GST 107 – Understanding Emergence

Formal Description

Emergence occurs when the causal organisation of participating components establishes and maintains a capability to produce or accept physical transfers that those components cannot produce or accept independently.

An assembly may be organised without possessing an emergent capability. A system, as defined in the preceding paper, possesses at least one maintained emergent causal capability. The novelty concerns what the organised entity can do, not necessarily a new substance, energy form or fundamental physical law.

An emergent capability may remain available without being exercised, provided its supporting causal organisation is sufficiently maintained.

Plain English Explanation

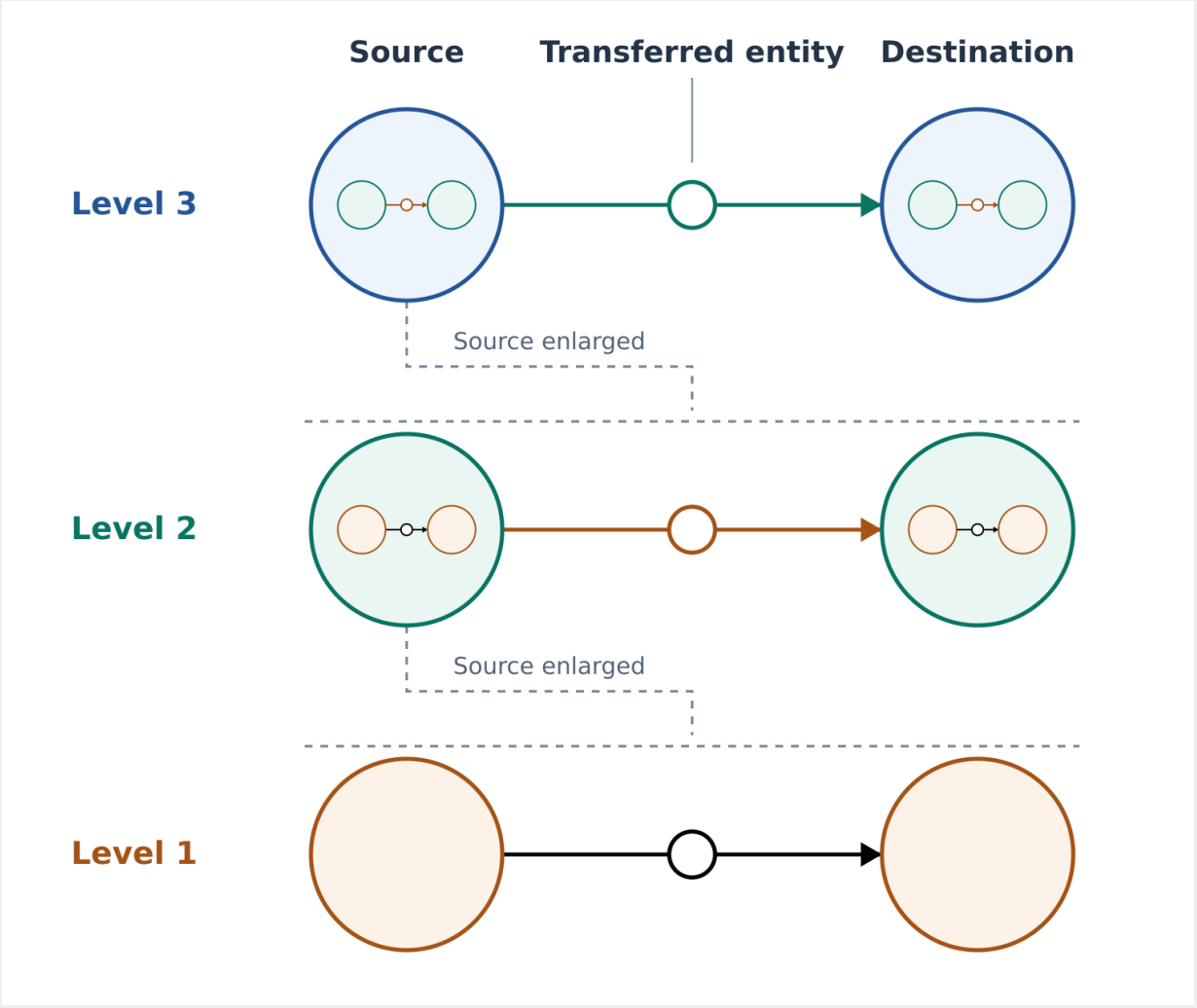
When parts work together, they can sometimes do something that none of them could do separately. That new ability is called an emergent capability. Simply putting parts together does not guarantee that anything new will emerge.

Think of an electrical generator. Its shaft, rotor and windings each have their own properties. Organised and operated together, however, they can convert mechanical input into electrical output. The capability belongs to their working organisation; it is not a property of any one part acting alone.

To understand emergence, ask what physical input the assembly accepts, what output it can produce, and how transfers between its components make that possible. The capability can exist even when the generator is stopped, provided it remains suitably assembled and functional.

Importantly, a new description of a familiar capability is not necessarily emergence. We must investigate the actual causal organisation and compare it with what the components can do independently.

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Causal transfers at three levels of organisation (simplified). Each source produces a transfer accepted by a destination. Higher-level entities contain lower-level interactions, but a new level of assembly does not automatically prove emergence.

Examples

Electrical generator: A driving mechanism supplies mechanical energy to a shaft and rotor. Their organised electromagnetic interaction with stator windings can provide electrical output to a connected circuit. The detailed transfers will be traced in the next module.

Enzyme: A correctly organised enzyme can facilitate a particular chemical reaction. The capability depends on its molecular structure and interactions; the enzyme need not be reacting at every moment.

Counterexample – several identical pumps operating side by side: Their combined flow may be greater than that of one pump, but greater output alone does not establish a genuinely new capability. We must ask what their organisation makes possible.

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Provenance and Links

Primary source: Challoner, J. A. (2026), A Causal Account of Emergence.

Foundation: Challoner, J. A. (2026), Causal Assembly Theory: Assembly and Disassembly as Causal Processes.

Relevant framework items: the definitions of emergence and causal emergence, and the causal emergence proposition (hypothesis).

Course sequence: this module introduces the principle; the next module examines the generator component by component; later modules address causal integration, causal levels and testing.

Practical Exercise

Consider a hand-cranked electrical generator connected to a lamp. Identify (a) the input to the generator, (b) the output accepted by the lamp, and (c) two internal components whose interaction contributes to that output.

Explain, in your own words, why the generator's capability might be emergent rather than simply the sum of separate component outputs. What would you need to investigate before reaching a firm conclusion?

Finally, suppose the crank stops turning but the generator remains intact. Has the capability necessarily disappeared? Explain the difference between possessing and exercising a capability.

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