## Systems Thinking for Sustainability

Contrasting different perspectives

Thomas P Seager, Arizona State University

<u>Thomas.Seager@asu.edu</u>

@seagertp

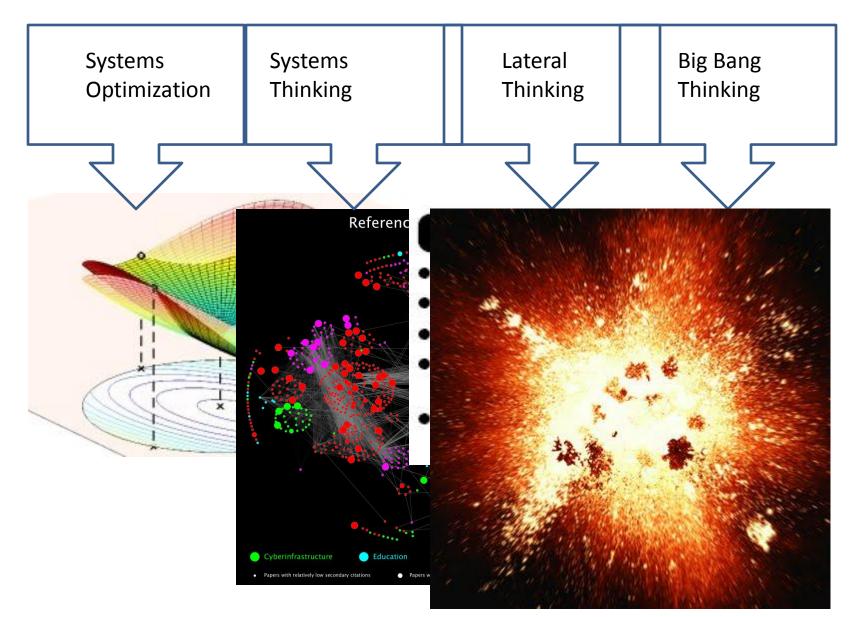
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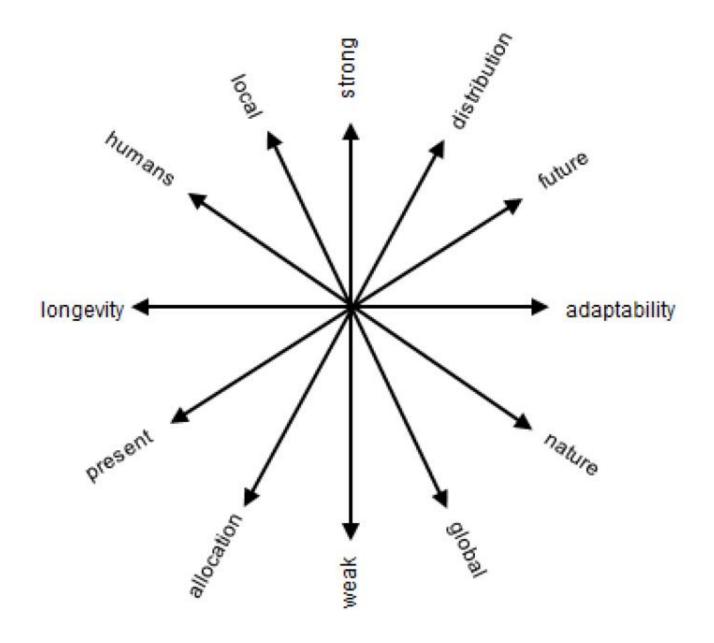


ECOLOGY individual survival predation, disease, reproduction, recovery, extinction, mutation, strategies natural selection regrowth evolution SUSTAINABILITY SPECTRUM **SECURITY** RELIABILITY RESILIENCE RENEWAL OUSTRY strategic forecasting & Schumpeter's "creative law enforcement, military failure & risk analysis, destruction", disruptive planning, disaster or & protection services quality management innovation D&D risis response ANTI-FRAGILE **FRAGILE ROBUST** steady-state: episoaic: genesis, CHANG static: preservation of dynamic: cyclic or preservation of growth, stasis, release pseudo steady-state status quo function and renewal FUNCTION temporary loss of impinges on function or maximize current function evolves function service functionality mitigation of or INJURY injury may change prevention or rapid recovery from replacement of loss to evolutionary path, result minimization of loss injury enhance functionality in new functions MECHANISMS redundancy, detection, remanufacture, repair, protection, armoring innovation preventative maintence regrowth

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Table 1: Science & Technology Orientations Towards Sustainability

		Attitude towards Technology	Focus	Expert & Ethical Culture	Approach to Complexity	Approach to Conflicting Views
BUSINESS-AS- USUAL		Optimism	Creating new things, resources. Ignores scale & efficiency.	Depth in a single sub-discipline. Professional ethics.	Simplification & reduction	Defense of techno- industrial ethos. Denial of opposing perspectives.
SYSTEMS ENGINEERING	Engineering within ecological constraints	Pragmatism	Cost optimization of maturing technology. Ignores scale.	Compart- mentalized, multi-disciplinary teams. Social ethics.	Cost-benefit optimization & efficiency	Litigation & regulation
	Sustainable engineering		Optimization for triple bottom line. Ignores scale.		Risk minimization	Structured participation
SUSTAINABLE ENGINEERING SCIENCE		Skepticism	Sustainability as a wicked problem.	Interactional expertise. Macro ethics.	Anticipation, Adaptation & resilience	Cooperation & deliberation