An introduction to “Society as a complex adaptive system”

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Walter Buckley, Walter Buckley, David Schwandt


Abstract

Introduction

Although the phrase “complex adaptive system” is one usually thought to have been coined at the Santa Fe Institute sometime during the 1990s, we can see by the title of this classic paper that the systems-oriented social thinker Walter Buckley had already been using the phrase “complex adaptive system” as early as 1968 and with pretty much the same connotations as it is used today. Thus, similar to how the phrase is contemporarily employed, Buckley explicitly crafted “complex adaptive system” to counter an equilibrium-based, “closed” view of systems which he felt was endemic at the time of his writing this paper.

The idea that the dynamics of social systems were dominated by an equilibrium-seeking tendency had become entrenched in social thought ever since the great economist Vilfredo Pareto (who, interestingly enough, had also introduced early speculations on power-law type distributions which are so popular today in complexity circles) had enunciated it strongly in his early version of sociology in the late nineteenth century. For Pareto, as was true among most economists at the time (and, as hard to believe as it is, is still so), equilibrium-seeking dynamics were at the core of economic theory (for a discussion of the idea of equilibrium-dominating in social and psychological systems, see Goldstein, 1990, 1995).

According to Laurence Henderson (1935), himself an early “general” systems theorist from within the discipline of physiology (and from which Walter Cannon had derived his own notion of physiological “homeostasis”), Pareto's thesis at the Polytechnic School of Turin was on the mathematical theory of equilibrium in elastic solids. Pareto had it that a social system was bound by equilibrium, as in any mechanical system so constructed, which meant that the system would automatically return to its former state after any sort of perturbation of its key variables (within a certain amount; see the Appendix below for Henderson’s mathematical formulation of this understanding of equilibrium). Henderson also indicated how close Pareto’s equilibrium model of social systems was to the equilibrium model of physical chemistry put forward and made a keystone of that discipline Le Chatelier. It was against interpretations of social dynamics as being dominated by equilibrium that Buckley offered his inspired exposition of complex adaptive systems. Unlike a system governed by a propensity to return to equilibrium after being disturbed, and in so doing losing structure as entropy increased, Buckley’s complex adaptive systems built-up structure as they adapted in the face of new internal and external interactions.

Buckley’s classic paper “Society as a Complex Adaptive System” (Buckley, 1968) can be seen as providing a useful bridge between the interests of complexity scientists and those of social entrepreneurs as they struggle to apply the concepts of complex adaptive systems to societal (social) change and innovation. The paper exemplifies the early sociological formulation of the concepts of complexity and system-adaptation in the context of social value creation and societal change. Buckley’s career as an American sociologist spanned the micro-meso-macro social divides by bringing a pragmatic understanding to complex social contexts that both social entrepreneurs and complexity scientists will appreciate.

In general, Walter F. Buckley (1922-2006) is considered a pioneer in the field of modern social systems, sociology, and socio-cybernetics. His early academic career resulted in the publication of Sociology: A Modern Systems Theory (1967) in which he constructed a foundation for a very contemporary-sounding dynamic, morphogenetic conceptualization of coevolving social structures that was not dependent on the ideas of equilibrium- or homeostasis-seeking processes. This effort was shortly followed by a compendium of writings (now considered classics) concerning systems and cybernetics, entitled Modern Systems Research for the Behavioral Scientist (1968) from which this paper was excerpted. Buckley’s far-seeing book emphasized a cross-disciplinary approach to the complexity of social change through the inclusion of such esteemed early systems thinkers and cyberneticians as W. R. Ashby, Norbert Weiner, Anatol Rapaport, Russel Ackoff, Margoroh Maruyama, John Von Neumann, Erwin Schrödinger, Kurt Lewin, and Geoffrey Vickers. The selection included in this edition of E:OC is an abridgment of the last chapter of that book. Buckley’s final work, completed after a long tenure at the University of New Hampshire (1971-1985), entitled Society-A Complex Adaptive System: Essays in Social Theory (1998) was not only a capstone to his contributions, but connects the nature of the complex adaptive social system model to societal issues, values, technology, power, policy, and social control. It provides a clear link between the dynamics of human interaction and the emergence of anticipated and unanticipated consequences that are critical to both the work of complexity scientists and social entrepreneurs.

The reader with a primary interest in complexity science will conclude that the concepts that constitute our theorizing and...
experiments today were actually formulated by Buckley more than forty years ago. In his introduction to his 1998 book, Buckley makes mention of the neglect of his early work by current theorists; however he ends with “To his credit, Gel-Mann came to recognize this kind of deficiency in referencing priority work within the [Santa Fe] Institute and offered a kind of apology for it in the preface to his layman’s book on complexity and physics, The Quark and the Jaguar” (p. 12).

In a very prescient fashion, Buckley’s six interrelated “principles of complex adaptive systems” (p. 493-498) provide a (now familiar) framework for understanding the complexity of social cultural systems and their structuring. He speaks of tensions as the “necessary needs” of the social system just as we do today (McKelvey, 2002); of the relationship between elements of the system and their dependence on information, or mapping, of the environment similar to Anderson’s discussion of schemata (Anderson, 1999); of the relationship between stability and change being a morphogenetic process creating structural elaboration that we now discuss as emergence and “self-transcending constructions” (Goldstein, 2007); of non-pathological deviant production and the need for requisite variety that contributes to change in selection processes which resembles our discussions of far from equilibrium states, non-linearity, and bifurcation to new states (Thietart & Forgues, 1995); of selection processes and lack of a capability for prediction much like our conceptualization of sensemaking and loosely coupled systems (Orton & Weick, 1990); and finally, he talks of an internal matrix of interactions that contribute to morphogenetic processes which foreshadows our central idea of “coevolving human interactions.”

These principles applied to “real” social situations (role of the Superintendent and conflict among the Kanuri) led Buckley to useful conclusions concerning complex adaptive social systems. Today, the cases provide the social entrepreneur (and the complexity scientist) with examples of the usefulness of complexity concepts in interpreting social change. They reveal, at the micro- and macro-levels, the power of choice, conflict (tensions), role determination and change, and the significance of goal differences. These reflect Buckley’s premise that,

Basic ingredients of the decision-making focus include, then: (1) a process approach; (2) a conception of tensions as inherent in the process; and (3), a renewed concern with the role and workings of man’s enlarged cortex seen as a complex adaptive subsystem operating within an interaction matrix characterized by uncertainty, conflict, and other dissociative (as well as associative) processes underlying the structuring and restructuring of the larger psychosocial system (p. 499).

Buckley’s work clarifies for us the complex nature of creating social value in environments characterized by a dependence on reciprocating agent interactions, non-linearity, and the emergence of both anticipated and unanticipated consequences of human actions. Although his views have been at times directed quite forcibly toward countering the concentration of power and control in only “selected” social structures, he was optimistic about the long term trends of society as a complex system. He believed there were grand trends now evolving characterized by greater flexibility of structure, evermore refined accurate and systematic mappings, and finally, “…the trend towards greater elaboration of self-regulating substructures in order—not merely to restore a given equilibrium or homeostatic level—but to purposely restructure the system ‘without tearing up the lawn’ in the process” (p. 496).

Each of these trends has implications for the current movement to understand society (social system) as a complex adaptive system. It is in this complex and progressive environment that the social entrepreneur must act to create social value. However, complexity science also reminds us of what Buckley (1998) would remind his students,

Don’t simply blame the individuals involved in policy decisions (although they must shoulder the moral and legal responsibilities); blame the sociocultural structure within which they are enmeshed. Search for the role pressures, the premiums and penalties that result from doing or not doing things in certain ways, the goals held out with associated carrots and sticks, and the tensions generated by the often incompatible demands of peers, family, sub- and super-ordinates, politicians, and national flag (p. 256).

## APPENDIX 1

### Appendix: Henderson’s formulation of an equilibrium dominated system

Consider a general equation for dynamics:

\[
\begin{align*}
\frac{\partial}{\partial t} x + \frac{\partial}{\partial y} y + \frac{\partial}{\partial z} z &= 0 \\
\end{align*}
\]

When the system is at rest or rates of change are constant, the terms \( dt \) drop out, and thus the statical equilibrium state is represented by:

\[
\begin{align*}
\frac{\partial}{\partial x} x + \frac{\partial}{\partial y} y + \frac{\partial}{\partial z} z &= 0 \\
\end{align*}
\]

This shows that the sum of the variations of the terms become zero after the system returns to equilibrium after being disturbed.
out of it, that is, the system is dominated by an impetus to return to equilibrium (see Goldstein, 1995).

References