HUMAN SYSTEMS
DYNAMICS INSTITUTE

# HSD Background


## Glenda H. Eoyang

6 June, 2014


HSD draws from a wide range of resources in the physical and natural sciences as well as philosophy and systems thinking. Of course all of this is in the context of on-the-ground practice with real people in real systems. Anyone can use HSD models and methods without understanding their roots. It is also possible to create new models and methods as variations on themes of existing tools without bothering with the underlying theory. In the early days of HSD I tried to connect the dots for people between the history and philosophy of science and the challenges of 20th (now 21st) century practice. I didn't do it well, and no one seemed particularly interested, so I stopped. Now, several factors inspire me to try again.

- The Network of Associates is now large enough to include some folks with the same crazy bent and curiosity as I had starting the work.
- Conversations in the HSDlearning.org space verge on fundamental concepts like causality, time, identity, etc., so I think the more complete theoretical grounding will be helpful.
- We, as a community, are ready to push the work farther into new domains and more deeply into current domains. If we are to do so with fidelity to the core of HSD, then that core needs to be more explicit.
- I have become more conscious of and confident in the ways that HSD is fundamentally different from other worldviews, theories of change, and methods of knowing. So, I'm feeling some urgency to share those insights.
- Most importantly, Associates and others are asking questions about the sources and foundations, and a resource for them will be helpful.

So, in this document, I have included resources that have influenced my thinking. I'm sure there are many more, but these are the ones that have been most constant and explicit sources of thought and action for me. I share these in the spirit of inquiry. The list is neither exhaustive nor essential. I understand that others may read the same resources and see something different. It is also clear that people can (and indeed have) come to the similar conclusions by various paths from diverse starting points.

Still, if you wish to follow threads of the theory and practice of HSD back through some kind of emergent evolution, these resources may be helpful.  The first is a bibliography of resources that have influenced my thinking with comments that relate them back to HSD theory and practice.  The second is an annotation of the "circle of sciences" that we use in HSDP to highlight the range of scientific influences on complexity and on HSD.

A recorded webinar works through the basic HSD assumptions of worldview, theory of change, and inquiry approach.  You can view it at http://hsdinstitute.adobeconnect.com/p7megi4bsug/

and see the slides at https://www.dropbox.com/s/g5bdrdkeq1jjnva/Cohort%20Call%2021MAY14%20v2.ppt.

I welcome our ongoing dialogue.

Glenda 6JUN14

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## HSD Bibliography


Bak, P. (1996). How nature works: The science of self-organized criticality. New York, NY, USA: Copernicus.

*This is a clear and compelling description of self-organized criticality. Bak gives an explanation based on accumulation and release of tension, which informed our definition of three kinds of change and the HSD theory of change.*

Brann, E. T., Kalkavage, P., & Salem, E. (1996). Plato's Sophist, or, The professor of wisdom. Newburyport, MA: Focus Pub./R. Pullins.

*This dialogue focuses on the essential role of difference in human experience of both knowing and being.*

Briggs, J., & Peat, F. D. (1989). Turbulent mirror: An illustrated guide to chaos theory and the science of wholeness. New York: Harper & Row.

*This provides a wonderful description of many fundamental ideas of chaos theory. It is the best description I am aware of that explains what attractor patterns are, how they show up in nature, and how they are computed from time series data.*

Cohen, J., & Stewart, I. (1994). The collapse of chaos: Discovering simplicity in a complex world. New York: Viking.

*Jack Cohen is a reproductive biologist and Ian Stewart is a mathematician. Together they try to shine a light on the underlying phenomena of chaos theory.*

Dooley, K. (1997). "A complex adaptive systems model of organization change." Nonlinear Dynamics, Psychology, and the Life Sciences, 1: 69-97.

*This is where the HSD definition of complex adaptive system (CAS) is drawn from.*

Eoyang, G. (2001). Conditions for Self-Organizing in Human Systems. Unpublished doctoral dissertation. The Union Institute and University.

*This is available online (http://www.hsdinstitute.org/about-hsd/dr-glenda/glendaeoyang-dissertation.pdf) and includes the initial logic of and evidence for the CDE Model.*

Eoygan, G. (1998). Coping with chaos: Seven simple tools. Lagumo Press.

*In this early book, Eoyang uses metaphors and recognized phenomena from complexit and chaos science to apply them as tools in organization challenges and opportunities.*

Eoyang, G., Holladay, R. (2013). Adaptive action: Leveraging uncertainty in our organization. Stanford University Press.

*This is a deep and detailed explanation of how HSD helps see, understand and influence patterns in complex adaptive systems. It shares stories of practitioners who use HSD in their personal, public, and professional lives.*

Galilei, G., Crew, H., & Salvio, A. D. (1933). Dialogues concerning two new sciences. New York: Macmillan.

*This dialogue at the edge of a new science brings together the old theory paradigm of Aristotle, new practice paradigm of a builder of bridges, and an ignorant interlocutor. In a shared inquiry they explore things that are known in practice and not fathomable in accepted theory. The argument about infinity is particularly compelling.*

Gleick, J. (1987). Chaos: Making a new science. New York, NY, U.S.A.: Viking.

*This was my introduction to chaos science. Here I met the ideas for the first time, and the metaphorical connections were obvious with my experience in business, consulting, teaching and facilitation.*

Goldstein, J. (1994). The unshackled organization: Facing the challenge of unpredictability through spontaneous reorganization. Portland, Or.: Productivity Press.

*Jeff gives a clear, concrete, powerful application of complexity and chaos metaphors to some common challenges for people and organizations.*

Holladay, R., Quade, K. (2008). Influencing patterns for change: A human systems dynamics primer for leaders. CreateSpace Publishing Platform.

*This primer offers a foundational understanding of HSD as a tool for Leaders at any scale in a system.*

Holladay, R., Tytel, M. (2011) Simple rules: Radical inquiry into self. Gold Canyon Press.

*This application of HSD in personal reflection and growth offers a model/method that supports deep reflection and planning at all scales of a system.*

Kelly, K. (1994). Out of control: The rise of neo-biological civilization. Reading, MA: Addison-Wesley.

*This is a great collection of short pieces about many different natural systems that demonstrate chaotic or complex behavior. The stories are exciting, and the principles are clear.*

Olson, E., Eoyang, G. (2001) Facilitating Organization Change: Lessons from Complexity Science. Jossey-Bass/Pfeifer.

*In this ground-breaking book Olson and Eoyang offer the first published presentation of the Eoyang CDE model and its potential for changing how people understand organization change.*

Patterson, L., Holladay, R., Eoyang, G. (2013). Radical rules for schools: Adaptive action for complex change. HSD Institute Press.

*This applies HSD in the challenges of school reform in the US, recommending a short list of Simple Rules that can change current patterns to support teaching and learning.*

Poole, M.S., Van de Ven, A., Dooley, K. & Holmes, M. (2000). Organizational Change and Innovation Processes: Theory and Methods for Research. Oxford: Oxford University Press.

*This group reviewed hundreds of journal articles on change in human systems and discovered some basic categories to inform research and practice.*

Prigogine, I. & Stengers, I. (1984). Order out of chaos: Man's new dialogue with nature. Toronto: Bantam Books.

*They begin with a brief history of science and make a compelling case for the necessity of a self-organizing science. Dissipative structures, irreversible time, and the concept of far-from-equilibrium dynamics are drawn from here.*

Quade, K. Holladay, R. (2010). Dynamical leadership: Building adaptive capacity for uncertain times. Gold Canyon Press.

*In this book for leaders, HSD offers an explanation of how leaders can see, understand, and influence change across a landscape of difference.*

Waldrop, M. M. (1992). Complexity: The emerging science at the edge of order and chaos. New York: Simon & Schuster.

*Two books entitled Complexity came out at almost the same time in 1992. This one, my favorite, uses examples from physics and mathematics to introduce the basic relationships and phenomena of complexity and chaos.*

Weick, K. E. (1969). The social psychology of organizing. Reading, MA: Addison-Wesley Pub.

*Weick lays out a theory of action that begins with tension and ends with new structures. While it pre-dated much of the work in chaos and complexity, it is quite close to the foundations of HSD.*

Zimmerman, B., Lindberg, C., & Plsek, P. E. (1998). Edgeware: Insights from complexity science for health care leaders. Irving, TX: VHA.

*This group, working through the Plexus Institute, collected many different models and methods and brought them together in a simple and accessible form. This approach has continued and is now recognized as "liberating structures."*

# Circle of Sciences

Influences that continue to shape the field of theory and practice

## *Autopoiesis*
*(http://www.oikos.org/mariotti.htm)*

- Maturana & Varela

Autopoiesis comes from Greek "self-made." Maturana and Varela see this as the primary distinction between living and non-living things. From their concept of self-organizing systems emerges an understanding of enactive cognition. In HSD we use these ideas to talk about self-organizing and, in particular, the significance of the container in influencing self-organizing dynamics.

## *Catastrophe Theory*
*(http://home.swipnet.se/~w48087/faglar/materialmapp/teorimapp/ekt1.html*)

- **Rene Thom**

Discontinuous change is represented mathematically by characteristic manifolds in space/time. As the number of relevant dimensions increases, the descriptive shapes become increasingly difficult to represent physically. In HSD we use Catastrophe Theory to consider dynamics of high dimension systems. Though movement in high dimension space can be patterned and recognizable, it cannot be predicted moment to moment, and the patterns cannot be described easily with a two- or three-dimensional model.

## *Cellular Automata*
*(http://mathworld.wolfram.com/ElementaryCellularAutomaton.html)*

- Stephen Wolfram

A cellular automaton is a very simple computer simulation that can generate complex and unpredictable patterns. It is one example of simple rules driving local behavior that generates systemic patterns. The cellular automaton is the simplest and most studied example of simple rules in action. In HSD we use the simple behavior of rule-based simulation models to think about the complex behavior of human systems.

## ***Complex Adaptive System***

*(http://en.wikipedia.org/wiki/Complex_adaptive_system)*

- John Holland

Collection of agents free to act in unpredictable ways, and their interactions generate system-wide patterns.  Sometimes called self-organizing systems.  The CDE Conditions for Self-Organizing were initially drawn from this field and confirmed in others.

## ***Deterministic Chaos Theory***

*(*http://en.wikipedia.org/wiki/Chaos_theory)

- Edward Norton Lorenz

Even simple and deterministic initial conditions can, under certain circumstances and in certain relationships, generate behavior that is unpredictable.  Strange attractor patterns and butterfly effects come from this discipline.  In HSD we often refer to uncertainty that emerges, even when initial conditions are well known.

## ***Dissipative Structures***

*(http://en.wikipedia.org/wiki/Dissipative_system)*

- Ilya Prigogine

Counter to Newtonian assumption that order always tends to disorder, order can sometimes arise "spontaneously." In a branch of thermodynamics, a system pushed far from equilibrium reorganizes itself and dissipates accumulated entropy (disorder).  The emergent patterns in complex systems that we discuss in HSD function as dissipative structures, for example innovation, teaming, trust, crowd behavior, and employee engagement.

## ***Dynamical Networks***

*(*http://en.wikipedia.org/wiki/Dissipative_system)

- Albert-Laszlo Barabasi

Traditional networks include nodes and connections.  Dynamical network theory considers how dependencies within and between networks can shift the nature, structure, and function of networks in a self-organizing way. HSD uses dynamical networks to inform our own management and organization decision making and to support clients in designing and implementing organizational change.

### *Emergent Evolution*
*(http://stephenjaygould.org/)*

- Stephen Jay Gould

Evolution can be seen as burst of creative process between periods of minimal change. Gould described this process as punctuated evolution and explored how complex, nonlinear dynamics were at work to set conditions for such a discontinuous process. In HSD we consider a similar phenomenon when we talk about dynamical change.

### *Fractals*
*(http://www.coolmath.com/fractals/gallery.htm)*

- Benoit Mandelbrot

When simple, nonlinear equations are solved repeatedly and the stability of the results plotted on a complex number plane, patterns are generated that are 1) self-similar across scales; 2) complicated but coherent; 3) never repeating; 4) really, really beautiful. In HSD we use the idea of iterative processes to generate coherent and quite diverse structures in human systems.

### *nK Landscapes*
*(http://en.wikipedia.org/wiki/NK_model)*

- Stuart Kauffman

Computer simulation model of network where the number of nodes and connections among them determine the stability and variability of the space. Used to model fitness and evolution of biological agents under various conditions. Sometimes they are called fitness landscapes, and the various states can be seen as parallel to the zones of the HSD Landscape Diagram.

### *Self-Organized Criticality*
*(http://en.wikipedia.org/wiki/Self-organized_criticality)*

- Per Bak

Studying sandpiles, Per Bak identified a mathematical relationship among the numbers, sizes, and frequencies of avalanche events. This relationship is a constant across discontinuous changes in many kinds of systems—both living and nonliving. He explained the phenomenon in terms of accumulating and releasing tension within or beyond a particular system boundary. This principle sets the groundwork for the HSD paradigm shift of dynamical change.

## *Synergetics (http://en.wikipedia.org/wiki/Synergetics_(Fuller))*

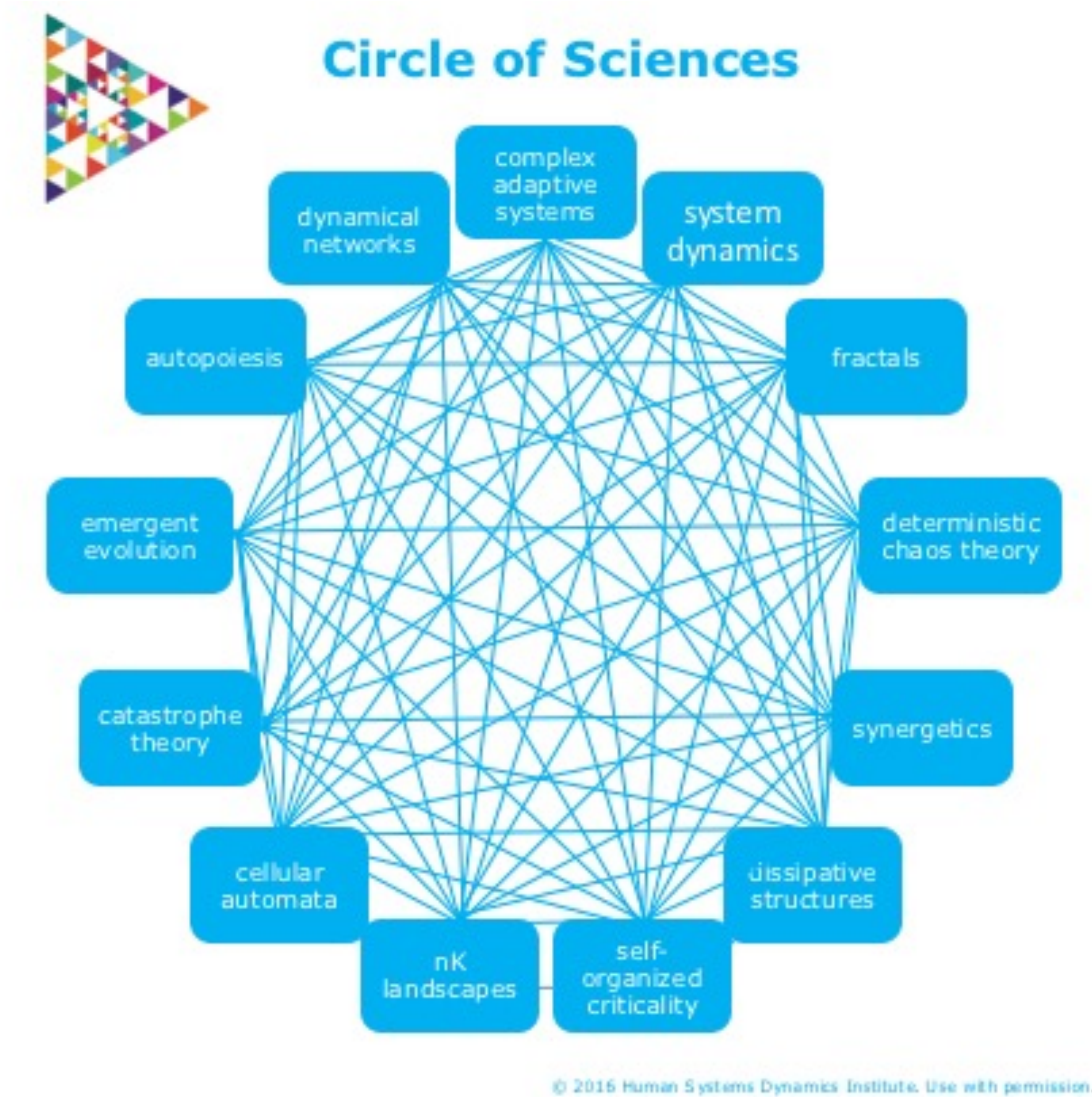
- Buckminster Fuller

Coherent patterns emerge at a systemic level from complex interactions of constituent systems. This study was used in early research and design for laser technologies. Relationships among the parts that influence emergent patterns are called order parameters. Influence of the pattern on the parts of the system are called control parameters. The self-organizing image in HSD is related to these dynamics.

## *Systems Dynamics (http://www.systemdynamics.org/what_is_system_dynamics.html)*

- Jay Forrester

System interdependencies modeled as a combination of stocks and flows, showing an accumulation of some relevant variable and the influence of variables on each other. Models can be qualitative and used to explore the underlying logic in a system or they can be represented in computer simulation models. From an HSD perspective, systems dynamics models are good representations of known differences and exchanges within a given container.


Circle of Sciences
complex adaptive systems
system dynamics
fractals
deterministic chaos theory
synergetics
dissipative structures
self-organized criticality
nK landscapes
cellular automata
catastrophe theory
emergent evolution
autopoiesis
dynamical networks
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