



GST 72 – Inputs and Outputs

Formal Description

Inputs and outputs are representations of transfers of matter, energy and information across the boundary of a system. A transfer entering the system boundary is described as an input, while a transfer leaving the boundary is described as an output. Inputs and outputs therefore depend upon the chosen system boundary and do not exist independently of it.

Plain English Explanation

Systems do not exist in isolation. They continually exchange matter, energy and information with their environments. These exchanges are known as transfers.

When we define a system boundary, we can describe these transfers relative to that boundary. A transfer entering the boundary is called an input, while a transfer leaving the boundary is called an output.

It is important to recognise that inputs and outputs are not different kinds of transfer. They are simply different ways of describing the same transfer from the perspective of a particular system. If the system boundary changes, the same physical transfer may no longer be regarded as an input or an output.

For example, fuel entering a vehicle engine is an input when the engine is treated as the system of interest. If the system boundary is expanded to include the entire vehicle, however, the transfer of fuel from the fuel tank to the engine becomes an internal transfer rather than an input. The physical transfer has not changed; only its representation has changed because the system boundary has changed.

Inputs and outputs provide the means by which systems interact with their environments. Matter may enter as raw materials and leave as products. Energy may enter as electricity or fuel and leave as heat or mechanical work. Information may enter as signals or instructions and leave as measurements, communications or control actions.

Understanding inputs and outputs helps us investigate how systems obtain the resources needed for continued operation and how they influence the systems around them. It also prepares us to examine the degree to which systems depend upon their parent systems or wider environments for these transfers.

In the next module we shall examine this dependence through the concept of coupling.



Inputs and Outputs Depend on the System Boundary

The same physical system represented using two different boundaries

DIAGRAM A

Engine as the
System of Interest

Only transfers that cross
the boundary are treated
as inputs or outputs.



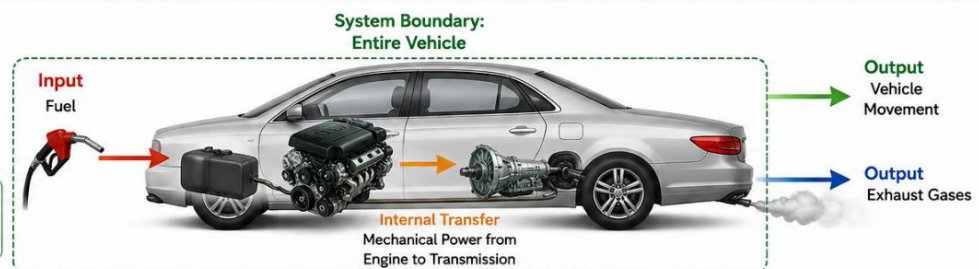
Physical Transfers (Same in both diagrams)

- Fuel flows from fuel tank to engine
- Mechanical power flows from engine to transmission
- Vehicle moves due to power at wheels
- Exhaust gases flow to the atmosphere

DIAGRAM B

Entire Vehicle as the
System of Interest

Transfers within the boundary
are internal and are not
treated as inputs or outputs.



Transfers are real.

Inputs and outputs are descriptions of transfers
relative to a chosen system boundary.

► Educational Emphasis:

Inputs and outputs are representational concepts
derived from ontological transfers.

- Input (enters system boundary)
- Output (leaves system boundary)
- Internal Transfer (within boundary)
- System Boundary

The physical transfers are identical in both diagrams. Only the system boundary—and therefore the classification as input, output, or internal—has changed.

Examples

A manufacturing plant receives raw materials, electrical energy and production schedules as inputs. It produces finished goods, waste materials, heat and production information as outputs. If an individual production line is selected as the system of interest, many transfers that were previously regarded as internal become inputs and outputs relative to the new boundary.

A human body receives food, water, oxygen and sensory information as inputs. It produces movement, heat, waste products and spoken communication as outputs. Individual organs within the body likewise possess their own inputs and outputs when regarded as systems in their own right.

Provenance and Links

The representation of systems using inputs, processes and outputs has been widely employed throughout systems theory, engineering and cybernetics. Within General Systems Theory, inputs and outputs provide a convenient means of describing how systems exchange matter, energy and information with their environments. These concepts are understood as representations of transfers across chosen system boundaries rather than as independent ontological entities.



Practical Exercise

Choose a familiar system such as a business, a hospital, a household or a biological organism. Identify the system boundary.

Then identify:

- The principal inputs of matter, energy and information.
- The principal outputs of matter, energy and information.

Now redraw the system boundary so that a larger parent system becomes the new system of interest.

For the new boundary:

- Identify which previous inputs and outputs have become internal transfers.
- Identify any new inputs and outputs created by the revised boundary.

Finally, explain why the underlying transfers remain unchanged even though the representation of inputs and outputs has changed.