Systems Processes Theory (SPT) and Sustainability: V. Application of Synergy to Regenerative Farming Systems

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Introduction

Modern agricultural systems in America have developed in such a manner that they no longer respond well to market pressure in terms of price points or consumer demand due to additional external influences. The standardization and mechanization required for the massive scale on which industrial agriculture is conducted means that all systems within the field are influenced in the direction of homogeneity. This destroys the synergy of any system, as the synergetic process both requires and creates novelty. It is this perpetual introduction of variety that allows a synergistic system to adapt and evolve over time. A sustainable farm can demonstrate synergy through its social, economic and geologic systems in order to regenerate its process, that of providing food, into perpetuity.

Systems Science and Sustainability

•Synergy is the process by which multiple elements work together to create a system that is more than the sum of the individual elements alone. All functional systems have synergy, and it is often what is lacking in unsustainable, manmade systems.

•Sustainable design requires an understanding of how elements ought to work together in order to create synergy. This provides not only a robust system, but also one capable of adaptation because synergy creates emergent properties.

•Synergy is also crucial to understanding environmental problems, such as global warming, that operate under the principle of the whole being greater than the sum of the parts. Rather than parsing the specific elements that contribute to global warming and addressing them individually, environmentalists or those creating environmental models must seek to understand how all of these elements work together to create a global catastrophe.

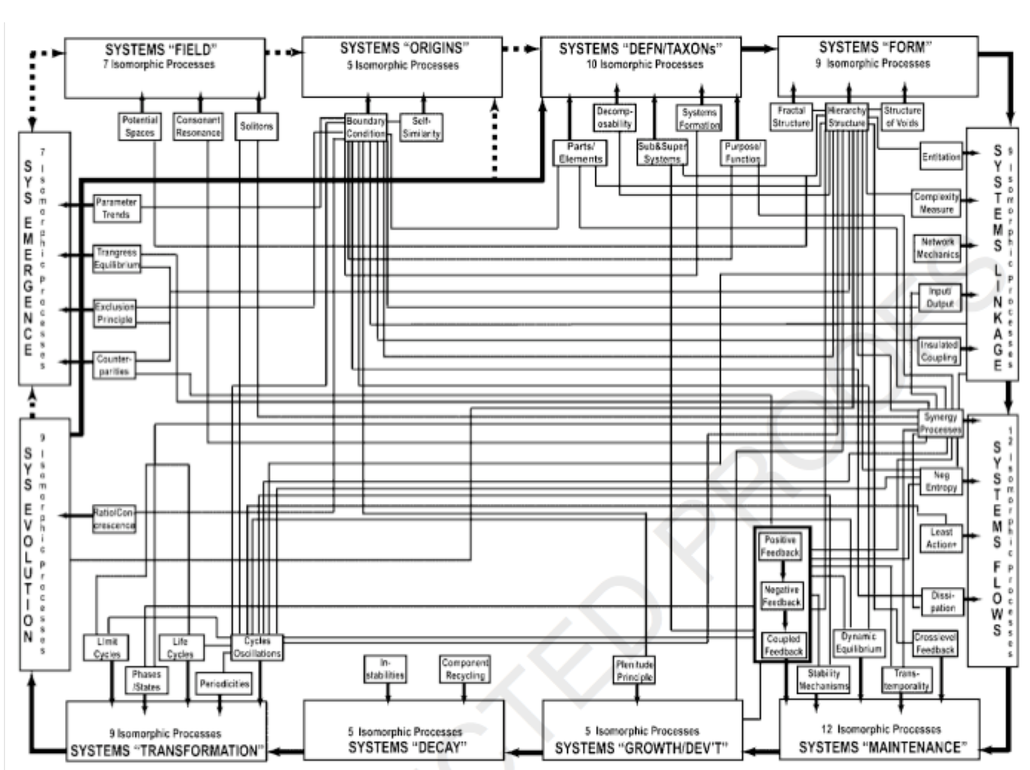


Figure 2. Network map showing ~85 linkage propositions between five isomorphic processes and the 42 systems processes and the with which they experience mutual influences

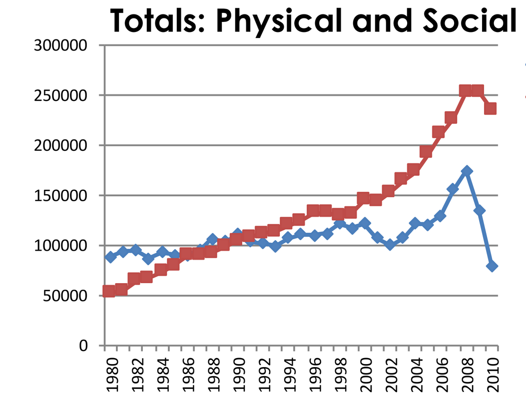
•Systems Processes (SP) are the fundamental unit of a system, and generalized systems theories need to be based upon them. Over 100 SPs have been recognized.

•SPs are axiomatic, meaning their existence precedes their manifestation in an actual system, and they describe the mechanics of how a system works.

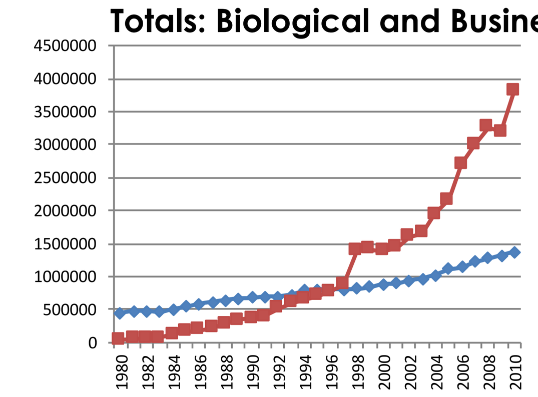
•This course covered the SPs of hierarchies, flows, cycles, networks, feedbacks, innovation mechanisms, origins, and self-organization.

•The diagram above shows 42 systems processes and their mutually influential relationships with five isomorphic processes.

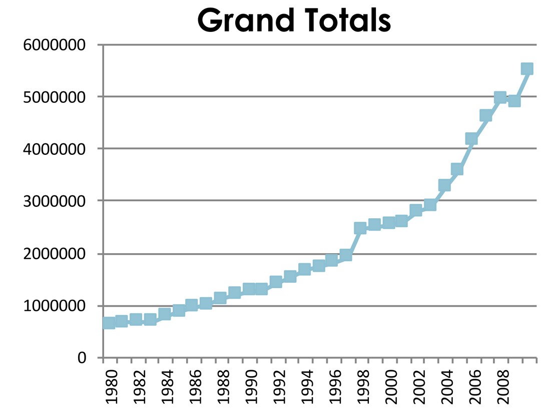
Trends in Literature



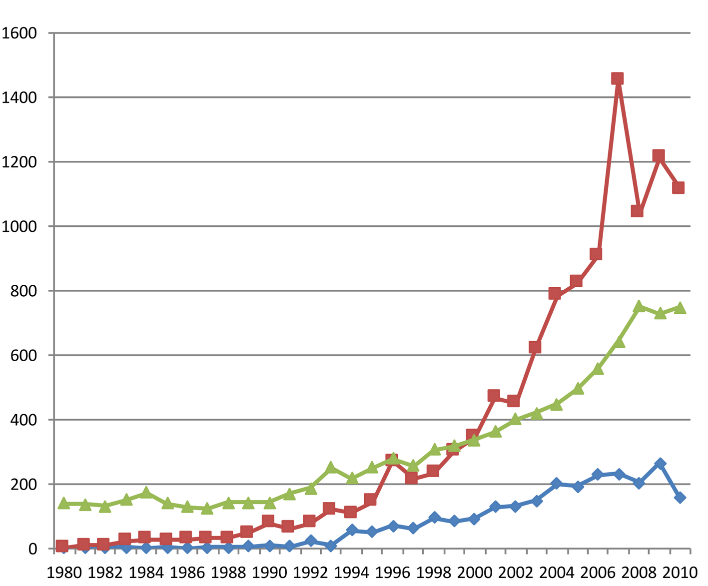
•1980-2010
•All systems processes in two smallest database types
•Recent drop-off trend represents an anomaly
•Both show an increased slope in the 2000s



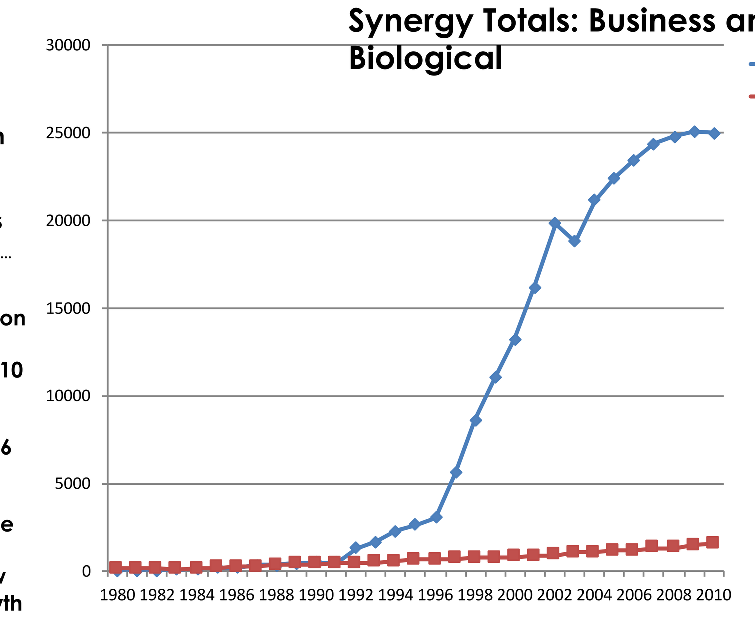
•1980-2010
•All systems processes in two largest database types
•Biological domain increases steadily
•Business domain shows exponential increase in 2000s



•1980-2010
•A total of 68 million articles were searched across 10 databases
•Yearly averages ranged from 1 to 6 million
•Trends are arithmetic until the early 2000s, and then tend to show exponential growth



•Search term: "Synergy"
•Psychical Systems total: 2,480 (smallest)
•Engineering total: 11,084
•Social Systems total: 9.855
•Engineering show sharpest upward trend in recent decade
•Physical systems underrepresented compared to overall totals



•Search term: "Synergy"
•Business total: 246,487 (largest)
•Biological systems total: 21,047
•Business trend shows sharper initial increase than overall totals, but begins to level out in the second half of the 2000s
•Biological systems are underrepresented as compared to overall totals

Systems Models

Adapted from a model by Howard T. Odum.
Odum, H.T. (1983). *Systems ecology: an introduction*. New York, NY: John Wiley & Sons Inc.

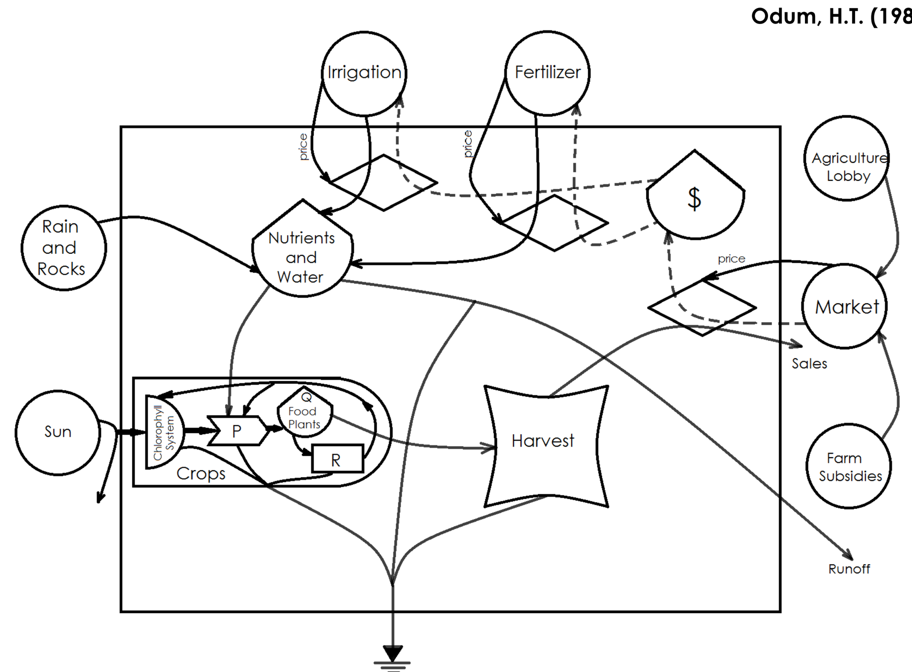


Figure 1: Factory Farm Model

•Intensive farming methods necessitate additional external inputs (irrigation and fertilizer)
•Runoff and heat sinks are increased and of a lower quality
•External social forces (lobbies and subsidies) are shown as energy sources
•Market does not act under free market rules
•Money aggregates and remains in storage
•Synergy is lacking because of removal of market responsiveness, need for external inputs, and unresolved outputs

•Internally managed farming techniques (composting and polyculture) reduce the need for external inputs
•Runoff and heat sinks are reduced and of a higher quality
•Capital flows freely through market
•Synergy exists in economic, social and geologic systems

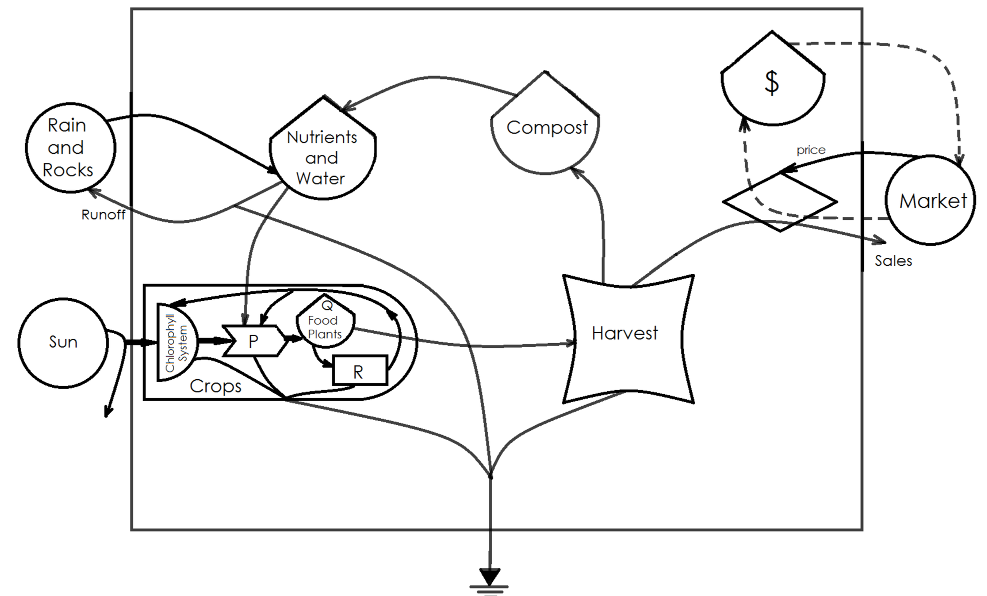


Figure 2: Traditional Farm Model

Applications

•Synergistic systems require plurality because the interactions among many parts creates novelty, which leads to emergence. The emergence of new entities allows systems to adapt over time, allowing them to be sustained. By raising a variety of plants and animals, the farmer is able to create new farming subsystems that reinforce the strength and health of the farm.

•The relationship between synergy and adaptation can be seen in any system, from an ecosystem to the free market economy. It can be said that the effect of adaptation, a system changing in response to its surroundings, is the added value of synergy beyond the value of its component parts.

•Just as with natural systems, engineered systems must recycle their waste back into an input in order to create synergy. This allows the system to be self-regenerating, which is necessary if the adaptive process is to continue indefinitely. This is a more longsighted view of sustainability, as the gene pool, rather than the entity is maintained over time.

•Synergy can produce both "positive" and "negative" effects in that it simply implies a mutual relationship. This can be beneficial, as with group cohesion synergy, or harmful, as with the enhanced effects of drugs as a result of chemical synergy.

•Synergy first gained popularity as a topic of research in business, where globalization made it a popular buzzword to describe ever-converging economic entities. Recently, engineering has shown the greatest upward trend in research, primarily due to increased interest in creating synergetic systems that possess many of the qualities described above.

•Very few articles exist regarding both synergy and sustainability, which points to a lack of research in this critical area of overlap.

ISSS/INCOSE

•INCOSE (the International Council on Systems Engineering) and ISSS (the International Society for Systems Science) have entered into a formal partnership which will facilitate the study of systems science. The cooperation between the two groups will allow a knowledge base to be developed for members of both fields.

•Representatives from both organizations have met in Arizona, Canada and England to outline and create these shared learning opportunities. The SSWG (Systems Science Working Group) has chosen four to five official projects to pursue.

•This poster serves as an example of a multi-disciplinary project, as several graduate students from systems science, systems engineering, sustainability, and other related fields contributed their unique literature surveys on a variety of systems processes. This cross-boundary cooperation benefits all participants, as well as their respective fields.

Conclusions

•Synergy is an important consideration for sustainability studies because it represents the capacity of a system to generate emergent behavior, which is essential to producing adaptive qualities. It is only via adapting to changing situations that gene pools can be perpetuated indefinitely, and sustainable systems must do the same.

•Including regenerative models into sustainable systems is a means of creating synergy, as the recycling of materials and flows creates system boundaries such that it is able to continuously cycle indefinitely.

References

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