Complexity and Governance

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Complex adaptive systems are everywhere and are a primary reason why our world is so unpredictable. Whether complex systems can be adequately understood or sufficiently managed remains an unanswered question central to the development of the emerging technologies. On the one hand, fields such as geoengineering and neurotech are exploring ways to intervene into preexisting complex systems. Other emerging technologies propose to build complex systems, such as AI computer networks, that will be entangled in the control and management of critical infrastructure. If governments and corporations are unable to fully understand the behavior of complex systems, increasing reliance upon them is a recipe for unforeseen crises.

Complex system can turn disastrous for five reasons: 1) Incompetence or wrongdoing by managers or workers 2) Design flaws or vulnerabilities 3) Normal accidents (Perrow 1984) that occur even when no one does anything wrong 4) Underestimating risks (Taleb 2007) and failure to plan for low probability high impact events 5) Black swans (Taleb 2007) – totally unforeseen low probability or emergent high impact events. Better regulation and oversight, decoupling subsystems through modular design, locating nuclear power plants and chemical factories far from residential areas, and other strategies could stops some of these disasters, but certainly not all of them.

Complexity also enters the development and governance of the emerging technologies in another way. The complexity of the brain and gene expression, for example, will thwart easy progress toward goals such as personalized medicine, synthetic biology, brain simulations, brain-machine interfaces, and cognitive or moral enhancements. The willingness to buy into hype that feeds false expectations is often the result of a failure to understand the complexity of the systems being studied. A better understanding of complex adaptive systems could significantly alter which research projects get funded. In addition, it would help in monitoring the development of various fields and in recognizing when technological thresholds about to be crossed are cause for concern.

Perrow, C. (1984). *Normal Accidents: Living With High-Risk Technologies.* Basic Books.
Taleb, N. (2007). *The Black Swan:The Impact of the Highly Improbable.* Random House.