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Functional Clustering of SoSP Systems Processes Proposing a General Systems "LifeCycle"

1. Problem Statement:

• Too many ideas to fit in your head……………………….?

• Users of the SoSP general theory of systems have requested simplification of the number and complexity of the alphabetical listing of 100+ systems processes. Previous papers reduced the complexity by hierarchical clustering of similar or more intensely linked systems processes. (see e.g. Poster # , this session)

• This poster presents five additional strategies to meaningfully organize & manage the long list of isomorphic processes to satisfy that expressed need.

2. Systems Biology: Clustering Protein Interactions

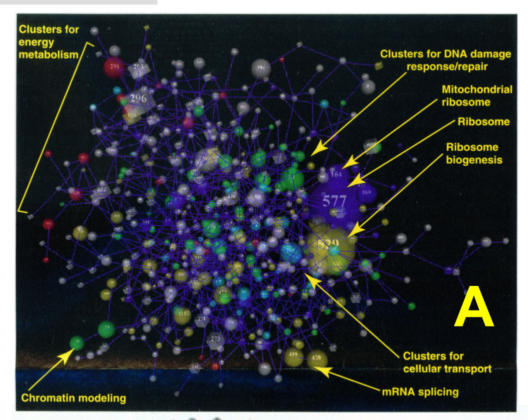
• The explosion of activity in the new field of Systems Biology provides an example of how to handle more data on networks of processes than human minds can handle.

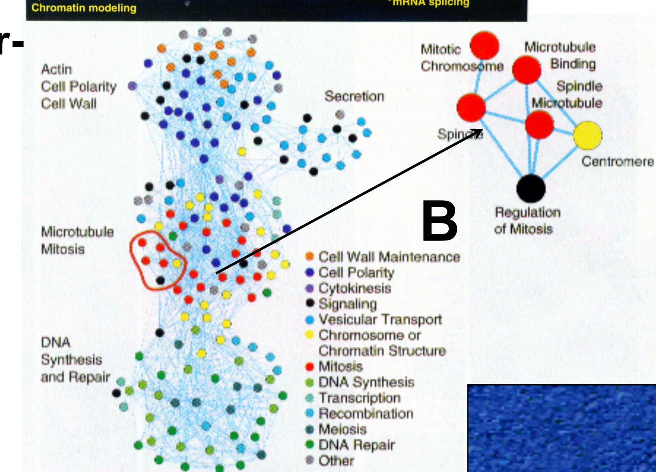
• Massive amounts of high-throughput data from current techniques (microarrays) uses computer analysis tools to render their very detailed output more understandable.

• The pictures at right are networks of real interactions between known gene/proteins proven by molecular tech's. Each ball represents one product; each line a specific interaction; the map is very similar to the Linkage Propositions (lines) that represent influences between Systems Processes (spheres) in SoSP lifecycle graphics below.

• Graphic A shows hundreds of yeast cell genes that work with each other. Those that interact the most intensely to accomplish a particular cell function are grouped in larger spheres and so labeled. This reduces the map complexity.

• Graphic B shows many genes responsible for key cell activities. They are grouped by function as shown (arrow).





3. Clustering of Systems Processes by Function

• The SoSP can use the same strategy. By study of the systems literature, we can propose how systems processes (SP's) participate TOGETHER in multiple sets to do particular, key systems functions, as follows:
  • For example, empirical studies of natural systems indicates that the SP's that are responsible for systems form and structure include:
    • Heteropoiesis (hierarchy generation); fractal producing processes; duality producing processes; development processes, and more
  • Those studies also suggest that SP's that cause dynamic equilibrium include:
    • Coupled (+) & (-) feedbacks; oscillations; flows, and more.

• Grouping of several SP's into a single cluster reduces the overall appearance of complexity in the SoSP mapping just as it does for genes/proteins in Systems Biol.

4. Prerequisite Relations Among Systems Processes

• Some SP's are more fundamental than others. That is, a particular SP may be based on the existence of others before it can manifest itself. We have termed these "prerequisite" in the sense that they are required in the natural evolution or emergence of natural systems (and presumably social systems).
  • For example, all "feedback" types, & all "cycle" types are dependent first on the SP "flows"; healthy flows must exist in a manifest system before they can be optimized or transformed into these particular kinds of other SP's.
  • The SP "dynamic equilibrium" is likewise dependent on having healthy positive and negative feedbacks that are coupled in definable ways (a SoSP motif)
  • Clustering prerequisites would also reduce SoSP complexity as well as reveal important dynamic relations between SP's for teaching & application.

5. Emergent Elaborations of Systems Processes

• After discussions of the problem in our on-line, distanced-learning GenSystems GSRDC Workshops, some students of SoSP have suggested that still another possibility is that some SP's in the long list are actually derivatives of others in the sense that they were present in more primitive form in more ancient or previous scales of the unbroken sequence of origins (see at bottom left).
  • For example, Friendshuh (pers. comm.) suggests that what the SoSP names as systems developmental processes and systems evolution processes are actually just different forms of feedback with different time dimensions.
  • Or that systems development processes are just a form of self-organization.

• While the SoSP prefers the greater detail of the stand-alone processes to help ID Linkage Propositions, clustering SP's emergent from others would also reduce SoSP complexity and increase usability. Both organizations have unique utility.

6. Learning Prerequisites on Systems Processes

• Efforts to teach the SoSP in the past to graduate students, young professors, and even seven classes of undergraduates (see ISGE Poster # , this session) have proven that solid knowledge of some SP's is needed before others can be understood.
  • For example, positive and negative feedbacks have to be understood as well as their "coupling" into balanced pairs before students can understand oscillations.
  • For example, "states/phases" has to be understood before one can know systems development & both system variation and development processes before one can adequately understand systems evolution processes.
  • Again, the grouping of the 100+ SP's simplifies the model; makes it usable.

7. Stages of a Proposed General Systems Lifecycle

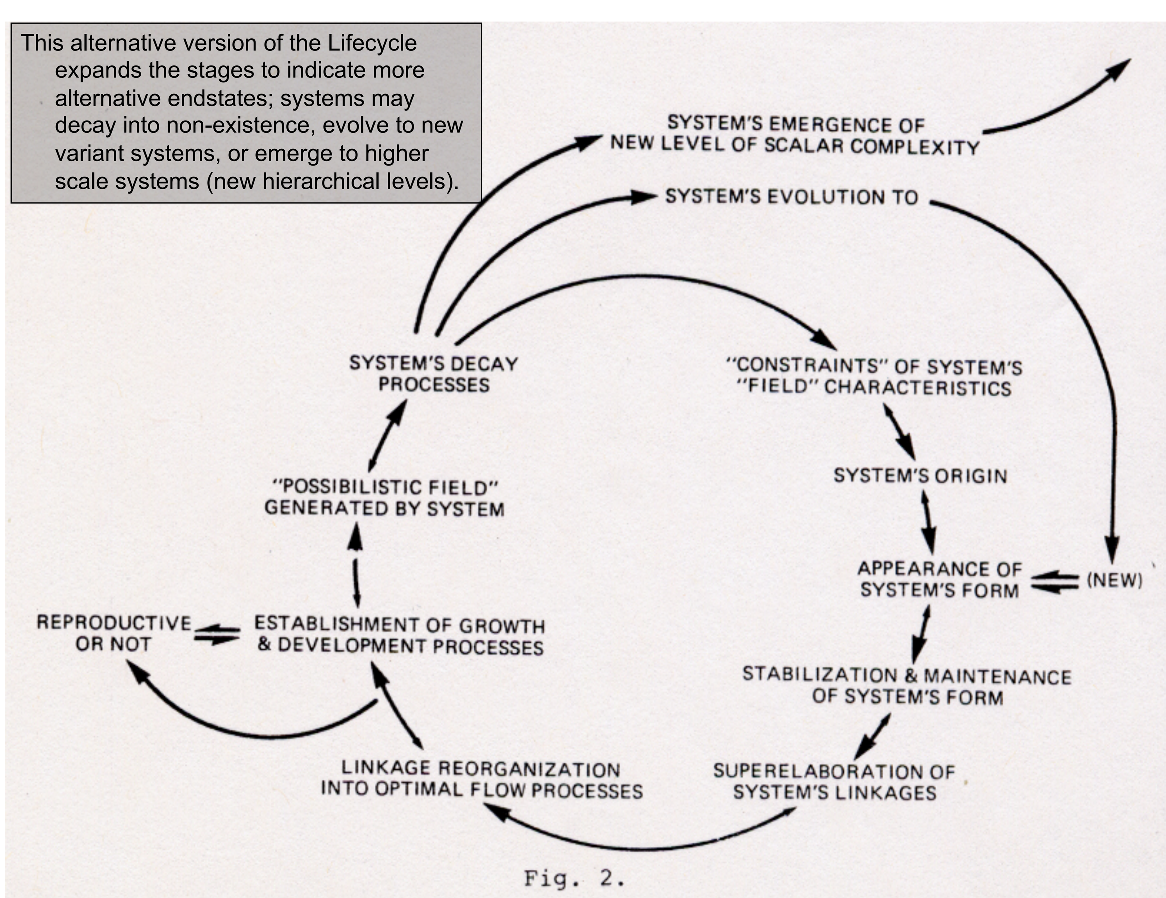
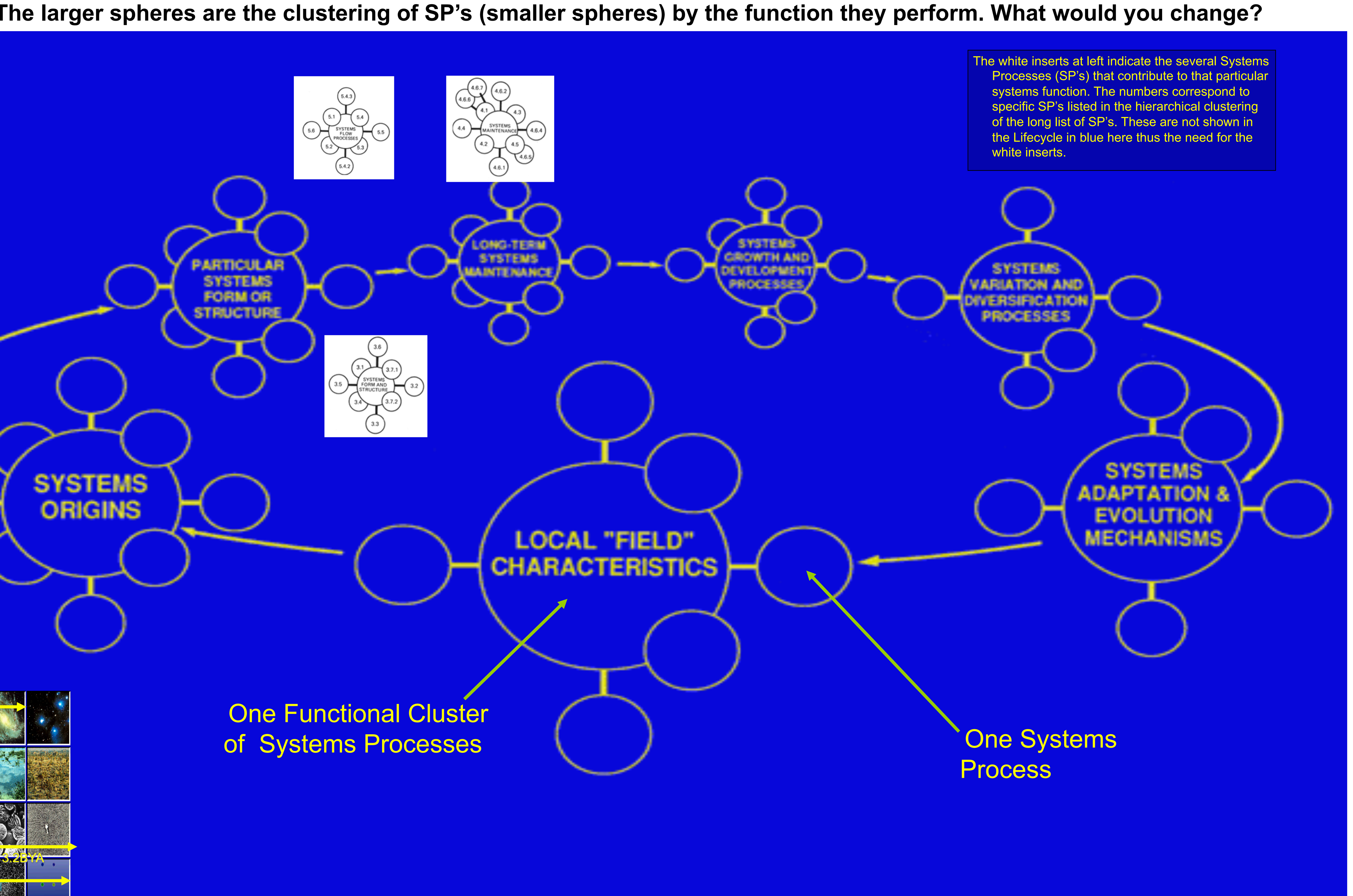


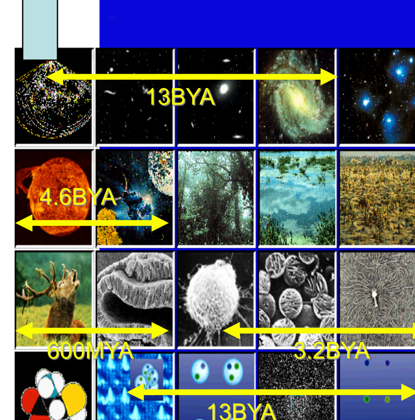
Fig. 2.

• GS LIFECYCLE1: Perhaps the most useful way of ordering the large number of SP's is to try to discover whether or not they are ordered in time. Do certain SP's follow each other in obligate sequence during the "life" of many manifest systems? This would add a new increment of knowledge beyond the SoSP that is of significance to understanding systems complexity, systems pathology, and the unbroken sequence of origins from physical to living to social systems (see SoSP I/F Cycles Poster # , this session). Below & to the left are two versions of such a GS Lifecycle. The larger spheres are the clustering of SP's (smaller spheres) by the function they perform. What would you change?

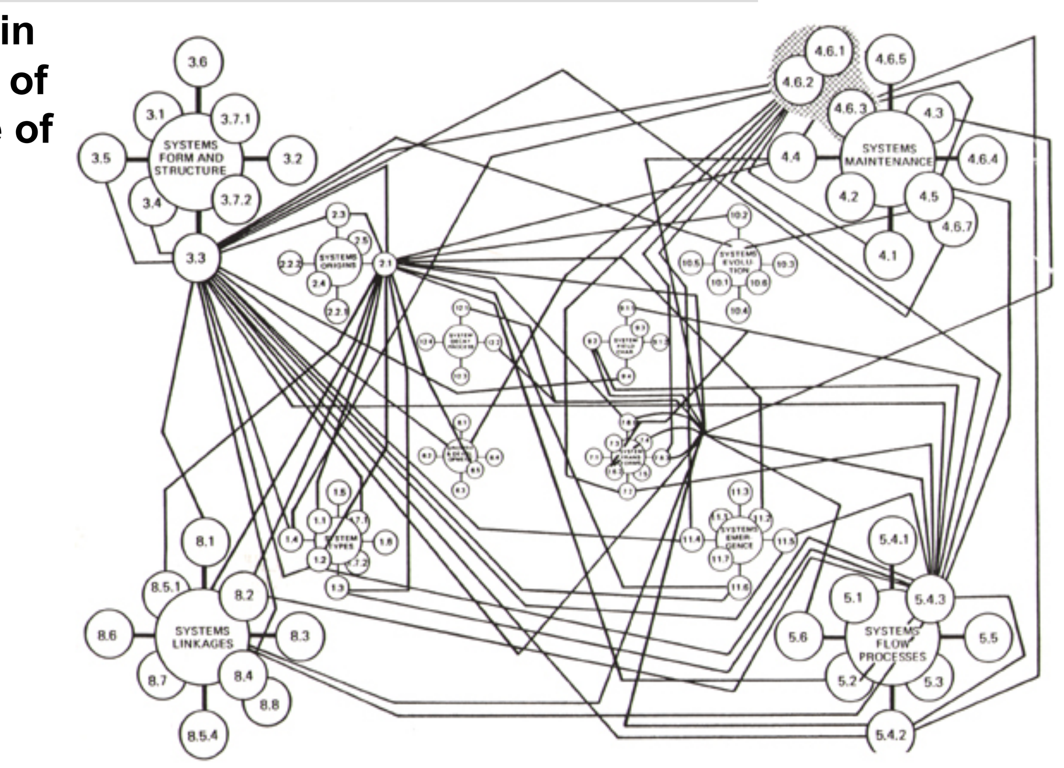


• GS LIFECYCLE2: Several versions of a GS Lifecycle will appear while many questions are addressed. The version at the right was the initial attempt to place the hierarchical list of SP's found by asking which "general function" each SP fulfilled (in the many compared manifest systems) into the temporal order of their action or succession.

• The one above expanded the concept of "field" SP's (not considered in much of conventional science) to "constraint" as well as "possibility" fields and related these to a symmetry breaking mechanism and the SoSP process theory of emergence of new levels.
  • The insert at bottom left is a matrix of 20 such emergent levels of the natural scalar hierarchy that represents the unbroken sequence of origins from physical to living systems (social not shown). Size in the hierarchy proceeds from bottom right to top left, both extremes proceed to the middle to generate social systems from the organism level. Note dramatically different origin times show the latter pattern.



7. SP's Assigned to Stages of Development...



• Previous graphic representations of the SoSP showed each SP as a numbered small spheres as above. The numbers corresponded to the number assigned to each in the hierarchically clustered list of 80 SP's at that time. Names would not fit on a summary graphic like this. Each iine represented a specific Linkage Proposition (LP) that denoted the influence of one specific SP on another to give a System of Systems Processes.
  • For example, the above depicts 64 very specific Linkage Propositions taken from the systems and natural science literatures between 33 Systems Processes contributing to 5 key systems functions.
  • BUT these systems functions are arranged in an arbitrary manner in the above mapping.
  • NOTE THEN that the "net" of Linkage Propositions as shown above would also be retained in the graphic of the GS LifeCycle shown at left. It would be a directed graph still retaining the many inter-connections of the network mapping above.
  • A cycle and a web simultaneously. The SoSP.