaptation* under conditions that cannot be fully specified in advance. Achieving this requires a careful balance between structure and openness, coordination and plurality, efficiency and reflexivity. Understood in this way, collective intelligence offers less a prospect of controlling societal dynamics than a possibility for engaging with them more consciously. It invites the design of systems that render processes of coordination more visible, more contestable, and more responsive, while acknowledging the limits of deliberate governance over such processes.

In this sense, the challenge of collective intelligence extends beyond technical or organizational issues into fundamentally epistemic and ethical territory. It concerns how we—in a world whose complexity exceeds any single perspective—collectively develop insights, interpret situations, and act upon them.

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