



GST 15 — PTP and TPT Systems Causality

Formal Description

Causal processes in systems may be represented in two complementary forms:

- **Process-Transfer-Process (PTP):** a representation of causality as transfers of matter, energy, or information between systems or processes.
- **Transfer-Process-Transfer (TPT):** a representation of causality as the transformation of inputs into outputs within a system or process.

These representations are complementary perspectives on the same underlying causal structure. Any causal network may be represented as a system of interconnected PTP relationships or as a system of interconnected TPT processes.

Plain English Explanation

We have seen that causal relationships involve transfers between entities. However, when we begin to analyse systems more closely, an important question arises: where exactly is causality happening? Is it occurring between systems, or within them? The answer is that it depends on how we choose to describe the situation. In fact, both perspectives are valid and complementary. In one view, causality is understood in terms of connections between systems. For example, heat may flow from a heater into a room, a signal may pass from one device to another, or one person may speak and another may hear. In each case, the focus is on the transfer occurring between entities. This perspective is known as process–transfer–process (PTP), and it emphasises relationships and interactions between systems.

In another view, the focus shifts to what happens within a system. For example, a heater converts electrical energy into heat, an engine converts fuel into motion, or a person receives information and produces a response. These processes can be described in terms of input, transformation, and output. This perspective is known as transfer–process–transfer (TPT), and it emphasises internal processes and transformation within systems.

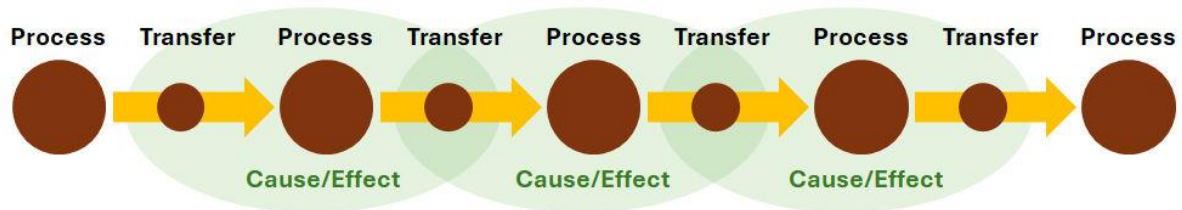
These are not two different kinds of causality, but two ways of describing the same underlying process. They differ only in perspective: PTP describes how systems are connected through transfers, while TPT describes how those systems transform what they receive. For instance, a heater produces heat as an internal transformation (TPT), while that heat flows into the surrounding space as a transfer between systems (PTP). The same underlying causal process can therefore be viewed either from the inside, focusing on transformation, or from the outside, focusing on interaction.

These two perspectives fit together seamlessly. The outputs of one system become the inputs of another, transfers connect systems together, and internal processes transform what is received. In this way, causality forms a continuous chain linking systems across space and time.

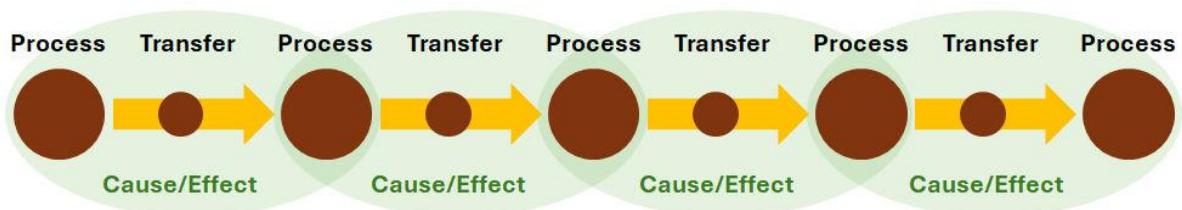
This distinction is important because it allows us to analyse systems in a coherent way. We can examine how systems function internally, how they interact externally, and move between these levels of analysis as needed. Without this dual perspective, causality in systems would appear fragmented, incomplete, or inconsistent.



TPT (Transfer-Process Transfer) Causality



PTP (Process-Transfer-Process) Causality



Examples

Example 1 – Heater and Room

- Heater converts electricity to heat → **TPT**
- Heat flows into the room → **PTP**

☞ Same process viewed in two ways.

Example 2 – Engine

- Fuel enters the engine, is burned, and produces motion → **TPT**
- Motion is transferred to the wheels → **PTP**

Example 3 – Communication

- A person processes thoughts into speech → **TPT**
- Speech transmits information to another person → **PTP**
- The listener processes the message → **TPT**

☞ This creates a chain of causality.

Example 4 – Biological System

- Food enters the body and is processed → **TPT**
- Energy is transferred to the muscles → **PTP**

Provenance and Links

This module draws on longstanding discussions in philosophy, systems theory, cybernetics, and scientific modelling concerning the nature and representation of causality.



The analysis of causality as a relationship between events has roots in the work of David Hume, who emphasised that causal connections are inferred from observed regularities in sequences of events. This perspective aligns with representations that focus on relations between processes and transfers occurring between entities.

A related perspective is found in the work of Kenneth J. Rothman, whose sufficient-component cause model represents causality as the combination of multiple contributing factors that together produce an outcome. This approach highlights that causal processes are often composed of interacting components forming networks of contributing causes.

In contrast, cybernetics and systems theory have long emphasised causality in terms of transformations within systems. In particular, W. Ross Ashby analysed systems as transformations of inputs into outputs, while Norbert Wiener developed frameworks for understanding communication, control, and feedback within systems. These approaches foreground internal processes and the transformation of matter, energy, and information within system boundaries.

The distinction between describing causality in terms of connections between systems and transformations within systems reflects these different traditions. Philosophical and epidemiological approaches tend to emphasise relations between events and contributing factors, while engineering and cybernetic approaches emphasise internal processes and functional transformation.

The formulation of causality in terms of process–transfer–process (PTP) and transfer–process–transfer (TPT) representations provides a unifying framework that integrates these perspectives. This dual representation is developed within General Systems Theory as a way of describing the same underlying causal reality from different analytical viewpoints, linking external interactions with internal transformations.

Within this framework, causal processes form interconnected networks, where outputs from one system become inputs to another, and internal processes transform what is received. This provides a foundation for analysing systems, processes, input–output models, and the flow of energy and information across systems.

Practical Exercise

Choose a real-world system (e.g. a household appliance, a person, or a natural system).

1. Describe the system using the TPT model (internal view):

- What are the inputs to the system?
- What internal processes transform those inputs?
- What outputs are produced?

2. Describe the same situation using the PTP model (external view):

- What systems are involved?
- What is being transferred between them (matter, energy, or information)?
- How do these transfers connect one process to another?

3. Relate the two descriptions:

- How do the outputs of one system become inputs to another?
- How do the internal processes (TPT) give rise to transfers between systems (PTP)?

👉 Write a short paragraph explaining how the TPT and PTP views describe the same causal process from different perspectives.