



GST 68 – Systems Hierarchies

Formal Description

A systems hierarchy is a recursive organisation of nested systems in which smaller systems form components of larger systems, while larger systems provide the context within which smaller systems operate. Each level of the hierarchy may be regarded as a system in its own right, provided it possesses its own causal organisation and emergent properties, behaviours or outputs.

Within a systems hierarchy, systems may be described in terms of parent systems, subsystems and supersystems. The terms *parent system* and *supersystem* are interchangeable, both referring to a system that contains the system of interest within its boundary.

Plain English Explanation

Complex systems rarely exist in isolation. Most systems are composed of smaller systems while simultaneously forming part of larger systems. This nested arrangement is known as a systems hierarchy.

Within a systems hierarchy, every subsystem belongs to a larger system. The immediate larger system is commonly referred to as the parent system, although the equivalent term supersystem is also widely used. Both terms describe exactly the same relationship: a system that contains the system of interest within its boundary.

Thinking of systems as members of a family provides a useful way of understanding these relationships. A subsystem may therefore be regarded as a child system, systems sharing the same parent are sibling systems, and the parent of a parent system may be described as a grandparent system. More generally, systems at higher levels may be regarded as ancestor systems, while those at lower levels may be regarded as descendant systems. These terms are simply convenient ways of describing the recursive nesting of systems within larger systems.

For example, a human cell is a system composed of interacting organelles. The cell is a child subsystem of a tissue, the tissue is a child subsystem of an organ, the organ is a child subsystem of the human body, and the body is itself a subsystem of wider ecological and social systems. Each level exhibits its own emergent properties while simultaneously contributing to those of its parent system.

Systems hierarchies allow complex organisation to develop without requiring every component to interact directly with every other component. Instead, interactions are organised through successive levels of systems, each contributing its own emergent capabilities to the larger systems of which it forms part.

It is important to distinguish a systems hierarchy from the developmental sequence introduced in earlier modules. A systems hierarchy describes the nesting of existing systems within one another. It does not describe how systems emerge from collections, configurations, assemblies and pre-systemic assemblies. The two concepts are complementary. One describes levels of organisation, while the other describes stages in the development of organisation.

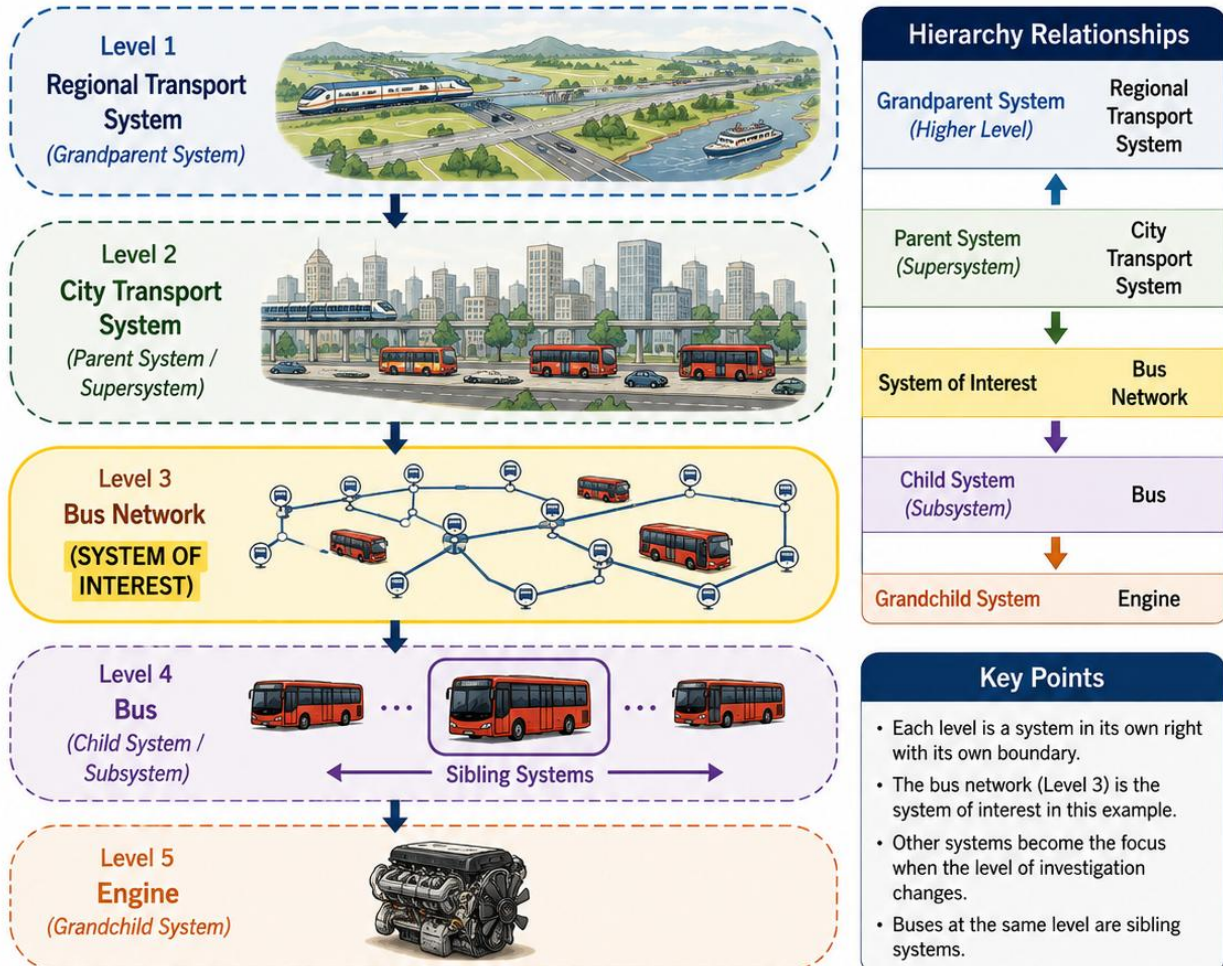
Recognising systems hierarchies allows us to investigate complexity at an appropriate level. We can examine a system in detail while understanding how it both depends upon and contributes to systems above and below it in the hierarchy.

In the next module we shall see how we select one level of this hierarchy for investigation by defining an appropriate system boundary.



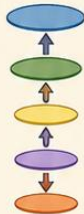
Systems Hierarchy: A Nested Example

Family Relationships Using Transport Systems



Note 1 – Position in a Systems Hierarchy

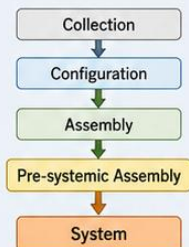
Every system occupies a position within a systems hierarchy. Whether it is regarded as a subsystem, system or parent system depends upon the chosen level of investigation.



Note 2 – Two Different Hierarchies

It is important to distinguish between:

- **Systems Hierarchy** – nested systems. Describes recursive relationships between existing systems at different levels.
- **Developmental Hierarchy** – stages in the emergence of systems. Describes development over time.



Educational Emphasis: Systems hierarchies describe recursive relationships between existing systems rather than stages in their development.



Examples

A university forms part of a systems hierarchy. Individual departments are child systems of the university. Departments within the same university are sibling systems because they share the same parent system. The university itself may be regarded as a child subsystem of the national higher education system, which in turn forms part of wider social and governmental systems.

A river catchment also forms a systems hierarchy. Small streams combine to form tributaries, tributaries combine to form rivers, rivers form catchments, and catchments contribute to regional and global hydrological systems. Each level exhibits its own emergent properties while contributing to those of its parent system.

Provenance and Links

The concept of nested systems has been recognised throughout the development of General Systems Theory. Hierarchical organisation enables complex systems to be understood as recursive organisations in which systems are simultaneously composed of smaller systems and incorporated within larger systems. The terms *parent system* and *supersystem* are widely used to describe the larger systems within which a system is embedded, while familial terminology such as child and sibling systems provides an intuitive way of describing these recursive relationships.

Practical Exercise

Choose a familiar complex system such as a business, a hospital, a school or a biological organism. Identify at least five levels within its systems hierarchy.

For each level:

- Identify its parent system (or supersystem).
- Identify any child subsystems.
- Identify any sibling systems.
- Describe one emergent property, behaviour or output that distinguishes it as a system in its own right.

Finally, explain how understanding the relationships between parent, child and sibling systems helps you understand the behaviour of the system as a whole.