Integration of Sources on Variation, Development & Evolution in System of Systems Processes (SSP Model) and Application to Environmental Biology: the GENSYSML Tool

Rena R. Escobedo
Dr. Len Troncale, Co-Author
Student Fellow, Comparative Systems Analysis Minor Program
Institute for Advanced Systems Studies (IAS)
and College of Science
Cal Poly Pomona, Pomona CA 91768

PURPOSE:

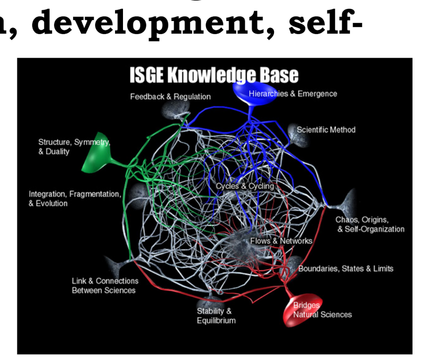
•This presentation is a piece of a class collaborated effort that includes a minor in Comparative Systems Analysis.
•The great goal is to better our understanding of how systems of all kinds and scales work to make improved design and performance of human systems possible.
•This certain poster focuses on three key systems mechanisms or processes common to many systems: Namely variation, development and evolution.

IDENTYFYING WORKERS AND INSTITUTIONS:

- David G. Green, Environmental and Information Science – Charles Sturt University, Australia
- International Committee for Research and Study of Environmental Factors", ICEF, Belgium
- Computational Analysis of Social and Organizational Systems (CASOS)
- Complex Systems of the University of Alaska
- Santa Fe Institute
- Rainer Feistel and Werner Ebeling, Berlin

IDENTYFYING FEATURES AND FUNCTIONS:

•Remember that the purpose of Identifying Features is to describe a systems process using conceptual representations of its main characteristics rather than the formal mathematical descriptions often used in systems analysis or in systems simulation. Therefore, the ideas below, TAKEN TOGETHER, constitute a first description of the general systems aspects of evolution.
•Very Long Periods of Time: Vastly longer time spans than that characteristic of the entity itself.
•Continuity and Directionality of Time: Change over time has the prerequisites that time segments follow each other in sequence and the segments are connected whether in physical, biological, or social systems. It is interesting that quantum levels and effects may not have this characteristic raising fundamental questions for this systems process.
•Very Large Numbers of Individual Entities: Not relative to other levels of entities, but rather immense numbers relative to its own level of organization.
•Production or Reproduction: On the biological level, the ability of DNA to organisms to reproduce large numbers of progeny is well explained. However, for physical systems many entities appear by production that is not reproduction. For example, many evolve stars from gasses, many galaxies from the big bang, many planets from star systems, many compounds from aggregation, etc.
•Variation: Although another systems process itself, the entities that are reproduced or produced in vast numbers cannot be exactly similar for the change we describe as evolution to occur. Yet they must share significant amounts of similarity or they would not be functional as recognizable as variants of the same basic plan.
•Constraint Field: This is the agent that restricts either the stability of later entities in a time stream or the success of reproduction in a living system (fecundity, longevity). Without this selection pressure on some variants relative to others, there is no change over time.
•Change Within Scalar Level: Change from one scalar level to another falls under the systems process of "emergence", not evolution. Evolution is restricted to change of variants within a scalar level of organization.
•Change Within a KorperPlanne: Change from one strategy of organization to another falls under the systems process of "emergence", not evolution. Evolution is restricted to change of variants within a strategy (bodyplan) of organization.
•Defined Contexts: The constraint field is the natural consequence of the sum total of all entities that co-exist with the evolving entity in the same time frame, proximal hierarchical scalar levels, and interaction networks.
•Using these ID Features TAKEN TOGETHER, students of general systems should be able to identify new examples of systems evolution they have not encountered before, and distinguish these from related systems processes like variation, development, self-organization, and emergence.



REFERENCES:

•Hammond, Debora. The Science of Synthesis, Exploring the Social Implications of General Systems Theory. 2003.
•Anderson, Paul E., Henrik, Jeldtoft Jensen. Olveira, L.P. and Sibani, Paolo. Evolution in Complex Systems. 2004.Wilet Periodicals, Inc. Vol 10. No.1

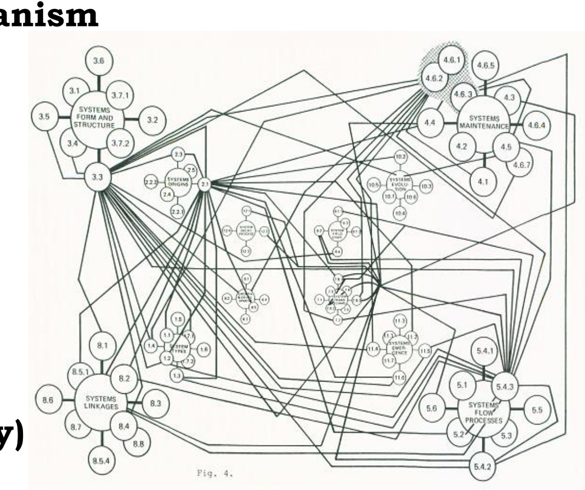
WORKING DEFINITIONS:

•From simpler legacy systems to the more advanced revisions made to these standards, the emphasis is on conceptual understanding of key techniques and protocols and their evolution.
•Variation – Changes within a system's components or its connectivity.
•Evolution - A gradual process in which something changes into a different and usually more complex or better form; Irreversible incorporation, or accumulation, of historical information. (Synonym: development)
•Development - A significant event, occurrence, or change; Predictable directional change.

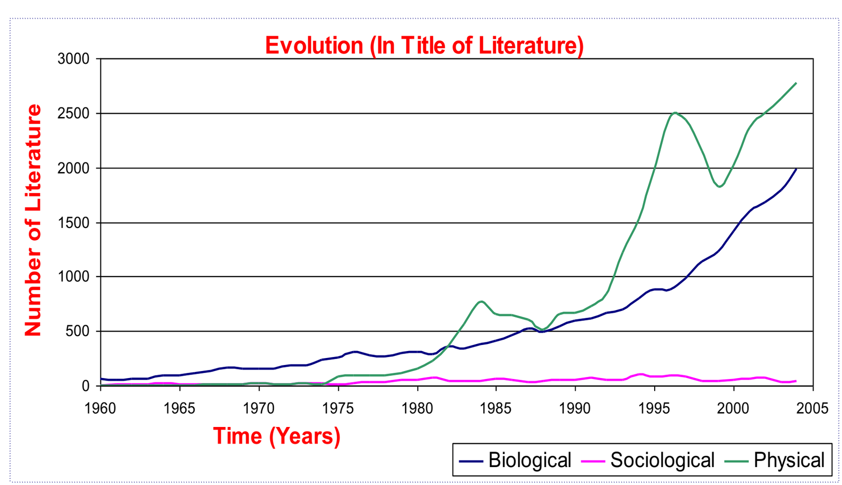
TYPES AND TAXONOMIES:

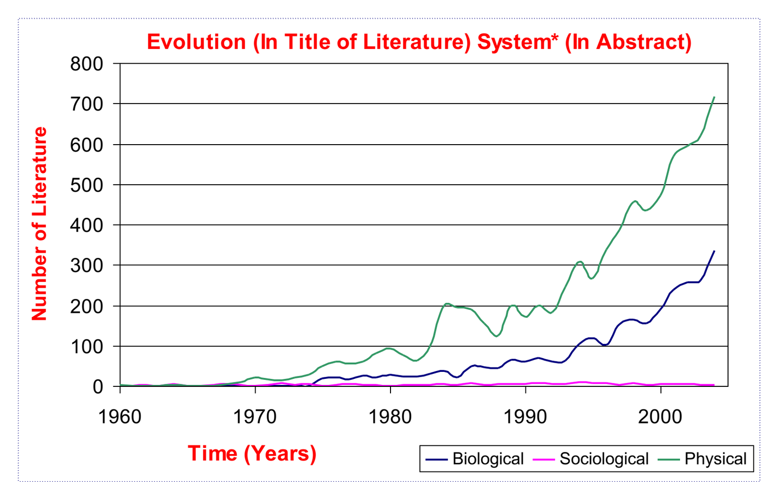
Types of systems in evolution:
•Randomness/Chaos Mechanisms
•Lotka-Volterra Competition Equations
•Ontogenetic / Phylogenetic Mechanism
•Concrescence
•Neutrality Principle
•Logarithmic Spiral of Variants
•Transgressive Variation
•Cooperation Equations

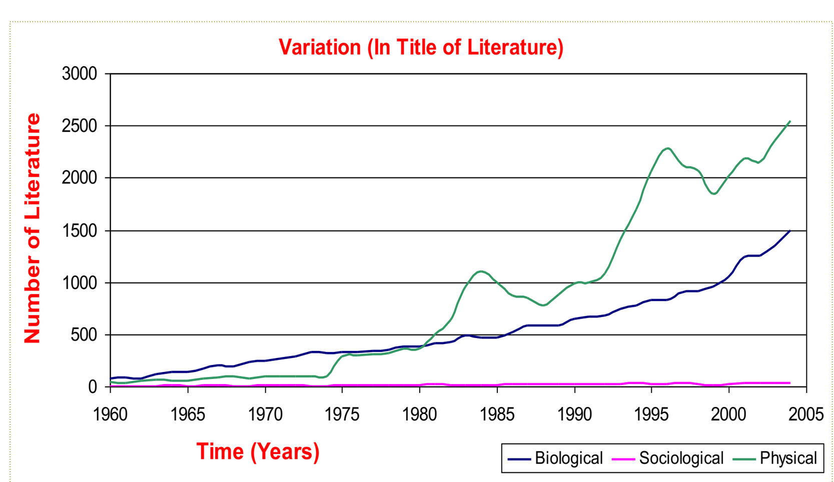
Types of systems in development:
•Von Baer's Laws
•Zipf's Law
•Morphometric Laws
•Allometric Growth (Proportionality)
•Principle of Plenitude

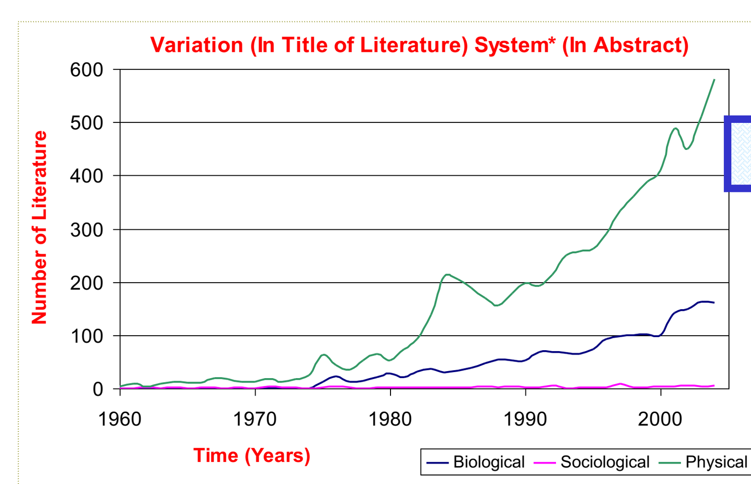


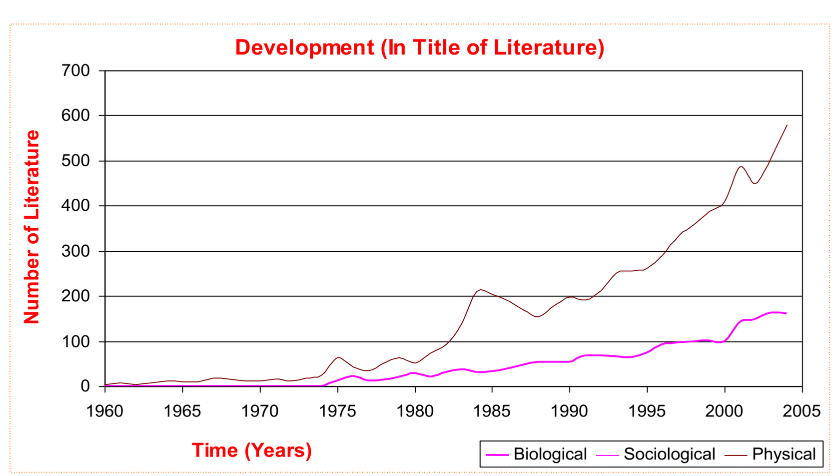
SOURCES: SCOPE OF TRENDS IN LITERATURE:

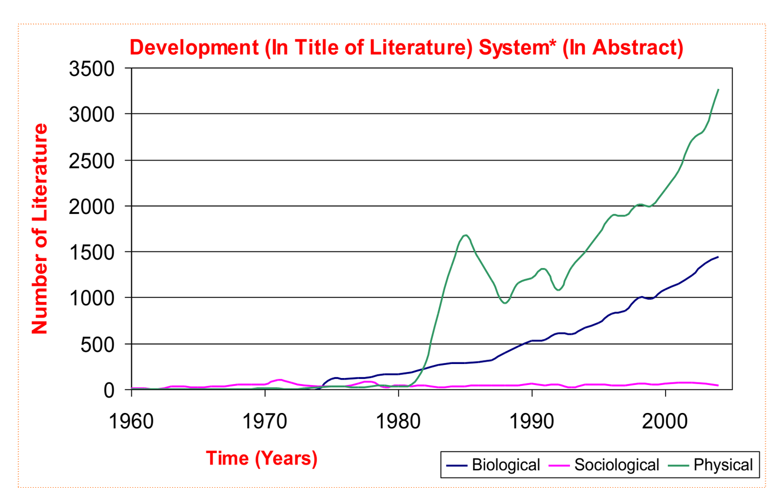






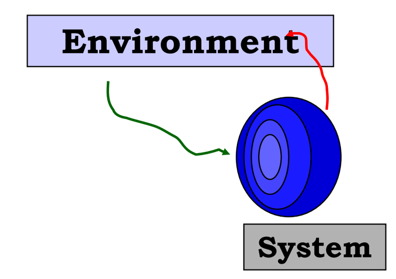






LINKAGE PROPOSITIONS:

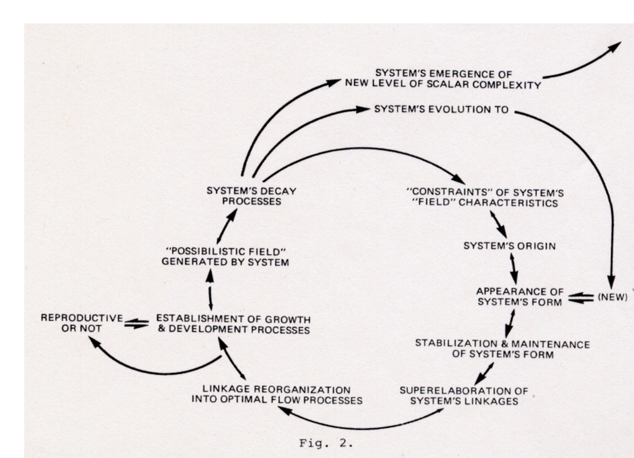
•Any similar system in nature needs same patterns/features or they will not work
•Trying to show similarities on an abstract level with linkage propositions.
•Instability in the form of unsatisfied counterparity leads, in part, to systemic evolution.
•Suggested Linkage Propositions by author:
-Systems evolution can cause systems variation.
-Stressed stability is, in part, the cause of evolution.
-As dimensionality is increased, complexity is increased and is in part the cause of an increase of a richer systembehavior.
-Development is, in part, the result of environment.



SAMPLE INFORMATION BITES:

•We present a tiny sample of here information bits that apply directly to the general systems-level of variation, development, and evolution rather than information bits on conventional biological evolution. The latter would be voluminous from a vast literature but would overemphasize this one type of system, namely living systems, relative to all others. Here we are trying to find what is common to these systems processes across physical, biological, and social systems.
•In discussing the evolution of systems thinking, Kramer and Smit point out that there is "no generally accepted, clearly defined body of knowledge concerning systems thinking." (Hammond)
•Each system is metastable when observed on short time scales, whereas at long time scales, each evolves towards greater stability. (Anderson et. al.)
•The long time effort of complex dynamics is evident in biological macroevolution, for example, in the form of a slowly decreasing extinction rate. (Anderson, et. al.)
•The system will tend to spend more and more time in the metastable states as it searches for a sufficiently large fluctuation that brings about a new and, on average, more stable configuration. This leads to slowing down of the pace of evolution. (Anderson et. al.)
•The dynamics of a complex system can be qualitatively summarized by considering the relation between time, configuration, and fickleness. (Anderson et. al.)

POSITION IN GENERAL SYSTEMS LIFECYCLES:



•From the state of System's Decay Processes, the System's undergoes evolution to create a new appearance of system's form.
•In the System's lifecycle establishment of growth and development processes is generated from linkage reorganization into optimal flow processes and then moves on to "Possibilistic Field" generated by systems.