

Comparative Systems Analysis of SoSP & Other Candidate General Theories/Tools



1. Need for Unification of Candidate Theories

- The purpose of the ISSS as stated by the Founders, as noted in our Constitution, on our current Web pages, and still currently active can be succinctly stated as
 - ✓ FIND SYSTEMS ISOMORPHIES IN VARIOUS FIELDS
 - ✓ HELP IN TRANSFERS OF THEORIES & MODELS ACROSS FIELDS
 - ✓ DEVELOP BETTER SYSTEMS THEORIES AND MODELS
 - ✓ LESSEN DUPLICATION OF THEORETICAL & SIMULATION EFFORTS
 - ✓ PROMOTE THE UNITY OF SCIENCE & IMPROVE COMMUNICATION AMONG SPECIALISTS
- The need to fulfill these goals is even greater now than when they were formulated in the 50's. In fact, we are facing even more critical systems of systems problems today than in those days with global warming, globalization, terrorists, more complex engineered systems, etc. etc.
- Although these efforts have expanded to application of theory, it is distressing that so many are leaping to apply what has not yet been elucidated in theory. How can you apply a consensus theory when a consensus does not exist. Are such applications worthy or doing as much harm as good? Where is the justification in proven models that interventions will work?
- There is a great need for better theories, models, tools, and techniques and better methods for evaluating and assessing them; especially the latter; ISSS does not even compare models
- This poster and presentation is aimed directly at addressing the goals listed above by comparing some extant theories to derive criteria for comparison and evolution of theories

2. The Power of "Comparative"

- The minimum actions by the ISSS community would be:
 - ✓ Clear identification of the candidate systems theories and teaching them
 - ✓ Detailed comparisons of the tools & models with criteria that force their improvement
- "Comparative" versions of many disciplines have advanced those fields at critical moments in their development leading them to discoveries that could never have been accomplished without the conscious, community effort at comparisons. For example:
 - ✓ **Comparative Taxonomy:** led to the metaknowledge that enabled recognition of evolution
 - ✓ **Comparative Anatomy:** led to the metaknowledge that enabled understanding of tissues/organs
 - ✓ **Comparative Physiology:** led to the metaknowledge that enabled many advances in medicine
 - ✓ **Comparative Genomics:** is leading to an understanding of many diseases and cures
- Given these powerful examples from the development of science, and given the goals of the ISSS listed above, it is time that the systems' field engaged in some comparative approaches
- Notice that one of the characteristics of the systems theory field as it has historically developed is the isolation of theories and tools from each other; exactly opposite synthesis & integration
- We believe this results partly from the very nature of building a "systems theory." It requires powerful integration and synthesis. Few individuals today have experience in synthesis and integration because it is not taught. Further, it often is best accomplished within the confines of one mind. It requires immense effort, energy, and persistence.
- The result has been "guru's" who espouse a particular theory and are not interested in others
- The experience of science shows that this is a recipe for no progress, no change, no improvement
- So we call for a "Comparative Systems Analysis" and "Comparative Systems Synthesis"

3. Some Candidate General Theories & Tools

- It is interesting that the ISSS does not offer a comprehensive listing of candidate systems theories, tools, and techniques to its membership. We regularly find members of this community, and several others described as systems-oriented, who are unaware of many alternatives theories and tools. We regularly receive requests for an introductory text to the field -- but no consensus text exists
- One way to identify candidate theories is to identify research texts by workers who have expended a lifetime of effort to produce a coherent systems theory or tool (or both) and have written a text to describe their personal synthesis. Some examples include:
 - ✓ Systems Ecology (Howard Odum)
 - ✓ Living Systems Theory (James G. Miller)
 - ✓ Reconstructability Theory (George Klir)
 - ✓ Synergy (Peter Corning) Synergetics (H.Haken)
 - ✓ Flexions (Murray Gel Mann)
 - ✓ General Systems Theory (L. Bertalanffy)
 - ✓ Systems Dynamics (Jay Forrester)
 - ✓ Interpretive Str'l Modeling (John Warfield)
 - ✓ Non-Equil Thermodynamics (Prigogine)
 - ✓ Network Theory (Barabasi et. al.)
 - ✓ Agent-Based Modeling (Holland et. al.)
 - ✓ Complexity Theory (Yam et. al.)
- To see many more alternative theories and approaches go to the detailed mapping produced by Li & Schwartz of the IIGSS at <http://www.iigss.net> that goes beyond GTS (also found in this poster series display)
- The chart at the center of this poster is just one, quick, analysis of a sample of the above works to compare their range of coverage using our CSA-based key criterium for an adequate systems theory or tool, that is, incorporation & use of an adequate range of systems processes or mechanisms.

7. At-A-Glance Process-Based 2D Comparison Matrix

• In the following chart, the index/contents of the key or major text representing the "school of systemic thought" was analyzed for coverage of the set of SoSP-recognized, isomorphic systems processes: The darker the intersect, the greater the coverage



8. Advantages of Process-Based Comparison

- The Comparative Systems Analysis at left has these benefits or value added
 - ✓ At-A-Glance feature helps quickly assess comparative range of coverage of each theory
 - ✓ Use of same comparison criteria (coverage of systems processes) ensures consistency
 - ✓ Use of 100+ items of comparison enables an unusually detailed analysis on key criterium
 - ✓ Use of systems processes are arguably the most fundamental criteria set for comparison
 - ✓ Can easily increase detail such as number of pages describing or number of case studies
 - ✓ Can easily add additional theories or new isomorphic structures or processes
 - ✓ Rubric used motivates others to come up with better or added rubrics for comparison

9. Disadvantages of Process-Based Comparison

- The Comparative Systems Analysis at left has these weaknesses
 - ✓ Comparison does not include evaluation of mathematical tools employed in each
 - ✓ Emphasis on systems processes favors SoSP model over other approaches
 - ✓ Use of Content Analysis via index entries does not go far enough into the depth or quality of coverage for each systems process
 - ✓ Validity and utility of comparison depends on arguments for primacy of "process" focus
 - ✓ Time-locked (r = 1968 to 1991); some of the works are older than others
 - ✓ Rubric depends on accuracy and level of detail of the indices & indexers of the texts

CAVEAT
The unexpressed assumption here is that Troncale and the Institute for Advanced Systems Studies at our university will complete the extensive text on the System of Systems Processes (SoSP) and its application to current, pressing Systems of Systems Problems (SoSP2) as planned in the next academic year. See the SoSP2 Posters in this display.

4. SoSP as "Integrative Eclecticism"

- How might the SoSP avoid the practices of much current systems theoretical work that they proselytize, are controlled by one "guru," are not self-critical, do not merge with each other, or are not engaged in falsifying or testing assumptions?
- Some of the ways SoSP is trying to overcome these inherent difficulties are:
 - ✓ One of two components of SoSP, the systems processes, are subject to direct testing in each of the case studies of each of the disciplines that work on any manifest system
 - ✓ The other component of the SoSP, the linkage propositions, are called that because propositions are expected to be tested;
 - ✓ Further neither the isomorphies nor propositions can be tested in the way typical of the sciences, but rather by "empirical extension" as described in the poster on SoS and Can There Be A Science of Systems?
- Thus we call SoSP a part of a "school" entitled "INTEGRATIVE ECLECTICISM"
- It is "integrative" because none of it is particularly ours; we incorporate freely any useful or rigorous findings from any natural sciences with appropriate citation
- It is "eclectic" because we study case studies from all domains; physical, social, biological; basic & theoretical; basic & applied; human & engineered

5. What Is A Systems Process? Why SP's?

- A process can be defined as a series of required steps or changes, in a required series, through which a set of objects proceeds. A process is dynamic.
- In the SSP we are looking for the "mechanics" of how (systems in general) work."How" describes the way things work. Science asks "how" questions. Non-science fields ask "why" things happen. If ever systems theory is to become a science, it must focus more on answerable "how" questions because they explain how systems are able to exist as systems. "How" knowledge enables intervention.
- There is a large contingent of people who hate mechanics and "how" questions. Humanists think it demeans free will. Even some scientists may see mechanics as the old Newtonian approach to the world. We focus on processes for neither reason. The way things work describes how systems happen better and at a more fundamental level than other descriptions according to the natural sciences.
- A modern view of the common word "process" is algorithm. An algorithm is a representation of the set of changes that must be performed to transform a given set of inputs into a defined output. One can express this set of changes in language, computer programming, or mathematics. No matter how humans express them, processes are what nature has been doing all along - long before humans existed.
- We can identify the process from the background because of the regularity with which the steps occur across the many duplications of a system and across many different types and scales of systems. This shows why processes are isomorphic. In the SSP model, a systems process is defined as that series of steps evolved by nature and typical of mature systems that adequately fulfills a needed systems function.
- Since the identity and sequence of the steps in the process are always the same, we see a process as a regularity that is constant despite the many different roles and functions they must perform in different types of manifest systems. So processes are the most fundamental isomorphy.

6. The "Structurprocess" Dilemma

- Sometimes the regularity across different systems is a structure, such as hierarchical clustering, or an empirical finding, such as Zipf's-Pareto Distributions. While the SSP focuses on processes that are the same across difference (so integrative/synthetic), it also includes structures that are common to many systems.
- What is the relationship between regular and similar "structures" in nature and regular and similar "processes?" In SoSP, structures and processes are just transforms of each other, like states or phases of the same system, or like energy and matter are transforms of each other. We even use the neologism "structurprocess" to transcend and avoid the artificial, anthropomorphic duality. (It has been reported that Bertalanffy used to say that structure is slow process, and process is fast structure.)
- So in the chart above, you will find both universal "structures" & "processes" as isomorphies