Systems thinking

In this learning material, students learn to think in systems rather than focus on the separate components of a system. This enhances the capacity to understand the limited nature of natural resources and the importance or sustainable resource use.

Introduction

A system is a group of interrelated and interdependent parts which can be natural or human-made. These parts influence each other directly or indirectly, and in this way they form a cohesive structure. To understand the functioning of a system, you can never simply consider the elements of the system, you have to understand their interdependent relationship to one another. Many modern-day challenges such as climate change, biodiversity loss, plastic pollution and social injustice (so-called 'wicked problems') can only be tackled using a systems-based approach.

In general, a system consists of several components:

- **Elements**: clearly defined within a system, yet changes in the elements have limited effect on how the system works
- **Connections**: the relationships between the elements play a very important role in the functioning of the system
- **Function or purpose of a system**: Some systems have a purpose, yet the outcome of the system does not always match the purpose.

Systems thinking

Consider the video about cats in Borneo as an example of systems thinking.

This example illustrates the complexity of most systems, and how their functioning and outcomes are often influenced by internal feedback loops and therefore unpredictable. Systems thinking requires a radically different approach of view (systems view), thinking (circular thinking), acting (structural action) and language.

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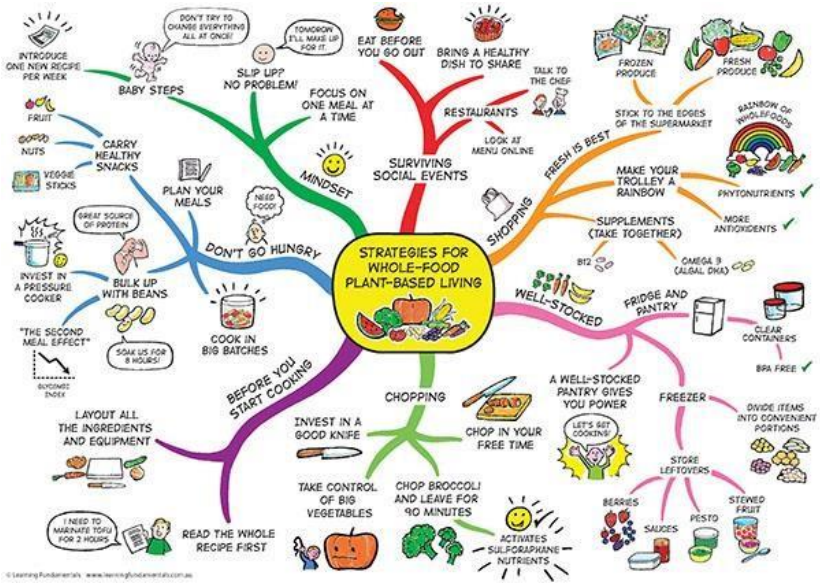
Tools for systems thinking

Below we illustrate some tools that are commonly used in systems thinking. In preparation, choose a wicked problem or system that you would like to evaluate.

Mind map

A mind map is a diagram composed of concepts, texts, relations and/or pictures, which are arranged in the form of a tree structure around a central theme. It is used to make an inventory of all aspects of a problem or subject along with the mutual relations between these aspects.



Exercise: Make a mind map of the wicked problem or system you have chosen. You can use a pen and a piece of paper, or use free software such as MindMup or MindMeister.

Behavioural pattern graph

A second tool for systems thinking is using graphs that capture the variables that are relevant to the system, and how they evolve over time. There are two types of variables:

- Hard variables are measurable (number, length, temperature ...)
- Soft variables are not measurable, but scalable (happiness, sadness, anger, need ...).

Looking for correlations between different graphs may reveal direct and indirect connections between elements of the system.

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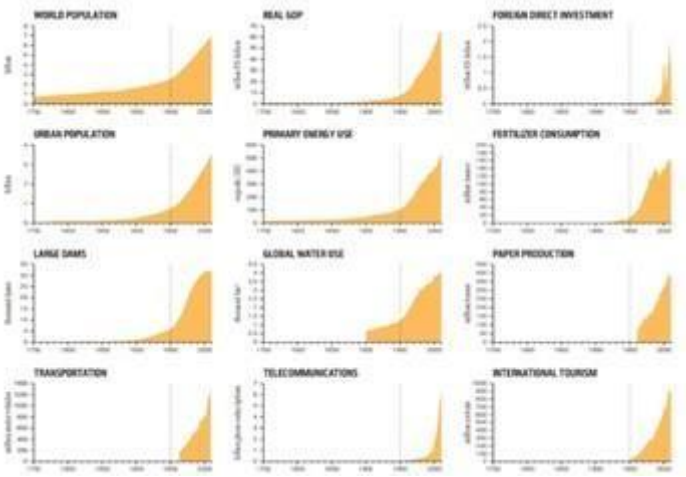

Exercise: Take 5 variables from your previous exercise. Sketch a graph on how these variables may have evolved over time. Is there a correlation? Also, look for 'real' data of these variables.

Connection circles

This tool is used to visualise the connections between the different variables of the system. Once these connections are mapped, the way they influence each other is highlighted using a '+' for positive correlations [if one variable increases (decreases), the other variable increases (decreases)] and a '-'for negative correlations [if one variable increases (decreases), the other variable decreases (increases)]. This method also helps you to find feedback loops. Learn about connection circles in this video.

Exercise: Now take 10 variables from your mind map and place them around a circle. Draw an arrow if there is a connection between two variables, taking into account the direction, the correlation (+ or -) and whether there are any feedback loops.

Causal loops

This tool is also used to visualise connections between variables of a system, but they help to map the workings of the system. The tool stimulates cyclical thinking and helps you to understand that consequences are often also causes and vice versa. This is because of the way feedback loops function within a system: a positive feedback loop may reinforce its own effect, causing an unbalanced situation that may quickly escalate (R = reinforcing). A negative feedback loop, on the other hand, has a stabilizing effect because variables keep each other in balance (B = Balancing). Learn about causal loops in this video.

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Exercise

Look at a documentary or listen to a podcast about a current wicked problem. Here are some examples:

- A plastic ocean
- A life on our planet
- Cowspiracy
- Just Eat It

Now apply systems thinking on the problem using the following steps:

Step 1

Capture as many aspects of the problem as you can by creating a mind map around the central problem.

Step 2

Based on this mind map, identify stakeholders and their behaviour/ impact concerning the problem. These are all the people or parties who influence or benefit the system around the problem.

Step 3

Now identify different events, patterns, systems and models within the overall system. Try to answer such questions as:

- Which negative events are happening because of the problem? E.g., climate change, biodiversity loss, …
- Which long-term trends underly these events? E.g., fossil fuel combustion, deforestation, … □ Which political, social, biological or economic structures contribute to these trends? E.g., Subsidized company cars, meat consumption, …
- Which personal values and assumptions contribute to the events and the patterns?

Step 4

Connect the events, patterns, systems and models by mapping their relationships. They can strengthen or weaken each other and feedback loops may occur. Use the causal loop technique to visualise these relationships.

Step 5

Look for solutions: which elements of the system could be tackled to yield the highest impact in the short term? You can highlight these in your visualisation of the system.

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Step 6

Which factors/ processes may inhibit or block a solution? Identify these factors, indicate them in your visualisation of the system and give a short description.

Step 7

Identify potential levers that may present a solution to the blocking effects. Indicate them in your visualisation of the system and give a short description.

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