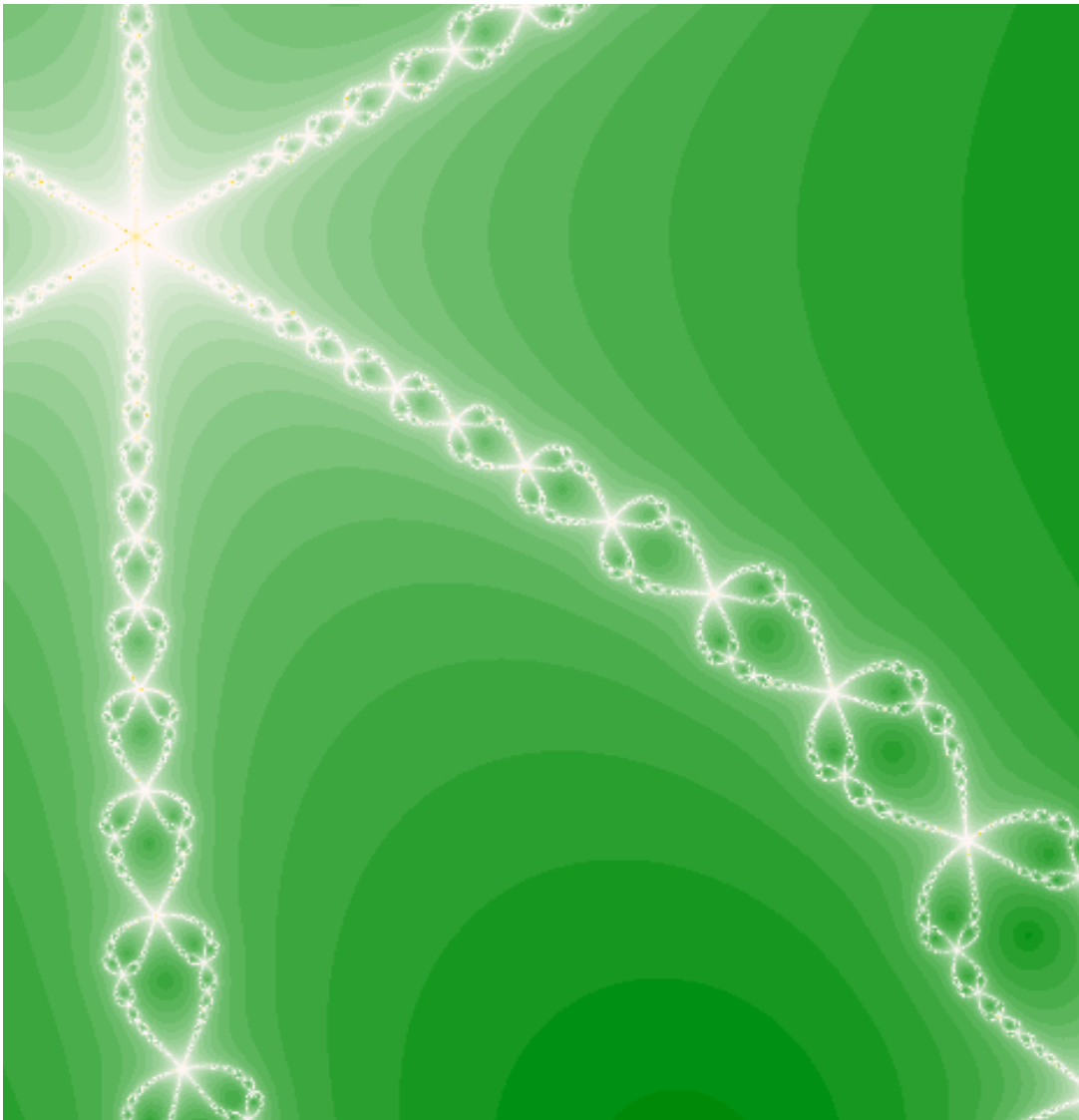


FORUM ON  
COMPLEXITY AND PUBLIC POLICY



Catalyst Institute for Applied Policy

MARCH 9, 2006



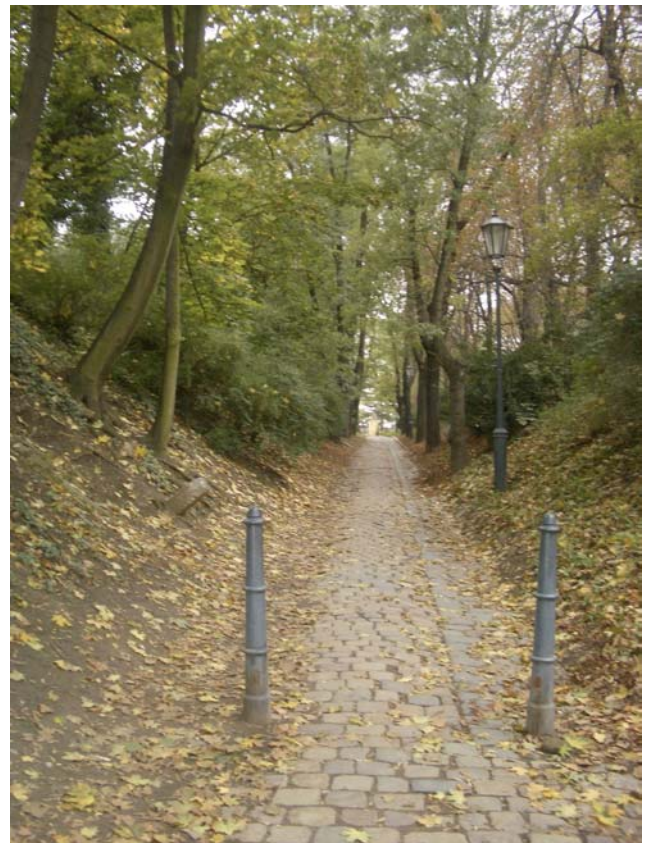
# Welcome

to the [Catalyst Forum on Complexity and Public Policy](#).

Policy instruments of the industrialized era are inadequate to the challenges we face in the globalized, 21<sup>st</sup>-century information age. New ways of defining problems and structuring solutions, as well as new forms of leadership are needed. An analytical framework uniquely suited to the highly-integrated nature of the modern world is offered by complexity science. The purpose of this Forum is to promote and assist in the migration of the concepts and techniques of this new science to the social sciences in general and to the analysis and formulation of public policy in particular.

Current rigorous applications of complexity science to social systems are, at best, embryonic. There are even those who question the legitimacy of the pursuit. Catalyst has assembled the leading thinkers in this field to examine the assumptions, and to engage in dialogue with you about the possibilities that might be unleashed by this new way of thinking. Complexity science is inherently collaborative, and our hope is to engender an ongoing, mutually beneficial exchange between you, the policy experts, and these and other complexity scientists so that we can cooperatively discern the way forward. Note that it is not our objective to create analogies or mine the romanced metaphors offered by complexity science (e.g. the butterfly effect); rather our objective is to enable the rigorous migration of the concepts and techniques offered by complexity science to the analysis of social systems.

We hope you enjoy the Forum, and use it as an opportunity to share you best thinking on your most difficult challenges.



# Catalyst Vision

The 21st Century is driven by complex systems. In particular, our social, economic, and political systems are highly complex. Complexity occurs when the mix of human activity becomes dense, and lines of causal interaction intersect at random, unpredicted, and/or uncontrolled points. From any given point, it is possible to determine in retrospect what has happened and why, but it is not possible to predict or control in advance what will happen because there are interactive dynamics in the system which are not explicitly defined, often not even seen.

The value of the complexity perspective is that it enables the analyst, protagonist, or change agent to view the system in terms of its component parts, and to assess possibilities in terms of the behavior of these parts. There is potentially infinite variety, and therefore significant creativity, involved in identifying the key system components that will make change possible. Artfully identifying and defining these components with vision and insight can release untold power and potential that did not previously exist. The objective of this process is to allow for the recombination of component parts in a manner that will support innovation. The best way to generate change is to build on what is. These system parts are the building blocks of what is. Combining them in new ways, forging new relationships, adding new perspectives or lines of communication, can allow resources to be used more effectively, and make cooperation possible that was heretofore not imagined. This is the role of Catalyst. Catalyst is a 21st Century solution to the challenges we face in this rapidly changing global milieu. It is the missing ingredient needed to trigger important changes in complex systems. As agents of change we bring to the table vision, established relationships, experience and expertise.

# Catalyst Mission

Catalyst is a group of experts in the functional fields of education, housing and community development, economic strategy, and public policy with years of experience in the operational techniques of business, government, academia, and non-profit organizations.

More importantly, we employ an approach to systems analysis, problem solving, and development which is based on the system's possibilities, not on its limitations or its past performance. Our commitment is to

assist in identifying, and then in creating the conditions necessary to realize those possibilities. Our techniques involve generating new partnerships and new ways of thinking, while building on what is, with the intention that solutions will be taken to scale. Our focus is on large systems to which the resources of government, business, foundations, and community institutions can cooperatively be brought to bare. Our problem solving techniques are derived from complexity science with the objective of demonstrating the applicability of these techniques to a wide range of systems, issues, and opportunities.



# Catalyst Methodology and Theory of Change

The overarching dynamic of modern complex systems is interaction. Today's problems are multi-dimensional and interdisciplinary. They operate primarily in the interstitial spaces of organizational and institutional intent. Organizations sacrifice breadth and depth of influence for effectiveness and control. This often leads to silos of operations that exhibit a serious mismatch not only between the organization and the environment within which it must operate, but also between the organization and the true nature of the issue or problem it is designed to address. Further, such organizations and institutions find it difficult to adjust in a timely fashion to the new circumstances generated by the constant change typical of our fast paced, information-driven, technological society.

These circumstances are particularly challenging under the conditions of complexity created by today's global, open-architecture systems. Straight line, cause and effect methodologies fail to accommodate the externalities generated by the unimaginable maze of possibilities created by crossing, overlapping, intermingling and outright canceling out of causal lines put in motion by traditional intervention strategies. There is no question that focused straight line strategies have produced remarkable results for humanity in their time; however, leaving aside issues of political intent and resources availability, still our lack of understanding of the behavior of complex systems has ushered us into the 21st cen-



ture with an antiquated system of public education, environmental pollution, increasing disparities along racial and economic divides, and a disintegrating commonweal. One of the reasons why traditional interventions are ineffective is that outcomes are more a function of system interactions than of intervention design. Catalyst has evolved an agent-based applied policy strategy that allows the problem to speak for itself, is interactive and evolutionary, forms partnerships and engages stakeholders, and builds on what is.

Catalyst views society as a complex system with its many parts woven together in an intricate network of relationships, beliefs, behaviors, needs and resources that portend infinite possibilities. The particular present manifestation of its many possibilities is at once magnificent and problematic. Our intention is to so engage with its institutions as to

shift it to a manifestation that is more magnificent than problematic and closer to the Pareto optimum that we all know is available to us, even within current resource constraints.

# Forum Program

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- 11:30** Welcome  
Claudia Pharis, Catalyst Chair and CEO
- 11:45** Keynote Speaker  
Dr. John Holland  
*Complex Adaptive Systems and Legislation*
- 12:45** Issues Panel
- Dr. Mitch Waldrop  
*Moderator*
- Dr. Yaneer Bar-Yam  
*From Education and Health Policy to Pandemics and Ethnic Violence*
- Dr. C.C Wood  
*Applications of Complex Systems Ideas in the National Security Arena: Two Examples*
- Dr. Robert Axtell  
*The Economy as a Complex System*
- 2:15** Questions and Answers
- 3:30** Adjourn

# Presenter Bios



JOHN HENRY HOLLAND is a professor of psychology and a professor of computer science and engineering at the University of Michigan at Ann Arbor, and an external professor at the Santa Fe Institute. His main research interests are complex adaptive systems (natural and artificial), computer-based models of cognitive processes, and the construction of models for computer-based thought experiments. Known widely as the "father of genetic algorithms," he is a board member of the International Society for Genetic and Evolutionary Computation, and is a member of the Board of Trustees of the Santa Fe Institute. He has been named a MacArthur Fellow and is a Fellow of the World Economic Forum. His two most recent books are *Emergence: From Chaos to Order* and *Hidden Order: How Adaptation Builds Complexity*.



YANEER BAR-YAM is the founding President of the New England Complex Systems Institute, an independent nonprofit educational and research institution dedicated to advancing the study of complex systems. Professor Bar-Yam has lectured at and advised numerous corporations and government agencies, the U.S. Military and the intelligence community. His most recent research has applied complex systems ideas to complex problems facing companies and societal networks. He has developed the understanding of how the structure, processes, and information flow of organizations can be designed to meet challenges at all scales. Professor Bar-Yam is the author of two books and over 150 articles in professional journals.

His newest book, *Making Things Work*, explains how the basic concepts of complexity theory can solve complex problems in healthcare, education, international development, ethnic violence, and terrorism.



CHRIS WOOD received his Ph.D. from Yale University in 1973. Following a postdoctoral appointment at Walter Reed Army Institute of Research in Washington DC, he returned to Yale as a faculty member with appointments in the Departments of Psychology, Neurology, and Neurosurgery. Chris left Yale in 1989 to lead the Biophysics Group at Los Alamos National Lab, a position he held until becoming the Santa Fe Institute's Vice President in 2005. At Los Alamos, Chris' group was responsible for a range of biophysical research, from protein crystallography through human brain imaging. During 2000-2001, Chris served as interim director of the National Foundation for Functional Brain Imaging, a collaboration involving Harvard / Massachusetts General Hospital, University of Minnesota, and a number of academic and research institutions in New Mexico devoted to the development and application of advanced functional imaging techniques to mental disorders. Chris' research interests include imaging and modeling the human brain, as well as biological computation in the broadest sense.

# Bios Continued



ROB AXTELL is Senior Fellow in Economic Studies at the Brookings Institution and a founding member of the Center on Social and Economic Dynamics (CSED) there. CSED is a research center dedicated to promulgating agent-based computational modeling techniques across the social sciences. Axtell is also an External Faculty Member of the Santa Fe Institute. He is co-author of "Growing Artificial Societies: Social Science from the Bottom Up" with J.M. Epstein (MIT Press, 1996). His research has been published in leading general science journals (e.g., "Science," "Proceedings of the National Academy of Sciences") and disciplinary journals. His new book, "Artificial Economies of Adaptive Agents," will appear soon.



M. MITCHELL WALDROP earned a Ph.D. in elementary particle physics at the University of Wisconsin in 1975, and a Master's in journalism at Wisconsin in 1977. From 1977 to 1980 he was a writer and West Coast bureau chief for *Chemical and Engineering News*. From 1980 to 1991 he served as a senior writer at *Science* magazine, where he covered physics, space, astronomy, computer science, artificial intelligence, molecular biology, psychology, and neuroscience. He is the author of *Man-Made Minds* (1987), a book about artificial intelligence; *Complexity* (1992), a book about the Santa Fe Institute and the new sciences of complexity; and *The Dream Machine* (2001), a book about the history of computing. He lives in Washington, D.C. with his wife, Amy Friedlander.



CLAUDIA PHARIS is a 30 year veteran of service to government and industry. Her experience in politics and public policy is broad and deep: seven years serving as Chief of Staff and then Senior Policy Advisor to Congressman Chaka Fattah; served at the Department of Housing and Urban Development, the Office of Management and Budget, and the U.S. Congress on both the House and the Senate Budget Committees. Later, she ran a successful small business in NYC and founded Mentor Systems International which developed multimedia educational products. Ms. Pharis is Founder and CEO of the Catalyst Institute for Applied Policy, a social systems intermediary that is engaged in problem solving in large complex systems. She has earned a BS in Physics from Trinity College, an MBA from the

Harvard University School of Business Administration, and is currently pursuing a Ph.D in Public Policy at George Mason University.



# Organizations Engaged in Complexity-Related Research

Santa Fe Institute  
Krasnow Institute  
New England Complex Systems Institute  
Center for Interdisciplinary Research on Complex Systems at Northeastern University  
Plexus Institute  
IBM Almaden Research Center  
Center for Complex Systems Research, University of Illinois  
University of Michigan Center for the Study of Complex Systems  
Institute Para Limes of the European Union  
Centre for Policy Modeling - Manchester Metropolitan University (UK)  
Program on Social Complexity - George Mason University  
Complexity Research Programme - London School of Economics (UK)  
Computational and Experimental Economics Laboratory - University of Trento (Italy)  
Center for Computational Finance and Economic Agents - University of Essex (UK)  
Center for Interdisciplinary Research - University of Bielefeld (Italy)  
Cluster on Complex Agent-Based Dynamic Networks (CABDYN) - Oxford (UK)  
Center on Social and Economic Dynamics - The Brookings Institution  
Center for Complexity Studies - Bucharest, Romania  
The Center for the Study of Institutions, Population, and Environmental Change, Indiana U.  
The LABORatorio Riccardo Revelli, University of Torino  
The Center for Nonlinear Dynamics in Economics and Finance, University of Amsterdam  
MIT System Dynamics Group - Sloan School of Management  
Center for Complex System Studies - Kalamazoo College  
Complex Systems Research Center - University of New Hampshire  
Duke Center for Nonlinear and Complex Systems - Duke University  
Center for Human Complex Systems - UCLA  
Complex Adaptive Systems Group- Iowa State University  
Institute for Systems Biology - Seattle, Washington  
Institute for Advanced Interdisciplinary Research - Houston, Texas  
Complexity and Management Centre - University of Hertfordshire  
Center for Complex Systems and Visualization- University of Bremen  
Centre for Social Theory and Technology - Keele University  
The Centre for Complexity and Change - The Open University  
Max Planck Institute for the Physics of Complex Systems - Dresden, Germany  
Complex Systems Management Centre - Cranfield University  
Austrian Institute for Nonlinear Studies - Vienna, Austria  
Computational Analysis of Social and Organizational Systems- Carnegie Mellon University  
Complexity in Social Sciences- European Commission Network  
Chaos and Innovation Research Unit - Aristotle University of Thessaloniki, Greece  
Society for Organizational Learning - Cambridge, MA  
T-13 Complex Systems Group - Los Alamos National Laboratory  
Center Leo Apostel for Interdisciplinary Studies, Belgium  
Clemson Research Institute for the Study of Complex Social System  
NSF Center for Discrete Mathematics & Theoretical Computer Science  
The Rand Corporation Science and Technology Policy Institute

# Suggested Reading

## Holland

- Emergence: From Chaos to Order* (1998)
- Hidden Order: How Adaptation Builds Complexity* (1995)

## Bar-Yam

- Making Things Work: Solving Complex Problems in a Complex World* (2005)
- Dynamics of Complex Systems (Studies in Non-Linearity)* (2005)

## Axtell

- Growing Artificial Societies: Social Science from the Bottom Up*, JM Epstein and R Axtell (1996)
- Why Agents? : On the Varied Motivations for Agent Computing in the Social Sciences*,  
Agent Simulation: Applications, Models and Tools, Macal and Sallach (2000)
- The Complexity of Exchange*, Economic journal (2005)
- Economics as Distributed Computation: Meeting the Challenge of Social Problems via  
Agent-based Simulation*, H. Deguchi, K. Takadama, and T. Terano (editors)
- Zipf Distribution of US firm Sizes*, Science vol. 293 (2001)

## Waldrop

- Complexity: The Emerging Science at the Edge of Order and Chaos* (1992)
- The Dream Machine: J.C.R. Licklider and the Revolution that Made Computing* (2002)

## Other

- Chaos: Making a New Science*, James Gleick (1988)
- Chaos: Theory in the Social Sciences*, Kiel and Elliot (1996)
- Democracy and Complexity*, Daniel Zolo (1992)
- Global Brain: The Evolution of Mass Mind from the Big Bang to the 21st Century*,  
Howard Bloom, (2000)
- The Meme Machine*, Susan Blackmore (1999)



**“I think the next century will be the century of complexity.”**

Stephen Hawking  
San Jose Mercury News, 2000

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