Rosemary C. Reilly
Warren Linds
Encyclopedia of case study research

Complexity

Complexity refers to the level of social organization of a particular integrated system under investigation. Complexity means more than just a "complicated" organization or pattern of endeavor. Complex phenomena cannot be understood by examining their constituent parts using simplistic reductions. Complex cases are "alive", purposeful, dynamic, evolving, spontaneous, adaptable, unpredictable, and self-organized. Sumara and Davis describe complex cases as having an integrity that transcends their components.

Conceptual Overview and Discussion

To be understood in any profound way, a case must be examined organically, taking into account the complex systems in which it is nested. A "complicated" case, in contrast, can be disassembled, understood with sufficient knowledge of its components, and then reassembled without disturbing its functioning. A strength of the case study approach is its ability to holistically investigate complex social events and to examine broadly-based complex systemic sets of causes and effects. Reality is complex, and the case method has the ability to deal with the full variety of evidence that a researcher may collect in order to peek into an intricate and unique social system.

Complexity is also a set of concepts that attempts to describe this intricate and particular level of organization, integrating biological, cognitive and social dimensions of examination. It is a theoretical perspective and methodological approach about vibrant, complex and unstable systems, their conditions, interrelationships, and spaces.

As a Theoretical Lens

Complexity theory contributes several useful theoretical perspectives that can assist researchers employing a case approach. As Stake argues, "issues as conceptual structures" can shape primary research questions in order to direct attention to a case's complexity and contextuality.

- Groups, communities, and organizations are *complex adaptive systems*: Complex adaptive systems contain "agents" which can be people, processes, or computer systems. Agents are able to exchange information with their environment and, through this exchange, learn, adapt and change their behavior. Agents interact on a local level; but such patterns are nonlinear, in that small "causes" may have large effects and large "causes" may have small effects. This theoretical lens encourages researchers to focus on the ongoing evolution of people interacting with elements within their environment.

- Systems are composed of a series of *complex responsive processes*: This refers to the actions of human bodies as they interact with one another so that a person interacts both with the social and, at the same time, with the self. Because these two interactive dimensions happen at once, individual minds/selves form the social while being formed by the social at the same time. Therefore, the social and the individual are the same phenomenon. This concept calls the researcher's attention to the patterns of relationships and the further patterns of interaction these relationships produce.

- Agents and systems are *co-emergent and have co-implicating relationships*: Since individuals and the systems they create are continually learning and adapting, and since the social and the self are formed at the same time through complex responsive processes, individuals and systems are intimately connected and co-evolve, mutually influencing their growth and development. Though cases are, as Stake suggests, generally bounded

systems, this theoretical perspective highlights the unique reciprocal, interactive exchanges between active agents and the environments in which they are embedded, and the difficulty to definitively state where the case ends and the environment or context begins.

Applications

As a Methodological Lens

Complexity theory contends that only a partial view of any system can be captured. A researcher using a case approach must attend to the conditions in which the system emerges and make sense of the living experiences of interaction. Systems do have elements, but it is the interdependencies and interactions among the elements that create the unique and particular whole. So the researcher using complexity needs to examine and illuminate the inter-relationships and interdependencies among the elements, including individuals, processes and forms of communication, as well as the unity of the system itself.

The following are additional dimensions to consider when systematically investigating a complex case.

- *The importance of context and history*: Yin states that a case study is an empirical inquiry involving a phenomenon embedded within its real-life context. Complex systems have a history. They not only evolve through time, but their past is co-responsible for their present. Patterns of human interaction produce further patterns of interaction. Past history and experiences are added on and therefore potentially shape future trajectory. History includes practices incorporated into a system's patterns of relating, embodied knowledge within networks and nodes, and a sequencing of the system's structural changes. In describing a case's history and context, significant events are important, but

understanding also requires paying attention to the configuration of relationships over time as well as the environment in which the system lives.

- *Permeable or open boundaries*: Complex adaptive systems are open systems. Individuals interact with others in the environment extending interaction and communication beyond the boundaries of the system. Both the system, and the environment in which it is embedded, change through these interactions. These changes ripple out, spilling into other systems. Though a case is defined with certain, clear boundaries, researchers should keep in mind that these boundaries are not rigid and static, but porous and bi-directional, and, in a sense, arbitrarily set.

- *Nonlinear dynamics*: Nonlinearity refers to the principle that the whole is not necessarily equal to the sum of its parts, and that a relatively small change can lead to significantly different system states. Since small changes are amplified by feedback loops (input-output circular processes that allow complex systems to change their structure through their own activity), this produces complex patterns of unanticipated consequences that make it impossible to predict long-term behavior. Positive feedback amplifies itself by strengthening the processes that gave rise to it; negative feedback weakens them. For the case researcher this may mean the use of process tracing, proposed by George and Bennett, in an effort to examine nonlinear complexity in detail.

- *Emergence*: Emergence is the arising of new coherent properties, patterns, and structures when systems undergo a process of reorganization. This "bottom up" phenomenon comes from patterns of behavior enacted by agents in an informal network of relationships that continually grows, changes, and adapts to new situations. Agents residing in one level produce behaviors that lay a level above them. Making sense of the dynamic processes

that give rise to and sustain evolving complex systems requires going beyond the notion of cause and effect. In emergent systems, global patterns cannot be reduced to individual behavior.

- *Spaces of possibility*: Systems interact in ways that change each of them resulting in the growth of complexity from relatively simple beginnings. The enlargement of the space of possibility arises from moving towards such complexity. When the case system approaches a far-from-equilibrium state, it is subject to spontaneous and dramatic reorganizations. These points of instability, or bifurcation points, allow the system to branch off into an entirely new state where new forms of order may emerge. For the researcher, this means examining in-depth the various transitional points within a system's evolution.

- *Nodes and networks*: These are the formal or informal subgroups of individuals that act as interconnections and function as centers of activity. Nodes rapidly come together, separate, and reform in different permutations according to need; networks tend to maintain long-term relationships throughout the rest of the system. Case researchers illuminate the connectivity and the configuration of relationships within these nodes and networks in an effort to map complex responsive processes.

- *Webs of significance*: This phrase, coined by Clifford Geertz, refers to the influence of culture on human behavior and the construction of social systems. Not only do human beings create and modify their culture, but culture also serves to define the social world. We cannot escape our cultures. We create and are suspended in them. The case researcher using complexity theory, therefore, focuses the analysis on an interpretive search for meaning within the relational nodes and webs of complex responsive processes.

Critical Summary

Complex social phenomenon cannot be understood by reducing it to its parts. Rather a more holistic approach is called for. Complexity is a theoretical perspective that attempts to respond to this understanding. Case studies viewed through this lens pose a challenge to researchers since cases are dynamic and constantly responding to the influences of culture and environment. Researchers must be mindful of these influences since they are integral to understanding the cases.

See also: Ecological Perspectives; Webs of Significance

Further reading and references:

George, A., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. Cambridge, MA: MIT Press.

Mainzer, K. (2007). *Thinking in complexity* (5th rev. and enlarged ed.). New York: Springer.

Stacey R., & Griffin, D. (2005). *A complexity perspective on researching organizations*. London: Routledge.

Stake, R. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.

Sumara, D., & Davis, B. (1997). Enlarging the space of the possible: Complexity, complicity and action research practices. In T. Carson & D. Sumara (Eds.), *Action research as a living practice* (pp. 299-312). New York: Peter Lang.

Yin, R. (2003). *Case study research: Design and methods*. Thousand Oaks: Sage Publications.