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Editorial: Complexity and understanding

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At first sight these two words seem to suggest opposing tendencies. A situation is ‘complex’ and that is why we find it difficult to decide what to do. But, we think that if we understood the situation, its origins and expected responses, then it would be easier to decide on what action, if any, to take. Obviously we are constantly trying to work out what is ‘going on’ around us and to talk to people and try to illuminate the situation. But this is not called ‘science’. This is just straightforward passive pragmatism. We don’t try to ask questions and illuminate a situation before it has occurred, but simply deal with what has arisen as best we can. A scientific approach begins when one thinks of a question and how it could be explored, using a method that has at least some generality. In hard traditional science knowledge grows by the repeated performance of repeatable experiments. That means that an experiment is performed for a closed system or with completely specified environment, and the elements that are contained within the system are completely defined and known. Atoms in a box, links and levers in a machine and crystal lattices are all instances where experiments can be performed all over the world by whoever wants to, and the same behavior will be found. As Popper stressed hard ‘science’ consists of the domain in which repeatable experiments can be performed, and learning only occurs when either a new experiment gives unexpected results or we find that what we thought was a repeatable experiment fails to repeat itself. Hard science only knows for sure things that are not true, not things that are definitely true.

Popper is quite right, but his definition only includes a small part of the universe. For the universe is the result of on-going evolutionary processes, in which multiple levels of emergent structure and organization have come into existence, and whose precise internal structures cannot be clearly defined. Obviously, in biology and especially in human systems, if one is to try to understand ‘scientifically’ the behavior and responses of a particular situation then one is faced with the fact that people and organisms are not transparent, and have ‘hidden’ capacities and responses that their individual and cultural history and evolution have created. Individuals are different because of their innate differences and also because of the precise individual histories.
that they have encountered in their lives, and indeed in the stories they have heard or read within their culture.

This very diversity is part of the evolutionary ‘success’ of the organisms involved in any observed ecosystem in which they are not currently crashing. But this inherent and somewhat unknown diversity is what makes a ‘hard scientific study’ so difficult. A repeatable experiment will have predictable results if the internal spectrum of responses is the same. As we know from complexity models, innovative ideas and responses come from non-average individuals and so in order to predict a response correctly, one would need to know details of all the ‘hidden’ ideas of individuals, in order to see which one may lead to emergent change—either successful, or disastrous. This would seem to me to be an impossible task, although one could reflect on what kinds of individual initiative could potentially destabilize the current system. This was the intention behind my early papers on evolution going back to the 1970s. Anyway, we can now see why biological and social science will never have the same ‘solidity’ as hard, physical science—because you cannot guarantee that any two systems are identical so cannot be sure that you have a predictable outcome from a repeatable experiment. This is why experiments with identical twins are important, though this can only guarantee genetic identity. Clearly, one can nevertheless repeat experiments on different systems and look at the different outcomes that occur—and attempt to find ‘explanations’ for these differences. These explorations can be useful in guessing possible outcomes, but this is not the same thing as a ‘scientific law’. Another point is that people and many organisms will not necessarily respond the same if an experiment is repeated on them! While the atoms and molecules, and cogs in machines do not usually get bored, or have a sense of humor, people often do. And they may well ‘learn’ from the previous experiment and change their response, or simply get annoyed with the repetition and ‘sabotage’ the research as a result. All this points to the idea that we can only hope for a ‘soft science’ when dealing with many people or organisms. This is despite the fact that within an organism there may well be quite predictable biochemistry that goes on. Because there are levels of internal structure that have evolved (molecular, intracellular, intercellular, organs etc.) then although the biochemistry is hard science, the behavior of individuals and populations within ecosystems may not be. This is clearly true of people since knowing their biochemistry does not reveal their history, culture and ideas, and so may fail entirely to predict their behavior—other than passing out, becoming ill of indeed dying.

Each population, culture or economic sector is itself made up of diverse elements and this micro-diversity changes over time as a result of the successes, failures and fashions that actually occur. Not only can we say that ‘prediction’ will be uncertain for
such systems, but also we will never really even understand their history because the precise micro-details and circumstances of the individuals involved in making history cannot be known. All we can do is to describe what happened, and who was involved, though it would be difficult to say why individuals made the decisions and took the risks they did. For living systems, we build interpretive frameworks rather than scientific laws.

Although the laws of physics must still hold, open systems with complex interactions between their elements can achieve a level of autonomy and freedom and will do things that have not been encountered before. For example, ‘emergence’ can occur as new patterns of organization occur, with new characteristics, new variables and new capabilities. We find not only that our quantitative prediction of the variables values is wrong, but they are qualitatively wrong and are probably looking at the wrong variables and asking the wrong questions.

In reality, elements join together to form collective entities and things around us are characterized by structure and organization at various scales. Over time, the performance of the system’ results not just from the elemental behaviors but also the structures of which they are part. The phenotype is not the genotype. Structures with various forms and symmetries possess emergent capabilities which accord differential successes over others. Micro-diversity includes these different collective entities and organizations and so innovations occur at different levels of structure, breaking previous symmetries with consequences that are completely unknowable! Life itself is the astonishing result of the emergent properties of folded macro-molecules such as proteins, and their emergent capacity to reproduce imperfectly.

In evolved systems how do we go about building sensible ‘interpretive frameworks? The answer is what we could call the inductive—deductive loop. We perform experiments on multiple systems and see whether we can discern patterns in the results. These patterns are then our ‘theory’ about such systems. Using our ‘theory’ we then investigate further cases and deduce expected results. When the expectation is fulfilled, it reinforces our ‘theory’, but if our theory is ‘denied’ by the experiment we are forced to change our beliefs.

This inductive-deductive loop is really the most fundamental view of the ‘learning process’. Over the years I have often included in my papers a figure of the ‘learning loop’, whereby the experimenter generates beliefs about the world. The dotted line as being someone’s skull and the diagram shows how actions made on the basis of accumulated beliefs and values get a response from the world.
If the response is ‘as expected’ then it will tend to reinforce the beliefs of the individual. However, if the results of an action come back and are not what was expected—then the individual has to decide what to do about it. The amazing thing is that there is no ‘science’ about how to review ones beliefs in the light of their denial. When I devised this picture of learning, I was (unconsciously) representing the actions of an honest scientist (me)—a seeker of truth. But of course, in reality, most people may well want to deny the denial, to pass rapidly on without drawing attention to it, and may not wish to show that their beliefs were incorrect. The faithful might even consider it a test of their faith and simply ask their leader what they should do. The ‘induction/deduction’ loop for social science does not pick up this personal, individual desire to find their ideas fulfilled. Since there is no scientific guidance on how to modify one’s views in the ‘best possible way’ then, for example, people with left or right wing views might modify the ‘question’ asked in order to try to extract the answer they want to find. This might be favorable to the views of their ‘friends’ or opposed to the views of their rivals. We may therefore join with other like-minded thinkers in a new set of beliefs/values that seem congenial. The new ideas may well prove satisfactory until the next crisis.

Another possible issue is that different ‘schools of thought’ may adopt different lessons from the failure of the previous ideas and oppose their ideological enemies in battle. In this way the process of ‘learning’ in social systems is not the rational, truth seeking process that we may wish for. Instead, the questions examined will reflect the particular views of the individuals, and so following a failure of a previous consensus, people and groups may interpret evidence in different ways, ones that support the views and opinions of the particular social group that the individuals are attracted to.
Furthermore, if the agents that are contained in our interpretive framework see the probable changes that it would predict, then they may well change their behavior to take advantage of the ‘knowledge’. This ‘reflexivity’ would then invalidate the framework and make it an additional part of the situation being viewed. This all goes to show that instead of seeking truth as in hard science, in evolved systems we can only seek for better interpretations of what has, is and might happen. A multi-agent model will have to contend with the idea that the behaviors represented may be affected by the ‘predictions’ of behavior of the system—thus changing agent behavior.

In summary then, we can say that ecological and particularly human systems cannot yield scientific laws of the kind possible in physics or chemistry. This is because ecological and human systems are the result of a long, multi-level evolutionary process which is on-going. This means that our research leads us hopefully to useful interpretive frameworks, with the proviso that we need to constantly ask whether things inside the real system have not in fact changed and look to revising the variables and interactions that are in our interpretive framework. So, modelling and the generation of clear interpretive frameworks are valuable in revealing when changes may have occurred in the real situation and behavior. Without this possibility of monitoring expectations all would be unclear. Forming interpretive frameworks and models allows us...
to focus on where in the system change seems to be happening, and some study and revision has become necessary.

In summary, complexity and complex systems are really the most important part of our lives. Recently, science has widened itself to the study of open, non-equilibrium systems (complex systems) and found strong limits to our possible knowledge and understanding. But of course, if we could have perfect knowledge of what must happen around and inside us, then there could be no freedom. The price of creativity, of innovation and of discovery is the lack of restraint on what can happen, and the impossibility of fully understanding the past, present or future of our lives. The laws of physics and chemistry are, of course, obeyed, but they allow for the creative evolutionary processes that lead to higher levels of organization and structure allowing emergent characteristics, features and capabilities. So, feeling regret that we cannot hope for a really ‘hard’ social or ecological science fails to recognize the wonderful, unlimited richness of what can evolve.
Calling Notices and Announcements

The 33rd International Conference of the System Dynamics Society
systemdynamics.org

Cambridge, Massachusetts, USA
July 19-23, 2015

Reinventing Life on a Shrinking Earth
CALL FOR PAPERS

Overview
While the Earth has not changed size in absolute terms, it is definitely shrinking with respect to the activity it supports. We have all experienced the effects of the greater connectivity: global economic recession, global business competition, pandemics, crowding and congestion, depletion of natural resources, strategic acquisition of water supplies, rising health care costs and management, and rapid economic development in many nations, spurring resource depletion, pollution, and climate change. Complex business and societal challenges have arisen from the increasing activity on the globe that conventional institutional designs have failed to address. System Dynamics uniquely provides a strategic framework to explore the challenges of a shrinking Earth, giving a greater understanding and exposing counterintuitive insights that allow us to reinvent our institutions and our lives.

Program
The conference program consists of invited and contributed sessions and workshops demonstrating the state of the art in the theory and application of System Dynamics. We welcome all research and documented consulting activities in System Dynamics, including applications of the methodology to solve real-world problems, new technical and software developments, and productive integration of complementary methodologies. The conference schedule is organized by thread so as to create coherent sessions for presentation. The tentative list of threads for 2015 is:

- Business
- Economics
- Environment
- Health
- Human Behavior
- Information and Knowledge
- Learning and Teaching
- Methodology
- Operations
- Public Policy
- Resources
- Security
- Stakeholder Engagement
- Strategy
- Business
- Information and Knowledge
- Methodology
- Operations
- Public Policy
- Resources
- Security
- Stakeholder Engagement
- Strategy

The annual System Dynamics conference brings together people from around the world to share important research and application results. The program includes plenary presentations that showcase important work in the field, parallel and poster sessions that present the most current research and applications, and a full day of skill-building workshops covering topics from basic software use to advanced analysis techniques. Panel discussions, special interest group sessions, student colloquia, a modeling assistance workshop, vendor exhibits, and demonstrations round out the program. The conference schedule provides time for social and professional interaction.

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Submission deadline March 18, 2015
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About The Society

The Society is an international forum that brings together researchers, theoreticians, and practitioners interested in applying dynamical systems theory, self-organization, neural nets, fractals, cellular automata, agent-based modeling, and related forms of chaos, catastrophes, bifurcations, nonlinear dynamics, and complexity theories to psychology and the life sciences.

Our members hail from numerous specialties within psychology, other social sciences, and biology, physiology, neuroscience, mathematics, philosophy, physics, computer science, economics, education, management, political science, engineering, and the world of art. Our membership spans more than 30 countries.

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Emergence: Complexity & Organization (E:CO) is an international and interdisciplinary conversation about human organizations as complex systems and the implications of complexity science for those organizations. With a unique format blending the integrity of academic inquiry and the impact of business practice, E:CO integrates multiple perspectives in management theory, research, practice and education. E:CO is a quarterly journal published in print and online by The Complexity Society, the Institute for the Study of Coherence and Emergence, Cognitive Edge, and Emergent Publications (formerly ISCE Publishing) in accordance with academic publishing standards and processes.

INTELLECTUAL ECOLOGY

E:CO’s niche is the opportunity to bridge three gaps:

- The distance between academic theory and professional practice;
- The space between the mathematics and the metaphors of complexity thinking; and,
- The disparity between formal idealizations and actual human organizations.

Organizations of all kinds struggle to understand, adapt, respond and manipulate changing conditions in their internal and external environments. Approaches based on the causal, linear logic of mechanistic sciences and engineering continue to play an important role, given people’s ability to create order. But such approaches are valid only within carefully circumscribed boundaries. They become counterproductive when the same organizations display the highly reflexive, context-dependent, dynamic nature of systems in which agents learn and adapt and new patterns emerge. The rapidly expanding discussion about complex systems offers important contributions to the integration of diverse perspectives and ultimately new insights into organizational effectiveness. There is increasing interest in complexity in mainstream business education, as well as in specialist business disciplines such as knowledge management. Real world systems can’t be completely designed, controlled, understood or predicted, even by the so-called sciences of complexity, but they can be more effective when understood as complex systems. While many scientific disciplines explore complexity through mathematical models and simulations, E:CO explores the emerging understanding of human systems that is informed by this research. Engineered and emergent views of human systems can coexist, creating a useful tension that drives organizational evolution. However, neither academics nor practitioners can leverage complexity alone. Academic discussions about complexity are often biased towards quantitative research and mathematical models that are inappropriately prescriptive for systems comprised of actors endowed with free will, who are simultaneously part of and aware of the
system. The metaphors of complexity have a usefulness of their own as well, but too often they are applied without adequate reference to the mechanisms, models and mathematics behind them.

**CONTENT IN CONTEXT**

Readers of E:CO are managers, academics, consultants and others interested in developing and applying the insights of complex systems theories and models to analysis and management of private-, public- and social-sector organizations and applying insights derived from organizational experience to understanding complex systems theories.

E:CO encourages multidisciplinary contributions from all sectors of social and natural sciences and all sectors of organizational practice. The journal’s unique format presents both reviewed and non-reviewed content from three overlapping sources. Peer-reviewed articles are at the heart of our content, but with an emphasis on communicating across boundaries. Academic articles pass double-blind reviews by two academics and one practitioner. When subject matter is theoretical or reporting research findings, authors will be encouraged to discuss practical implications of the ideas. Similarly, practitioner articles also will be double-blind reviewed by two practitioners and one academic. When appropriate, authors will be encouraged to connect to theory or research that has either already been done or needs to be done.

Additional non-reviewed content includes feature articles, essays, profiles, conversations and conference summaries, as well as news, commentary, book reviews, etc. Each article will be clearly marked according to which path it took to publication.

E:CO incorporates *Emergence*, originally published by the Institute for the Study of Coherence and Emergence.

**SUBMITTING MATERIAL TO E:CO**

E:CO is interested in receiving work from a wide range of perspectives:

- Theoretical and practitioner based;
- Both conventional and unconventional methodologies;
- Case study work;
- Approaches to teaching management or leadership;
- Work covering a variety of organizational types, size and ownership;
- Cross cultural studies and work from Australasia, Africa, Central and South America and the Far East as well as the USA and Europe.

We ask that authors set their paper clearly within the context of the notion of complexity and complex systems, however they chose to define such, and that
the practical implications and transferable lessons from their work be clearly described.

Note that quantitative studies (including those which focus on survey results and related statistics) are not suitable for *E:CO*. Authors are limited to one mathematical formula per paper (additional formulae may appear in the technical appendix). If you wish to submit work of a quantitative nature, please represent it qualitatively. Figures and tables should be illustrative. Quantitative and statistically based submissions will be returned without review. Each article in *E:CO* will be accompanied by space on the *E:CO* web site for additional materials and discussion forums.

**FORMAT**

All submissions are electronic and must be made via:


Suggested length is 4000 to 5000 words. Review pieces and essays should be 2000 to 3000 words. Note: additional material considered relevant and/or related by the author(s) can be posted on the web site, which will be associated with each accepted article. The author(s) will be responsible for securing all necessary permissions for material to be posted on the web site.

From August 1st, 2014, all submissions are to be made via the online https://journal.emergentpublications.com, which is based on the new Anntoum 2.0 (http://annotum.org/) WordPress (https://wordpress.org/) theme. The move to our new workflow environment is to better support the review and revision process, and also provide the foundation for a more diverse distribution system coming early in 2015. This will allow easier distribution of *E:CO* content across the many mobile platforms. Print will also continue to be available. Early pre-prints will also be made available before the scheduled issue publication dates.

If you have any questions about the new submission please contact Kurt Richardson (Managing Editor) at kurt@emergentpublications.com.

**Notes on Content**

**Figures**

Figures must be provided in .PNG format, and render well in both color and greyscale.

**References**

From August 1st, 2014 all references will be included as footnotes (as supported by the Annotum 2.0 workflow system). Support for CrossRef (http://www.crossref.org/) is coming soon, but in the meantime references need to
be entered following a standard format. The main difference between E:CO’s requirements and those for other journals is that for E:CO the ISSN and ISBN numbers for periodicals/journals and books are required. Some examples are provided below:


Note that all books and journals must have their ISBN and ISSN included, respectively, where known. From issue 9.1 (2007) the town, state and publisher are no longer needed for books for which there is a current ISBN. Only older books (pre-ISBN) require town, state, and publisher.

If you have trouble finding journal ISSNs then try entering the journal’s name within inverted commas and “ISSN” into Google. For example:

“Journal of Management” ISSN

Failure to format references correctly may create delays in the publication process.

**ACCEPTANCE PROCEDURE**

The Editors and Managing Editor will review all submissions for suitability. Manuscripts deemed suitable are reviewed independently by members of the editorial review board, and their recommendations guide the Editors in their acceptance decision. The reviews are double blind—neither authors nor reviewers know the identity of each other. However, we encourage a close working relationship between reviewers and authors and the workflow system that is in place can support such collaboration if both parties agree.

All reviewing for E:CO is done electronically via our online Annotum 2.0-based workflow system. Authors will be updated via email.
The intrafirm complexity of systemically important financial institutions

In November, 2011, the Financial Stability Board, in collaboration with the International Monetary Fund, published a list of 29 “systemically important financial institutions” (SIFIs). This designation reflects a concern that the failure of any one of them could have dramatic negative consequences for the global economy and is based on “their size, complexity, and systemic interconnectedness”. While the characteristics of “size” and “systemic interconnectedness” have been the subject of a good deal of quantitative analysis, less attention has been paid to measures of a firm’s “complexity.” In this paper we take on the challenges of measuring the complexity of a financial institution by exploring the use of the structure of an individual firm’s control hierarchy as a proxy for institutional complexity. The control hierarchy is a network representation of the institution and its subsidiaries. We show that this mathematical representation (and various associated metrics) provides a consistent way to compare the complexity of firms with often very disparate business models and as such may provide the foundation for determining a SIFI designation. By quantifying the level of complexity of a firm, our approach also may prove useful should firms need to reduce their level of complexity either in response to business or regulatory needs. Using a data set containing the control hierarchies of many of the designated SIFIs, we find that between 2011 and 2013, these firms have decreased their level of complexity, perhaps in response to regulatory requirements.

For more information refer to:


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