



Adaptive cycles and Panarchy

The origin of the adaptive cycles' model derives from the comparative study of ecosystem dynamics. It is meant to be a tool for analyzing the dynamics of natural or other systems.



Foto: Hugo Inda

Currently it is a required reference tool for transcendent system analysis (that originates from the interaction of multiple systems, such as SES).

Traditionally SES and natural systems dynamics have focused on the concept of succession that describes the transition from phases of exploitation (e.g. the rapid colonization of recently disturbed areas) to conservation periods (slow accumulation and storage of energy and materials). Adaptive cycles include two additional phases related to the destruction and organization processes, generally left in the background in favour of growth and conservation. When considering the four phases of the cycle (r: growth and exploitation; K: conservation; omega: release; alpha: reorganization or renovation) and related processes, system dynamics can be studied taking into account their organization and resilience.

The four phases of adaptive SES cycles are as follows:

- Exploitation (new political/social organization of the system).
- Conservation (maintenance and proliferation of the new system).
- Release (revolution).
- Reorganization (regime change to a new paradigm).



Key References

Gunderson, L.H. C.S. Holling, y S. S. Light. 1995. *Barriers and Bridges to the Renewal of Ecosystems and Institutions*. Columbia University Press, New York.

Gunderson, L.H. y C.S. Holling, Editors. 2002. *Panarchy*. Island Press, Washington, D.C., USA.



Adaptive cycles alternate between periods of incorporation and transformation of resources and shorter periods that create opportunities for innovation and change. Adaptive cycles exhibit two major phases or transitions. The first, often referred to as the foreloop (forward cycle), from r to K , is a slow, incremental phase of growth and accumulation. The second, referred to as the backloop (backward cycle), from ω to α , is a rapid phase of reorganization where renewal takes place and windows of opportunity for innovation are created.

During the sequence from exploitation to conservation, connectedness and stability increase and capital is slowly accumulated and sequestered. In natural ecosystems, capital means the ecosystems' nutrients and biomass. In a socio-economic system, capital can also include other key attributes, such as energy, networks of human relationships and mutual trust, among others. Competitive processes lead to a few species, social strata or actors (depending on the system in question) becoming dominant and substantially reducing diversity, which is generally retained in residual pockets.

In ω abrupt changes with liberation of energy and resources occur, such as ruptures of institutional models or the emergence and growth of creative countercultures; in α a nutshell: fragility and instability of the status quo. The passage from α to ω represents the rapid reorganization leading to renewal.

Very briefly, the four stages that characterize an adaptive cycle result from, on the one hand, the interaction between growth and accumulation, and novelty and renewal on the other. From this point of view, adaptive cycles are an excellent tool for understanding how persistence and transformation processes coexist in SES dynamics.

There are three fundamental properties that determine adaptive cycles. The system's potential available for change. The potential determines the range of future options. This property is the wealth of the system, in terms of resources, financial capital, and human capital, among other attributes. The system's internal control is the degree of connectivity between internal controls and processes. This attribute reflects the degree the controls' flexibility or rigidity and their sensitivity to disturbance. Adaptive capacity is the system's resilience, an attribute that quantifies vulnerability to unexpected disturbances. This attribute is the opposite of vulnerability.

Panarchy is a nested set of adaptive cycles operating at discrete scales. Adaptive cycles are nested in a hierarchy through time and space. The reader may find this concept very difficult to understand. In the same way that a particular system is always part of a larger system, adaptive cycles can be part of larger cycles or represent a period within a series of adaptive cycles that have occurred in longer periods of time.

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