

Resilience and Organization in Entangled Systems

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The purpose of this Special Issue has been to thematize the systemic aspects of human cognition. Specifically, the interconnection of the themes of resilience and organization reflects that resilience is irreducible to static traits and should be considered as something that can be organized. First, there is Resilience (capitalized), which is at the core of classical engineering approaches where a human designer engages in strategic planning and/or development of a design or prototype that is then implemented in practice [1]. Such Resilience also covers deliberate organizational design and, thus, phenomena such as reorganization, merging, etc. In principle, capitalized Resilience covers any kind of intentional, planned, or engineered change meant to strengthen or improve parts of a system (in fact, any type of system) in order to make it more resilient.

However, there is a more spontaneous and emergent type of resilience, which attests not to design (which typically takes place in an abstracted realm), but simply to living—even though we can also find it when we embody our own designs. Thus, we are concerned with the kind of flexibly adaptive resilience (non-capitalized) that we find in biological systems, and which is also found in humans, even though our continuous striving for reason, objectivity, and predictability clearly favors Resilience (for a further discussion of the two kinds of resilience, see [2]). We should note that the two distinctions of resilience just made can be understood in different senses depending on the nature of the system in question, including as a capacity to absorb, withstand, or recover from disruption [3].

Across the contributions, resilience is therefore not treated as a property located within individual agents or isolated structures, but as an emergent outcome of organized relations across socio-technical, cognitive, and material systems. Organization is the medium through which resilience is continuously produced and transformed.

Moreover, both forms of resilience highlight the difficulty of separating resilience from human social organizing. While non-capitalized resilience can be understood as an evolutionary capacity shared with other animals, including bacteria and cellular systems [4], human resilience is embedded in a socially saturated cognitive ecology, as emphasized by Hutchins [5]. In such ecologies, cognition is not confined to individual minds. It is distributed across social norms, conventions, and intersubjective relations. Accordingly, organizational structures are constitutive parts of the cognitive system itself, shaping adaptive processes both directly and indirectly.

Taken together, this distributed and organizational understanding of cognition provides a shared lens through which the contributions to this Special Issue can be read.

Wei and colleagues examine safety governance in high-risk industries through a socio-technical and distributed cognition perspective, arguing that resilience is an emergent property of organizational systems rather than an attribute of individual actors. The study develops a cross-level analytical model in which managerial safety prioritization is translated into organizational outcomes through three distinct carriers: institutionalization, digital safety system support, and team safety climate. These carriers represent formal,



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material, and relational mechanisms through which managerial attention is embedded in organizational arrangements.

Zaharia and colleagues develop a category-theoretic model of human communication and cognition, with a particular focus on lived experience and its temporal dynamics. The framework extends Robert Rosen's anticipatory systems theory to account for human interaction as a complex, relational, and time-evolving process. A central motivation is to move beyond mechanistic and purely past-determined models of behavior by incorporating anticipatory causation, impredicative structures, and organizational closure as formal properties of living systems. Building on Rosen's (M,R)-systems and Category Theory, the paper proposes the Performance–Resilience–Sustainability (PRS) model as a formalization of human communicative dynamics. This model aims to capture how behavior (performance), adaptive updating (resilience), and higher-order self-maintenance (sustainability) interact within an anticipatory system that integrates past and future states in present behavior.

Turning to MSMEs in a South American context, Sánchez-Rodríguez and colleagues develop a conceptual framework for digital organizational resilience in resource-constrained enterprises. Situated within a broader Special Issue on resilience and entangled systems, the authors draw on resilience engineering, socio-materiality, and distributed cognition to argue that resilience emerges as a systemic property of socio-technical entanglement rather than residing in any single organizational component. They identify four interdependent dimensions—human, technological, organizational, and institutional—which jointly shape adaptive capacity. Within this model, digital infrastructures and natural language-mediated human–machine interaction play a key role in enabling coordination, sensemaking, and adaptation across these dimensions.

The essay by Tomassi and colleagues explores language as a dynamic mechanism in cyber-sociotechnical systems (CSTSs), arguing that it plays a central role in enabling resilience and adaptive coordination. In particular, the authors suggest that language helps bridge the gap between traditional resilience engineering frameworks and systems-oriented control theory by functioning as a stabilizing and coordinating mechanism across human–machine interactions. Language, including narratives and specialized terminologies, is presented as both stabilizing and adaptive, allowing complex sociotechnical systems to maintain functionality under changing conditions. In this context, the authors advocate a systemic and enactivist perspective in which cognition and coordination are distributed across human and non-human agents. They further draw on the WAX framework to describe how knowledge is continuously transformed through iterative conversion processes such as socialization, externalization, and internalization. Concepts such as simplicity, complexity, and complexity compression are used to explain how language simultaneously reduces and reorganizes complexity, enabling efficient communication and adaptive system behavior CSTSs.

Building on a systemic perspective, Vallée-Tourangeau's paper theorizes human problem-solving and creativity. It explicitly contrasts with the cognitivist approach, which ascribes explanatory importance to an initial idea as the causal origin of creative processes. Instead, drawing on Science and Technology Studies and 4E cognitive science, the author replaces this diffusion model of ideas with a translation model, in which ideas are continually transformed through interaction. The explanans is no longer an internal mental representation, but the emergent creative outcome produced through socio-material systems. Specifically, the paper advances the STS-inspired claim that non-human material actants stand in a symmetrical relationship to human actors within these systems. Thus, creativity does not emerge as the realization of a pre-existing idea, but as the result of iterative relations between people and material arrangements, particularly through prototyping.

Collectively, the contributions to this Special Issue converge on a shared framing of resilience, cognition, and organization. Across diverse empirical domains and theoretical approaches, organization is consistently shown to be not merely the context in which resilience operates. In this sense, resilience is inseparable from the processes of coordination, communication, and material engagement that constitute entangled systems. The Special Issue thus points toward a systemic understanding in which cognition and organization are constitutive of its emergence across multiple levels of analysis.

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