

# Innovation Systems are Self-organizing Complex Adaptive Systems

## Extended Abstract

Creativity and innovation can be viewed as Complex Adaptive Systems (CAS) phenomena that occur at different scales, including individual, group, and organization levels. It is conjectured that at the collective level, creativity and innovation can be conceptualized as emergent properties of a system of interacting agents within a CAS. Such systems consist of processes that are dynamic, non-linear, path dependent, and self organizing, in which global (e.g., creativity, innovation) properties emerge from the local interactions of actors, which influence one another in response to influence they receive. As such, the model-based exploratory strategy advocated in this study aims to facilitate revealing the minimal structural and behavioral conditions, that is, the simplest set of assumptions, for the emergence and sustainment of organizational creativity and innovation. To illustrate the utility of the proposed approach, CAS mechanisms and principles are substantiated in terms of the structure and dynamics of a specific form of collective production community, called Open Source Software (OSS) development. The synergy between such communities and innovation systems are established, and it is posited that OSS development exhibits the characteristics of self-organizing complex adaptive systems. The premise of the proposed model is based on the observation of similarities between the systems model of creativity and the mode of production in such communities. Specifically, evolution processes that involve variation and selection through professional attention are conceptualized using various organizational design configurations (i.e., network membership, structure) and governance mechanisms (i.e., coordination, conflict resolution, and decision making) to mimic the co-evolution of the project and the community. The paper concludes by proposing a set of proxy metrics that can be used to evaluate emergent system of interactions and organizational structures in OSS communities to measure their innovation output, as well as potential.

The anticipated benefits of abstracting a conceptual model of collective creativity and innovation based on the CAS perspective are three fold:

- (1) A formal simulation testbed improves empirical understanding of creativity by making it possible to explore whether particular types of observed regularities pertaining to creative organizations can be reliably generated via agent-based CAS models.
- (2) The proposed strategy helps investigating if such models can be used as computational laboratories for the discovery of organizational designs that are creative and conducive to innovation? This serves to normative understanding by determining if certain designs proposed for community networks, governance mechanisms (i.e., coordination and decision making styles), and culture result in desirable innovation performance over time.
- (3) Agent-based simulation of organizational creativity also enables theory generation by facilitating better understanding of innovation dynamics over full range of possible configurations and behaviors.

**Keywords:** Computational models of creativity, innovation, complex adaptive systems