GST 99 — Systems and Emergent Causal Capabilities

Formal Description

A causal capability is what an entity can do under suitable conditions. A capability is realised when the relevant interactions and transfers actually occur. An assembly can retain a capability while it is inactive.

Causal emergence occurs when an assembly can produce or accept a transfer that depends upon its maintained organisation and that its components cannot produce or accept when acting separately. In this course, a system is an organised assembly with a maintained emergent causal capability. A pre-systemic assembly has organisation but no such capability. Both can accept inputs and produce outputs. This module will discuss maintained capabilities and the next will discuss whether or not those capabilities are emergent.

An occasional outcome can occur from configurations of entities that exist independently in an environment but they lack a maintained capability. Rather, we need to identify relationships that persist between occasions of use and explain how together they enable a transfer. Likewise, a new shape or arrangement is not sufficient evidence of emergence. The question is what the arrangement enables the assembled entity to do.

By the end, the learner should be able to distinguish capability from activity, apply the course's definitions of system and pre-systemic assembly, and explain how different processes can share components.

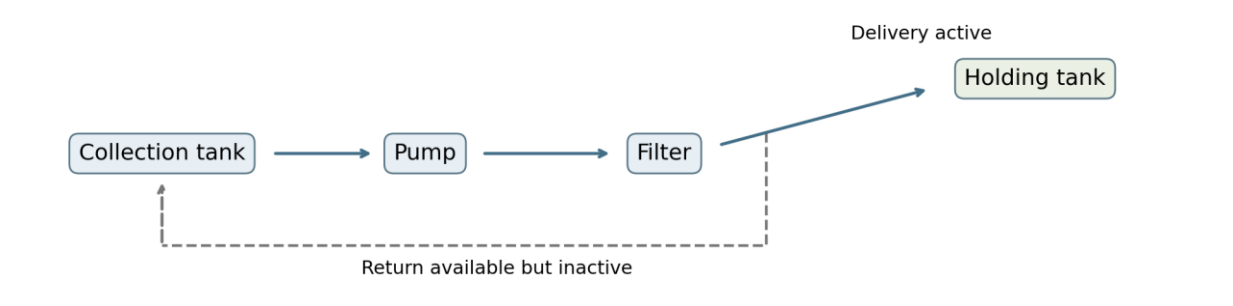
Plain English Explanation

Consider a pump with an assembled drive, impeller and casing. Each part can participate in transfers when considered separately. The drive can turn a shaft, for example. But delivering a sustained flow of water against a pressure difference depends upon the parts working together. The drive turns the impeller, and the casing directs the water between the inlet and outlet.

Switch off the assembled pump and the flow it produces stops. The parts remain organised, so the capability can persist. If power and water become available and the flow path is open, then the pump can operate again. If the parts are instead disconnected, the same inputs cannot produce the same organised pumping process.

Water may also move through a pipe on one occasion because a temporary difference in water level drives it. Observing flow alone does not tell us whether a pump produced it or whether the installation retains the capability to do so. To make that judgement, we must trace the energy input and the path taken by the water, and identify the relationships that remain in place after pumping stops.

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In this example, the pump and filter serve both the delivery and return pathways. The solid arrows show water being delivered to storage. The dashed route is available but inactive because its valve is closed.

Examples

One System Can Comprise Several Processes and not all are necessarily active at any particular time. Return to the recycling installation in GST 96. Water can pass through the pump and filter on its way to storage or return to the collection tank for another pass. The two pathways share components. If only the storage route is open, then delivery can be active while recirculation remains possible under different valve settings.

If no water is flowing, we should ask why. A closed valve or loss of power can prevent a maintained capability from being exercised. Removing the return pipe takes away the installed route. Opening the valve would no longer be enough; the connection would first have to be restored.

To classify an unfamiliar assembly, we must specify the transfer, the conditions and the level being studied. Then ask whether the components could produce or accept that transfer acting separately, and what maintained relationships make the difference. If those relationships are unknown, we should leave the classification open. A single observation of an output, or its absence, is not enough.

Provenance and Links

Foundational Causality explains interactions through transfers. *Causal Assembly Theory: Assembly and Disassembly as Causal Processes* uses maintained organisation and emergent causal capability to distinguish systems from pre-systemic assemblies. The next module examines how this causal account explains emergence.

Challoner, J. A. (2026a). Foundational causality. Rational Understanding. https://rational-understanding.com/efgst/

Challoner, J. A. (2026b). Causal assembly theory: Assembly and disassembly as causal processes. Rational Understanding. https://rational-understanding.com/efgst/

Practical Exercise

Compare three observations: an intact pump with its power switched off; the same pump delivering water against a pressure difference; and water moving once through a pipe under a temporary difference in water level. For each, say what you observed and what you can infer about a retained pumping capability.

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On the recycling diagram, trace the two routes and identify their shared components. Explain the difference between closing the return valve and removing the return pipe.
Choose another assembly. Name a transfer it can produce or accept, identify which component relationships enable it, and explain what evidence would show that the capability persists between occasions of use. Could the components produce or accept the same transfer acting separately?

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