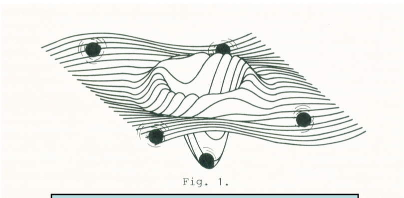
Dr. Len Troncale, Dept. of Biology, &
Institute for Advanced Systems Studies
California State Polytechnic University
Pomona, CA, 91768
lrtroncale@csupomona.edu

Pre-Requisites, Discinyms, Discriminations, & Mutuality
IN THE SYSTEM OF SYSTEM'S PROCESSES MODEL (SoSP)

Tenets of the SoSP Model

• The System of Systems Processes Model is based on the following working assumptions: (The purpose of this poster is to elaborate three derivative consequences of these assumptions)

✓ Generalized systems theories need to be based fundamentally on systems processes (SP) /or/ mechanisms as their fundamental constituent or basic units
✓A full set of systems processes are both necessary and sufficient
✓ Systems processes are axiomatic meaning they precede their manifestations in real systems
✓ Systems processes are minimal states requiring the least resources to accomplish systems survival (that is least energy, material, space, numbers, information or their combinations)



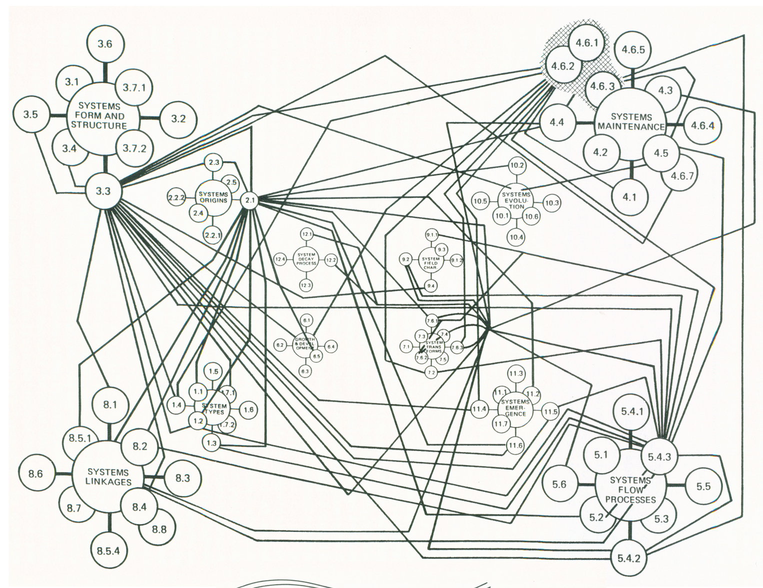
SysProcess as Minimal State

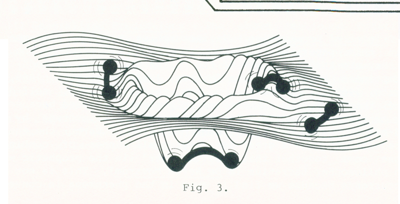
✓ All systems processes are equal
✓ All systems processes interact with each other in non-trivial and definable ways forming a network
✓ Systems processes must be isomorphic or present in every key phenomena of the several natural sciences
✓ Interactions and mutual influences between systems processes can be expressed as language-based units we call isomorphic Linkage Propositions
✓ Identifying Features & Functions distinguish systems processes from each other; this poster adds pre-requisites, discinyms, and key discriminations
✓ There is not one, single general theory, but rather a hierarchy of related, ever more inclusive theories with defined ranges of validity
✓ The interactions between systems processes and hierarchy of models raises systems science to the level of a system of systems model

Processes Pre-Requisite for Other Processes

• In our study of the "interacting net" of systems processes during our Comparative Systems Analysis classes during AY2006, we have found that some of the processes require the action of other processes. There are definable and non-trivial dependencies.

✓ Each node in the network of systems processes shown at right depicts a single systems process (such as cycles/cycling) and each line depicts a specifiable and generic interaction between that process and other processes which we call "linkage propositions" (hereafter LP's)
✓ This particular network graph of SoSP systems processes shows xx LP's for x isomorphic systems processes (please see Intro Posters 1 & 2 for more detailed explanation of these concepts)
✓ However, this network graph does not show the newly elucidated "prerequisite" chains inherent in the axiomatic set of systems processes
✓ As shown at right,a Linkage Proposition is also considered an arrangement of interactions that is minimal in its use of resources and so probability favors any newly emerging or manifest system (new scalar object) to also assume the SoSP LP's

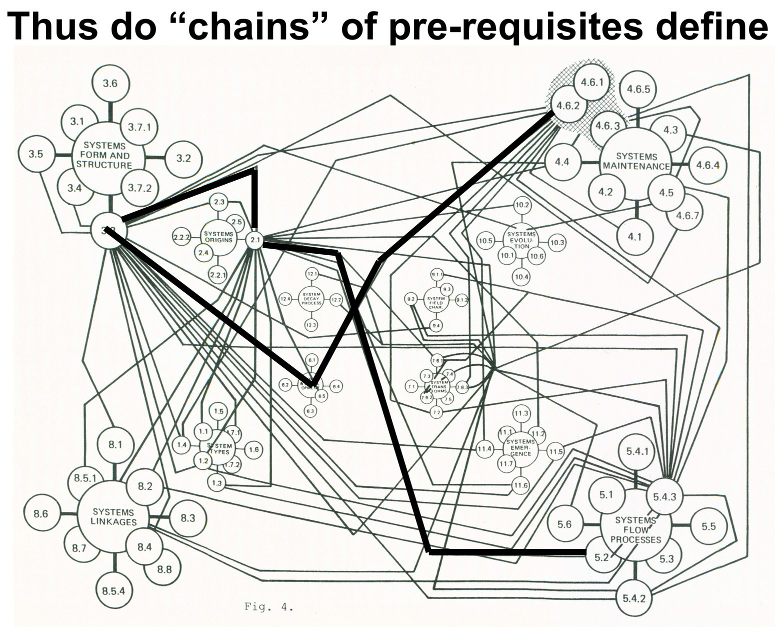




• So a pre-requisite systems process is one whose presence and action is required for the existence and action of a subsequent systems process. If the subsequent systems processes is dependent on the prerequisite process, why are all processes defined in the SoSP as equal? Because the entire set is needed to achieve systems-level stability, complexity, and continued existence and development

Examples of Pre-Requisite Chains

• FLOWS as a systems process are fundamental to a number of other systems processes. Thus "flows" are a "primitive" or "pre-requisite for the others to exist
• INTERACTIONS as a systems process requires flows. One of primitive components of our dimensional universe (material, space, information, energy, number) must be transferred between entities for it to be said that they interact
• BINDING as a systems process requires flows. In most natural and social systems, we say one entity is bound to another due to exchange of parts or sharing of parts. This "exchange" or "sharing" implies a flow between the two entities. E.g. exchanges mark the strong, weak, and nuclear forces in sub-atomic particle physics. In social systems it may be an exchange or sharing of information
• Ergo, FLOWS are a pre-requisite for BINDING or INTERACTIONS
• And then BINDING is fundamental to the EMERGENCE of new scales of HIERARCHY
• Thus do "chains" of pre-requisites define some of the network of SoSP interaction



• The LP's that link the many systems processes together are flows. So each of the lines in the SoSP model are flows; but flows have their own rules and regularities as observed across many manifest systems. So even if a specific LP "line" represents an otherwise characterized influence, it is still also fundamentally a flow.
• This is the nature of a "pre-requisite systems process; it simultaneously underlies other SP's but is itself an SP.
• The bold lines in the regular SoSP iconic map shown at right graphically depict some of the "pre-requisite" chains in the overall map.

• Another example would be COUPLED POSITIVE & NEGATIVE FEEDBACKS which must precede a system exhibiting the SP of CYCLES & OSCILLATIONS
• Another example would be that BOUNDARY CONDITIONS as a systems process are necessary before INPUT and/or OUTPUT processes can be recognized
• The ease with which a few of these "prerequisite chains" have been found indicates to us that there are many others that can be elucidated in future work
• So pre-requisite SP's are used to build the conditions for other SP's and as such become the well-connected nodes of the SoSP model just as certain airport hubs are critical to the air travel system or p53 protein is critical to the cell's metabolome
• It is still an open and debated question in the SoSP model whether or not these pre-requisite chains are a phenomenon of their own or simply one of the classes of Linkage Propositions with special import.

The "Mutuality" Conjecture

• Another outcome of the discussions with students of the Comparative Systems Analysis (CSA) classes during the 2006 academic year was the gradual recognition that as we defined the Identifying Features for any one of the 80+ systems processes, it required that we include other systems processes as ID Features
• This added confidence to our working assumption (stated above) that the SoSP model was a set of equal and interdependent or interlocked mechanisms; many of them required the presence of others of the set in order to exist
• We are calling this the "Mutuality Conjecture." All of the 80+ systems processes are mutually interactive or exhibit mutual influences on each other as a set
• We use "conjecture" here in a manner similar to its use in mathematics; there is some evidence for the intuition, but it has not yet been proven; most systems insights should be described as conjectures in our opinion, not laws
• Too often in the past systems insights have been declared "laws" without adequate proof or demonstration. Examples in our opinion are Ashby's Law and Deutsch's Law which may hold in certain circumstances or certain types of systems, but not all

What are Discinyms?

• "Disci" stands for "disciplines" and "nyms" is the suffix for "synonyms" so discinyms literally means "disciplinary synonyms." We use the standard meaning for "discipline" here such as the Hegis Code of recognized speciaties and knowledge bases
• Everyone knows that synonyms are defined as different words that mean similar things ("syn" together or same, and "nyms" names). So discinyms are words invented by different specialists to name processes discovered in very different systems at different scales using very different techniques but which actually, when abstracted to the systems level, are the same general processes.
• The SoSP invented the word "discinyms" to encourage specialists to perceive and think beyond their specialty training. Not thinking beyond one's specialty is a major obstacle to recognition of general theories of systems (GTS). Reductionist workers accomplish great things, but are very much isolated in their community. By studying different manifest systems, they emphasize the differences over the similarities. Discinyms try to achieve a balance by emphasizing the similarities over the differences.
• Disciplines are composed of loose clusters of much more highly focused specialists. For example, cell biologists may sound like a sub-discipline of biology, but in fact cell biologists work almost entirely confined to one of a hundred or more sub-sub-sub-specialty phenomena. They may work only on mitochondria, or one type of cancer, or microtubules, etc. They have to do this or they could not keep up with the literature for just that one ultra-specialty. So the "stovepipe" concept of rigorously separated departments and disciplines extends even to separations within the disciplines. As science progresses and the immense detail of our knowledge base expands, there will be ever more numbers of "stovepipe" separations to fragment our knowledge. The concept of discinyms is meant to provide another means to express universals that allow re-synthesis of the fragments.

Examples of Discinyms and Insights

• In our demo of the Integrated Science GE educational program based on the SoSP, the box at the right is a dynamic chart. If you click on any of the checks, you are presented with an analysis of the systems process for that column found in the discipline of the row
• We have examined many "case studies" of systems processes in many natural systems, which led us to recognize they often use different words to describe the same general process as below …..

• DISCINYMS	DISCIPLINE
• Homeostasis	Physiology
• Dynamic Equilibrium	Physics/Engineering

• DISCINYMS	DISCIPLINE
• Duality	Many disciplines
• Bifurcation	Chaos Theory
• Counterparity	SoSP

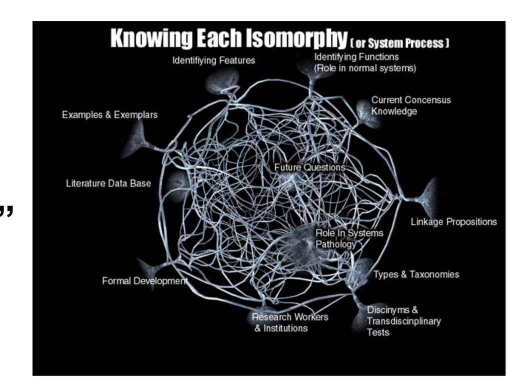
• DISCINYMS	DISCIPLINE
• Up-Regulation	Cell & Molecular Biology
• Positive Feedback	Systems Biology or Theory
• Down-Regulation	Cell & Molecular Biology
• Negative Feedback	Systems Biology or Theory
• Regulation/Homeobox	Developmental Biology
• Circular causality	Engineering

• DISCINYMS	DISCIPLINE
• Self-Criticality	Materials/Physics
• Bifurcations	Chaos Theory
• Phase Transitions	Physics/Chemistry
• Tipping Points	Sociology/Econ
• Catastrophes	Mathematics

• DISCINYMS	DISCIPLINE
• Hierarchy	Biology/Physiology
• Clustered Network	Category/Net Theory
• Subsumption	Reductionist NS's
• Clustering	Astronomy/Statistics
• Emergent Scales	Natural Sciences

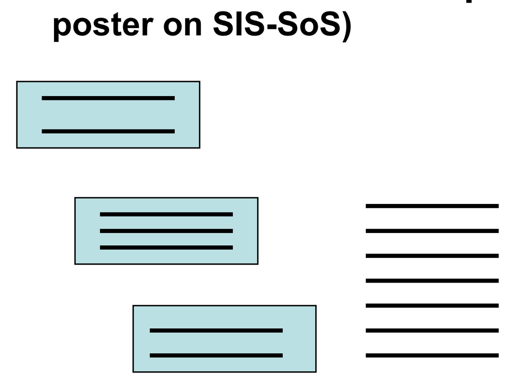
• DISCINYMS	DISCIPLINE
• Autocatalysis	Biochemistry/Cell Bio
• Autopoiesis	Systems Theory
• Self-organization	Many natural science
• Crystalization	Geology
• Self-Assembly	Chemistry
• Morphogenesis	Developmental Bio

• GENSYSML is building a number of similar "translational" lists
•A similar problem arises between different candidate systems theories or different schools of thought in systems theory
• For example, Forrester's Systems Dynamic's group uses the term "closed" system for the circular nature of any feedback, but "closed" has an entirely different meaning in most other systems theories
• The only recourse is building a large database (GENSYSML?) that gathers lots of data on each putative isomorphy as shown at right …



Key Discriminations in the SoSP Model

• Our CSA classes this academic year also discussed and extended the observation in past papers that much of the work in systems theory was conflating or mixing together phenomenon that were possibly quite distinct
• In the SoSP, it is considered self-defeating to not clearly distinguish some processes because it makes it impossible to approach their empirical verification or extension (see poster on SIS-SoS)



• Consider the key problem of finding a way to "discover" the real clusters or "hierarchical levels" in a natural system covered in a series of our Institute papers. Empirical approaches are hampered by confusion between two different types of hierarchical level in our opinion. Sub-specialization levels appear after the emergence of a new scale of entity, while the emergence process is responsible for appearance of the new scale as shown in the cartoon at left. The blue box levels result from emergence processes. Once in existence, forces favor subspecialization by another process resulting in the bold line levels. We humans come later to observe and erroneously define a hierarchy of bold lines as one sequence and due to one process

• Emergence is very popular at present. But the term is often used in ways that mix its meaning with terms like "evolution" or at least "punctuated evolution" as well as a host of other terms such as "origins" and "self-organization"
• In the SoSP each of these terms is considered a different systems process with distinct differences in process and outcome

Functional Significance of Discriminations to SoSP Research

• These discriminations help in the quasi-empirical research and methods practices for elucidation of the SoSP
• Any effort to characterize the "gaps" between emergent levels is frustrated by the conflation of different types of levels arising from different processes just described
• If emergence is left at the popular definition level of merely the appearance of a new quality, it encompasses too wide a range of real examples to find a theory to explain all of the range
• But if it is defined as only applicable to those unique cases where a "new scale of entity" (definable in measurable magnitudes and statistics) with an entirely new organizational plan (definable as appearance of wholly new binding & interaction processes), then the far more restricted set can better yield to empirical analysis
• The conscious recognition and cataloguing of "discinyms" could help those interested in finding universals communicate better
• For those working on "systems of systems problems", the new field within the military and systems engineering communities, recognition of discinyms may help recognize parts of different modeling tools, techniques, and simulations relate to each other; how they can be translated into and directly communicate with each other
• When applied to systems theory and the concept of a hierarchy of ever more abstract & more encompassing or universal models, discinyms and discriminations would help relating the more general models to specific disciplines and domain problems