GST 63 – Systems

Formal Description

A system is an identifiable organisation of causally interacting components or processes that exhibits one or more emergent properties, behaviours or outputs that cannot be produced by its individual components acting independently. Systems persist through the continual transfer and transformation of matter, energy or information and interact with their environments through organised causal relationships.

Plain English Explanation

A system is much more than a collection of parts. It is an organised whole in which components or processes interact in such a way that new capabilities emerge.

Earlier modules introduced collections, configurations, assemblies and pre-systemic assemblies. Each represents an important stage in understanding organised reality. A system differs because its causal organisation has developed to the point where the whole is capable of behaviours, functions or outputs that its individual components could not achieve on their own.

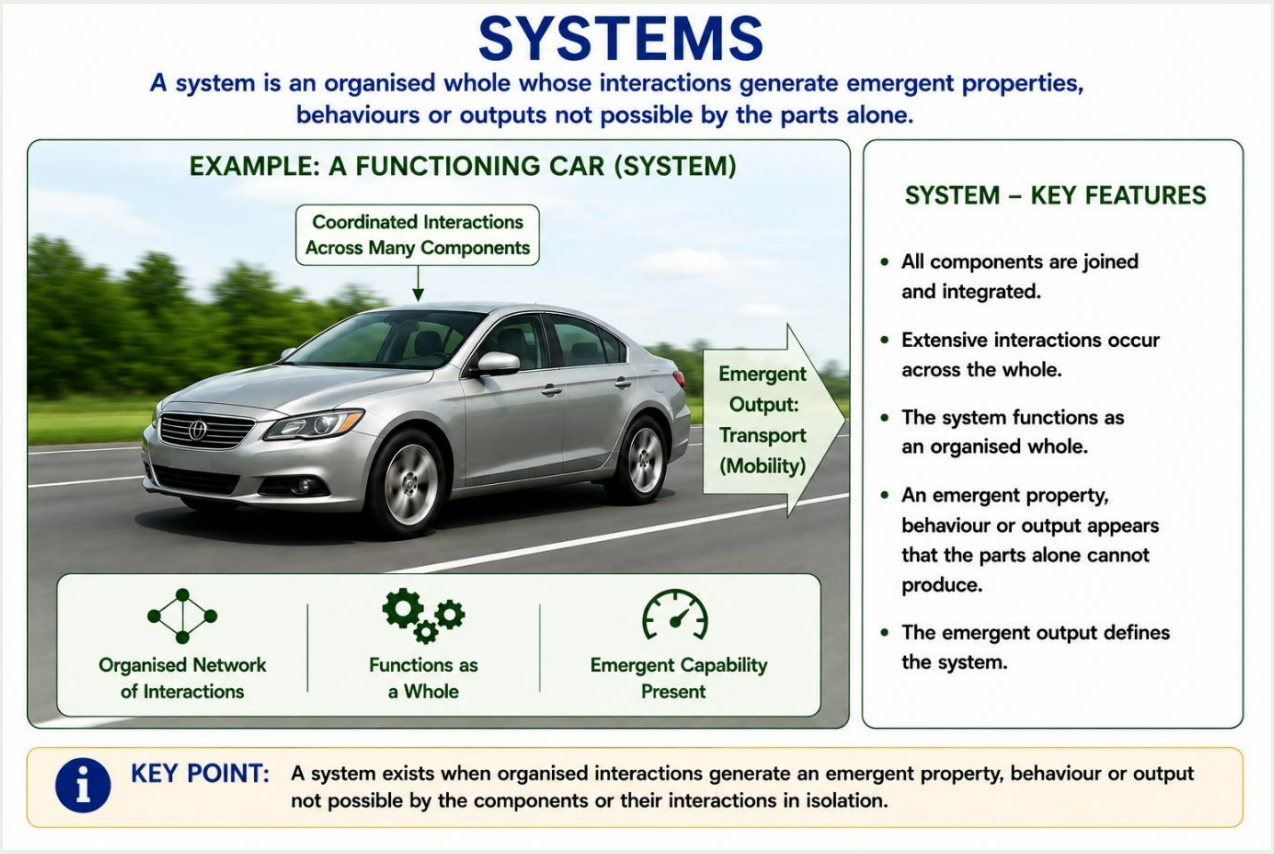
Consider a bicycle. Its individual components—wheels, frame, chain, pedals and handlebars—each possess their own properties. As they are assembled, increasing causal interactions develop between them. Only when these interactions become sufficiently organised does the bicycle acquire the ability to transport a rider. This ability is an emergent capability of the system rather than of any individual component.

The same principle applies throughout nature and society. A living cell is a system because its organised chemical processes sustain life. A business is a system because the coordinated activities of its employees, equipment and information enable it to produce goods or services. An ecosystem is a system because the interactions between organisms and their environment generate behaviours that cannot be explained by considering each organism in isolation.

Systems continually exchange matter, energy and information with their environments. These transfers enable systems to maintain themselves, adapt to changing conditions and influence other systems. If the causal organisation of a system is disrupted sufficiently, its emergent capabilities may be lost, even though many of its components remain present.

Understanding systems therefore requires more than identifying their components. It requires understanding how those components are causally organised and how that organisation gives rise to new properties, behaviours and outputs.

In the following modules we shall examine how systems become organised into larger contexts through components, subsystems, hierarchies and boundaries, enabling them to interact with their environments.



Examples

A modern aircraft contains thousands of components. Individually, none can transport passengers through the air. When organised into an integrated whole, however, they produce the emergent capability of controlled flight. The aircraft is therefore a system rather than merely an assembly of parts.

A forest is also a system. Trees, soil organisms, animals, water and atmospheric processes continually interact through organised causal relationships. Together they regulate nutrient cycling, energy flows and ecological stability in ways that no individual organism could achieve independently.

Provenance and Links

The concept of a system lies at the heart of General Systems Theory and has been developed by many scholars, including Ludwig von Bertalanffy, Kenneth Boulding, Russell Ackoff, James Grier Miller, Bela H. Banathy, Peter Checkland and Gerald Midgley. Although definitions vary, there is broad agreement that systems comprise interacting components organised into coherent wholes. The definition adopted here emphasises organised causal interaction and emergent capabilities as the distinguishing characteristics of systems.

Practical Exercise

Choose three examples from different fields, such as an engineering system, a biological system and a social system.

For each example:

- Identify the principal components or processes.
- Describe how they are causally organised.
- Identify at least one emergent property, behaviour or output that the individual components could not produce independently.
- Explain how transfers of matter, energy or information enable the system to function.

Finally, consider what would happen if one of the key patterns of causal organisation were disrupted. Explain how this might affect the system's emergent capabilities.