Predictive Analytics, Generative AI, and Intelligence Augmentation in Socio-Technical Systems:
Root Metaphors, Automation, Embodiment, and the Partitioning of Autonomy

David Ing

OCAD University, Toronto, Canada +
International Society for the Systems Sciences

Hellenic Society for Systemic Studies (HSSS)
22nd National & International Conference
University of Peloponnese
October, 2025

Image CC-BY Mike Cassano (2009) *Most Interesting Pothole*

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Agenda

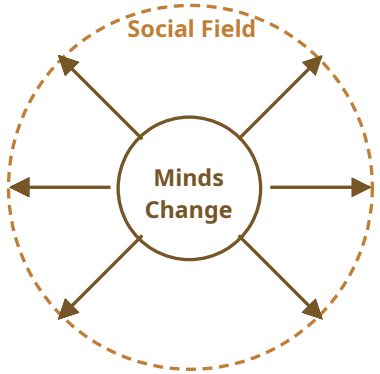
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The Tavistock Institute codeveloped three systems perspectives

Socio-Psychological Systems Perspective

Psychological Forces → Social Field



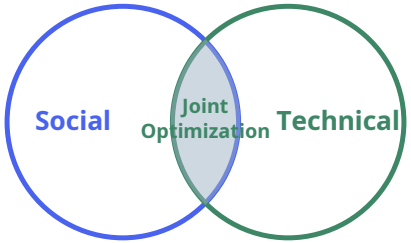
Contrast: The Clinic



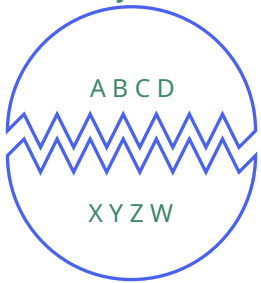
Social Forces → Psychological Field

Socio-Technical Systems Perspective

Joint Optimization & DP2

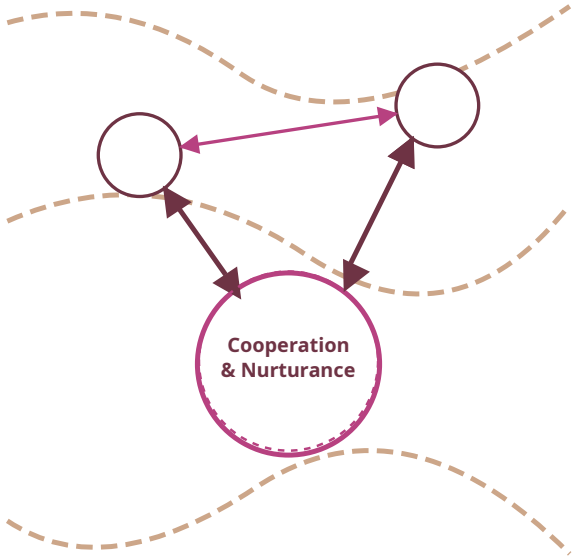


Redundancy of Functions



Socio-Ecological Systems Perspective

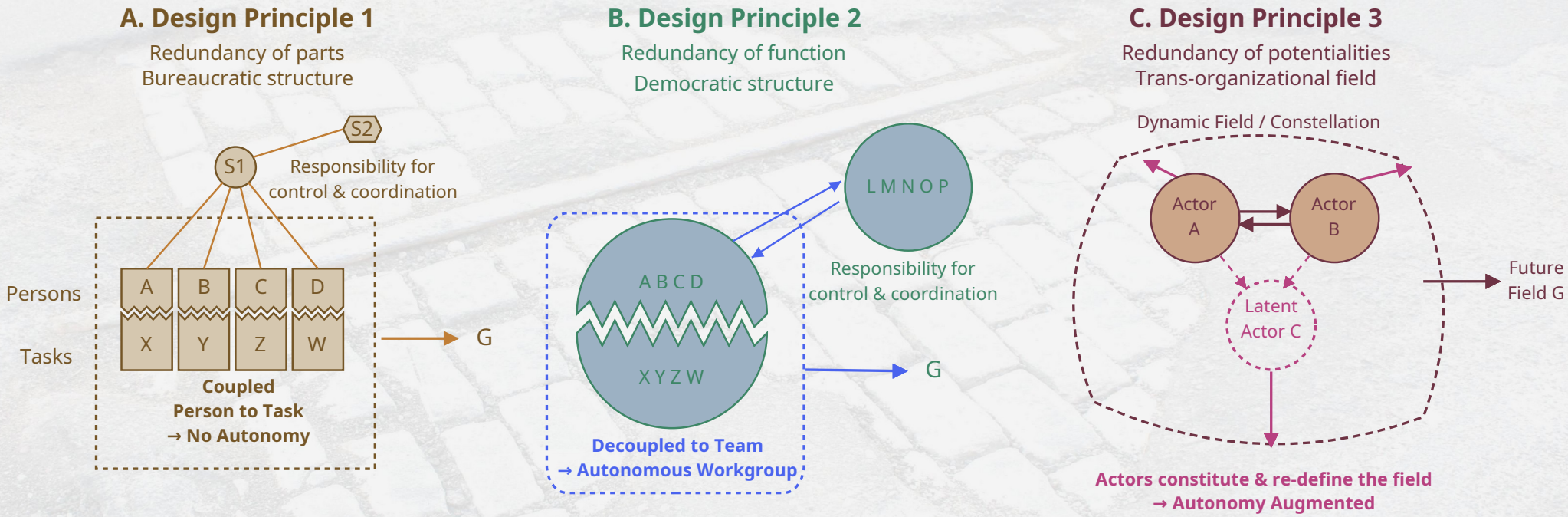
Interdependence & Complexity



Trist, Eric L., and Hugh Murray. 1997. “Historical Overview: The Foundation and Development of the Tavistock Institute to 1989.” In *The Social Engagement of Social Science: The Socio-Ecological Perspective*, edited by Eric L. Trist, Frederick Edmund Emery, and Hugh Murray, 3:1–35. Philadelphia: University of Pennsylvania Press.

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The Socio-Technical Systems perspective sees alternative forms for organizing people with machines, as DP1, DP2 or DP3



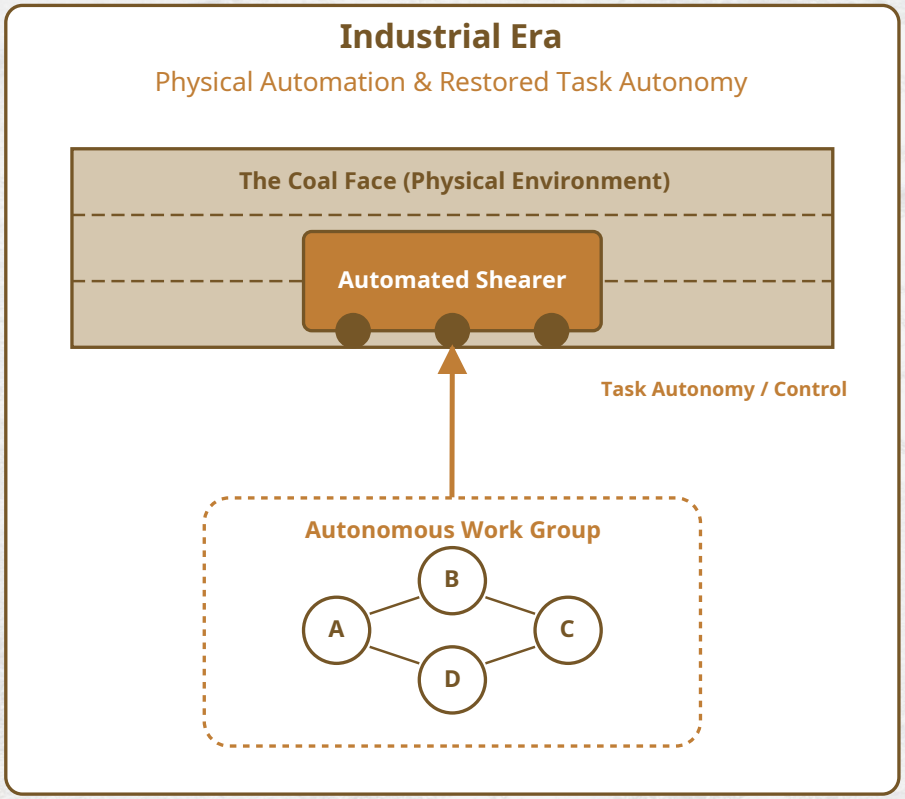
Emery, F. E. (1993). The Second Design Principle: Participation and the Democratization of Work. In E. L. Trist & H. Murray (Eds.), *The Social Engagement of Social Science*: 2 The Socio-Technical Perspective (Project MUSE, Vols. 1–3, pp. 214–233). University of Pennsylvania Press. https://muse.jhu.edu/chapter/1775948

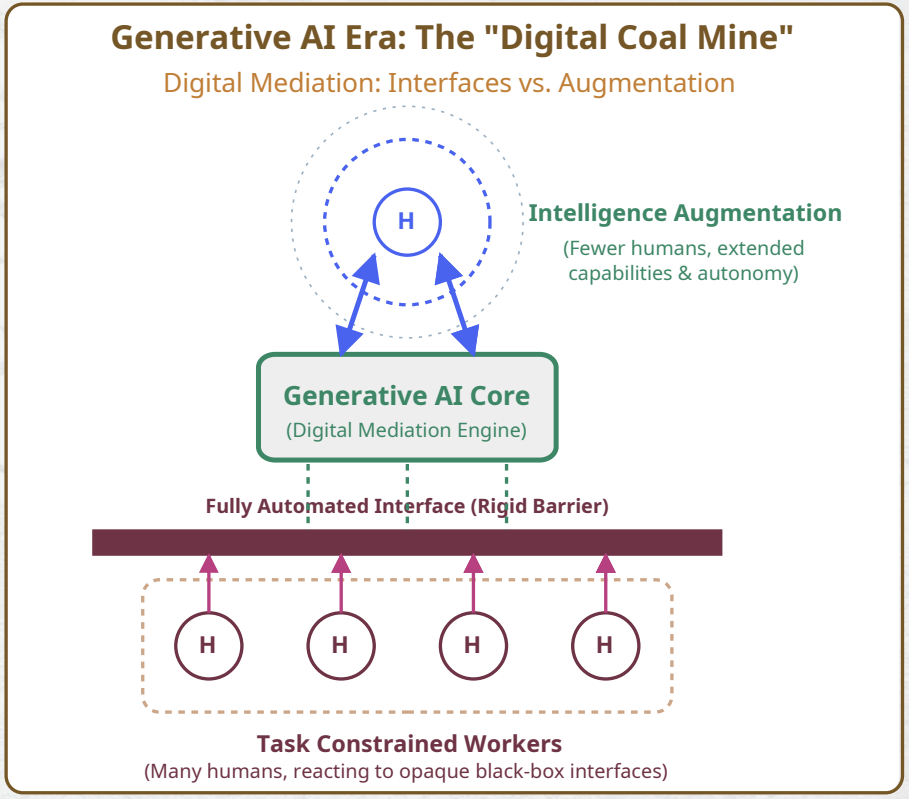
Selsky, J. W., Ramírez, R., & Babüroğlu, O. N. (2013). Collaborative Capability Design: Redundancy of Potentialities. *Systemic Practice and Action Research*, 26(5), 377–395. https://doi.org/10.1007/s11213-012-9257-5

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A. STS, SES, SPS (page 3 of 3) …

While STS matured in the industrial era of physical machines, the Internet and service systems raise challenges of "digital coal mines"





Austrom, D., & Ordowich, C. (2019). Calvin Pava. In D. B. Szabla, W. A. Pasmore, M. A. Barnes, & A. N. Gipson (Eds.), *The Palgrave Handbook of Organizational Change Thinkers* (pp. 1–31). Palgrave Macmillan. https://doi.org/10.1007/978-3-319-49820-1_104-1

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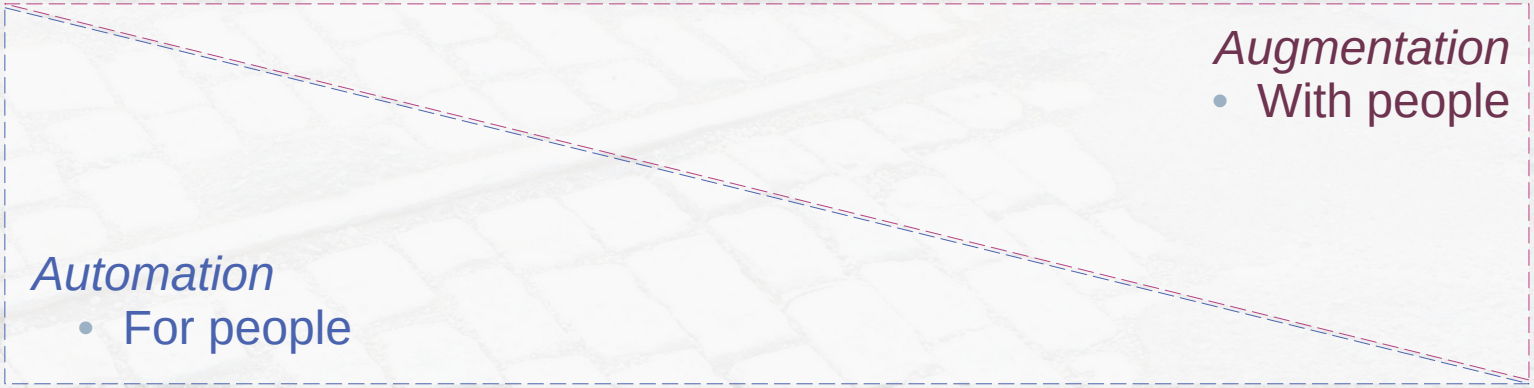
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Three Computing Traditions Are Reshaping Socio-Technical Systems

	Predictive Analytics	*Generative AI*	*Intelligence Augmentation*
	What is likely to happen?	What can be represented?	How can capability improve?
	Prediction	Generation	Augmentation
	Forecasting	Content as text, images, audio, video	Learning, judgement, coordination
Transportation	Collision prediction	Simulation, route generation	Driver assistance
Multimedia Journalism	Clusters, segments	Story production (audio, video)	Surfacing hidden patterns

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Choices About Automation and Augmentation Become Questions About How Autonomy Is Partitioned



Transportation	Automated routing and approvals	Copiloting, dynamic analysis of conditions
Multimedia Journalism	Transcribing, tagging, translating, summarizing	Brainstorming, finding angles, reorganizing

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C. Root Metaphor Theory (page 1 of 4) …

Pepper described six world hypotheses, of which four were judged to be relatively adequate with sufficient precision and scope

	Dispersive manner for organizing evidence	***Integrative*** manner for organizing evidence
Analytic mode of reasoning	**Formism** *Root metaphor*: **Similarity**, as recurrence or recognizable features *Example*: An oak tree, while conditions may vary so each is distorted from the norm	**Mechanism** *Root metaphor*: **Machine**, where exerting force or energy produces predictable outcomes *Example*: A tree stump puller, with a lever (bar with fulcrum)
Synthetic mode of reasoning	**Contextualism** *Root metaphor*: **Situation**, as a historic event in its living actuality *Example*: A live performance with a solo improvisation by a musician with band members co-responding	**Organicism** *Root metaphor*: **Constructive Development**, with orderliness of changes from stage to stage *Example*: A living being with a progressive experience continuing as an integrated whole

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The features of the four world hypotheses underscore distinctiveness in the appreciation of coherent systems types

	Dispersive manner for organizing evidence	***Integrative*** manner for organizing evidence
Analytic mode of reasoning	**Formism** *Root metaphor*: **Similarity**, as recurrence or recognizable features *Theory of truth*: **Correspondence** between (an) instance(s) and a likened ideal *Categories*: **Characterizations** (of qualities and relations) *Nature of time*: **Universal or irrelevant**.	**Mechanism** *Root metaphor*: **Machine**, where exerting force or energy produces predictable outcomes *Theory of truth*: **Causal adjustment** to a mature nominalism (i.e. named response to stimulus) *Categories*: **Primary qualities** (effectual aspects) and **secondary perception** (symbols in the mind) *Nature of time*: **Schematic time** as location (linear and dimensional)
Synthetic mode of reasoning	**Contextualism** *Root metaphor*: **Situation**, as a historic event in its living actuality *Theory of truth*: **Operationalism**, via qualitative confirmation of solving a specific problem *Categories*: **Strands, texture, quality, novelty** *Nature of time*: **Qualitative duration**, **event** relative to a specious present	**Organicism** *Root metaphor*: **Constructive Development**, with orderliness of changes from stage to stage *Theory of truth::*: **Coherence**, where fragments cohere with their nexus, free of contradiction *Categories*: **Progression** (steps), **final outcome** (ideal) *Nature of time*: **Directional arrow**, successive integrations

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C. Root Metaphor Theory (page 3 of 4) …

The analytic-synthetic modes and dispersive-integrative manners are ontologically grounded in the stability of Western substance philosophy

	Dispersive manner for organizing evidence	***Integrative*** manner for organizing evidence
Analytic mode of reasoning	**Formism** *Root metaphor*: **Similarity**, as recurrence or recognizable features	**Mechanism** *Root metaphor*: **Machine**, where exerting force or energy produces predictable outcomes
Synthetic mode of reasoning	**Contextualism** *Root metaphor*: **Situation**, as a historic event in its living actuality	**Organicism** *Root metaphor*: **Constructive Development**, with orderliness of changes from stage to stage

	Dispersive manner for organizing evidence	***Integrative*** manner for organizing evidence
Analytic mode of reasoning	**Formism** **Analytic**: parts in relations are presumed; each whole is inferred. **Dispersive**: unpredictability (non-determinism) is presumed; determinate order is denied.	**Mechanism** **Analytic**: parts in relations are presumed; each whole is inferred. **Integrative**: determinate order is presumed; unpredictability (non-determinism) is denied.
Synthetic mode of reasoning	**Contextualism** **Synthetic**: wholes are presumed; parts in relations are inferred. **Dispersive**: unpredictability (non-determinism) is presumed; determinate order is denied.	**Organicism** **Synthetic**: wholes are presumed; parts in relations are inferred. **Integrative**: determinate order is presumed; unpredictability (non-determinism) is denied.

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C. Root Metaphor Theory (page 4 of 4) …

A new World Hypothesis is proposed as (Con)texturalism-Dyadicism, embracing both dispersive and integrative manners

	Dispersive manner for organizing evidence	***Integrative*** manner for organizing evidence
Synthetic mode of reasoning	**Contextualism**: *Root metaphor*: **Situation**, as a historic event in its living actuality *Theory of truth*: Operationalism, via qualitative confirmation of solving a specific problem *Categories*: Strands, texture, quality, novelty *Nature of time*: Qualitative duration, event relative to a specious present	**Organicism** *Root metaphor*: **Constructive Development**, with orderliness of changes from stage to stage *Theory of truth*: Coherence, where fragments cohere with their nexus, free of contradiction *Categories*: Progression (steps), final outcome (ideal) *Nature of time*: Directional arrow, successive integrations
	(Con)texturalism-Dyadicism: *Root metaphor*: **YinQi ⇌ YangQi dancing through [eight] seasons**, as ((YinQi) ∝ 1/(YangQi)) wayfaring in unfolding wanwu [dissipating ⇌ concentrating] textures *Theory of truth*: Entailment, traceability back through history, with anticipated outcomes indetermined *Categories*: Rhythmic shifts in (con)textures, situational propensity, dyadic diachrony *Nature of time*: Kairotic, with propitious periods and inopportune periods	
	Dispersive + integrative manner for organizing evidence	

Interpret the double harpoon as reversibility in chemistry: (YinQi ⇌ YangQi) == (YinQi is complementary with YangQi).

Interpret the math symbol ∝not as alpha: (YinQi ∝1/(YangQi)) == (YinQi is inversely proportional with YangQi).

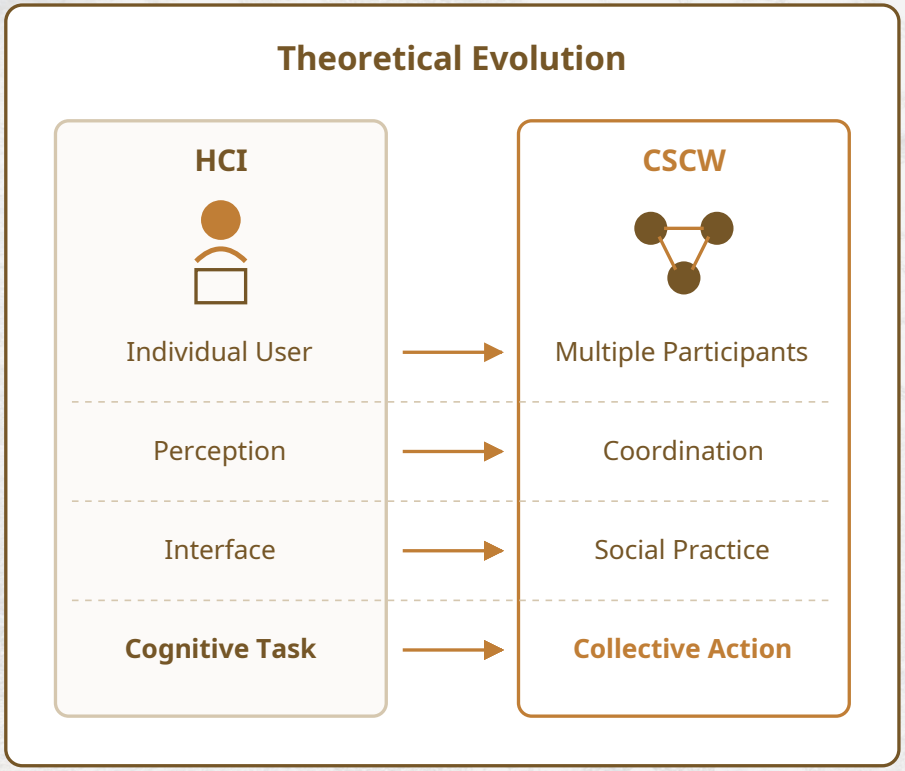
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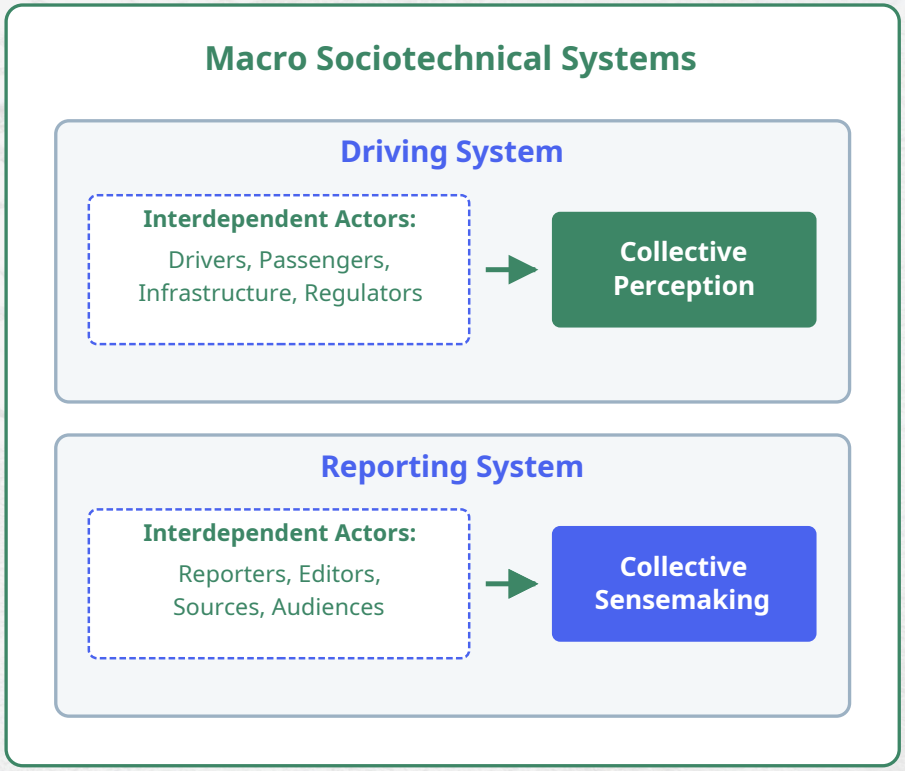
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Socio-Technical Systems extend beyond Human-Computer Interaction into Computer-Supported Cooperative Work





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Behavioral psychology was founded on “what is inside your head”; ecological psychology countered with “what your head is inside of”

Systems Approached as Thinking Before Doing

Mind Before Body

- Thinking
- Representation
- Cognition
- Models



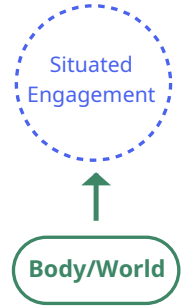
Vulnerabilities of the Behavioural Approach

- **High Mediation:** Dashboards, analytics, synthetic media distance the observer from lived reality.
- **Error Asymmetry:** Framing Errors > Factual Errors
  Mitroff Types III & IV: Solving the wrong problem precisely.

Systems Approached as Experienced Embodied

Body Before Abstraction

- Moving
- Participation
- Embodiment
- Experience



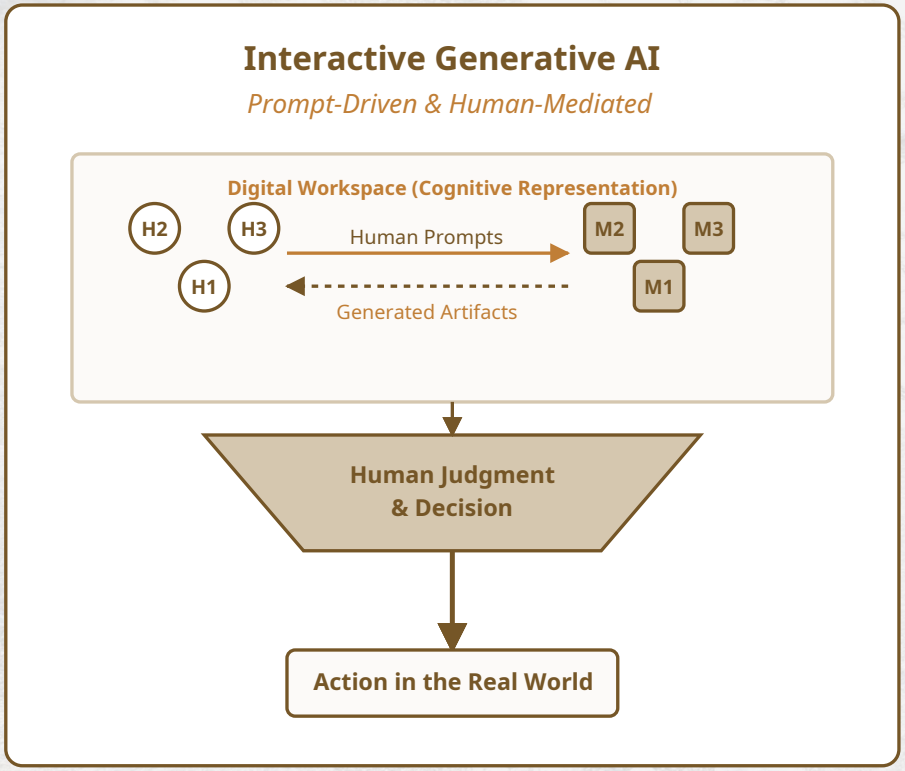
Strengths of the Ecological Approach

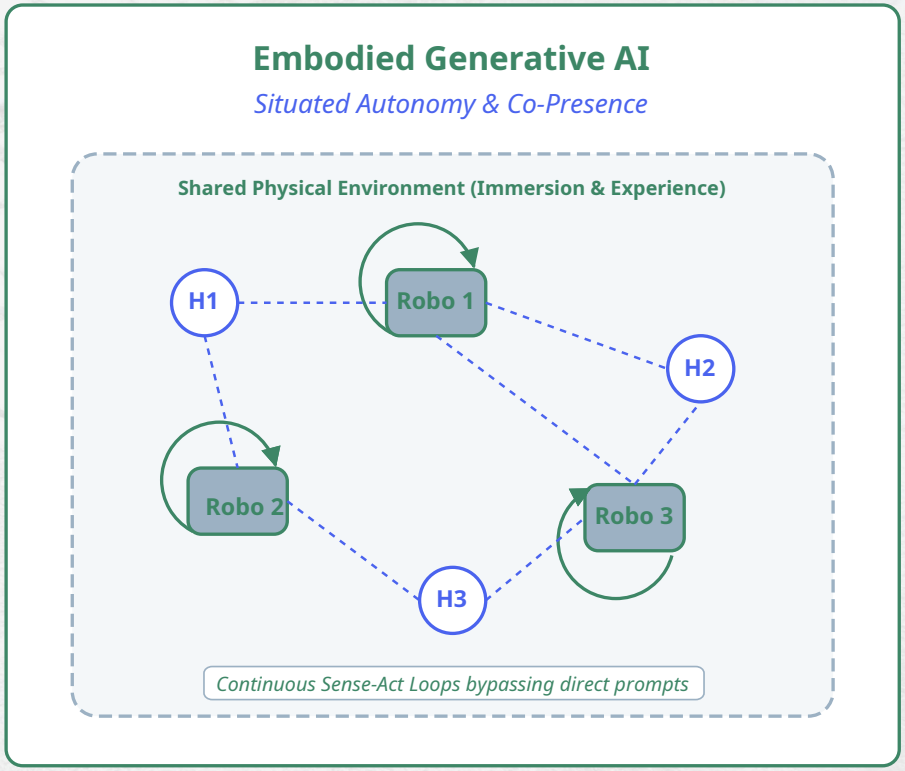
- **Direct Engagement:** Action precedes conceptualization.
  Learning occurs through movement, habit, and physical presence.
- **Grounding:** Situational reality resists abstract framing.
  Reduces Type III errors by ensuring the right problem is experienced first.

Mace, W. M. (1977). James J. Gibson’s strategy for perceiving: Ask not what’s inside your head, but what your head’s inside of. In R. Shaw & J. Bransford (Eds.), *Perceiving, acting, and knowing: Toward an Ecological Psychology* (pp. 43–65). Lawrence Erlbaum Associates.

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While many would associated Gen AI with prompt interfaces with humans in the loop, autonomy can be assigned to robots and devices





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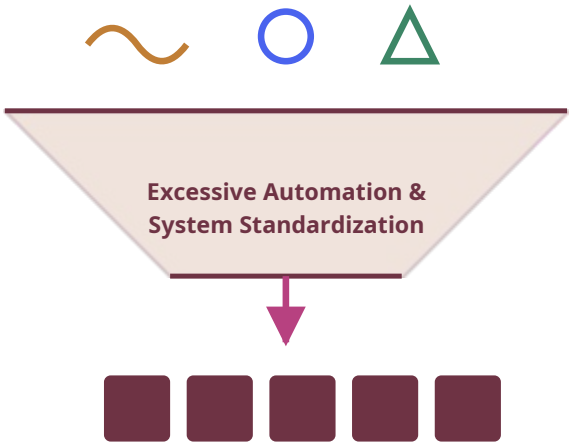
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Beyond assigning autonomy to humans and machines, cooperating across plural world hypotheses involves negotiating sufficient order

The Developmental Trap: Imposed Order

Extending one presumed worldview over all agents

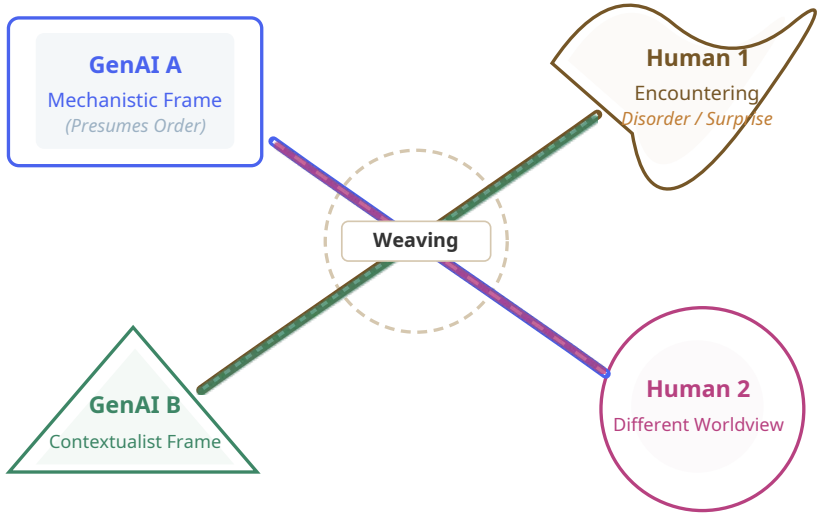


Coordination → Standardization → Loss of Plurality

- The system becomes orderly but is **collectively less capable**.
- Human agents are deskilled, unable to encounter **disorder & surprise**.

The Developmental Choice: Negotiated Order

Weaving capabilities without a single shared world hypothesis



Productive Differences & Collective Capability

- Autonomy preserves the capacity to **see, inquire, and act differently**.
- Cooperation requires **sufficient coordination** without erasing plurality.

Parhankangas, A., Ing, D., Hawk, D. L., Dane, G., & Kosits, M. (2005). Negotiated order and network form organizations. *Systems Research and Behavioral Science*, 22(5), 431–452. https://doi.org/10.1002/sres.717

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