BURGE HUGHES WALSH

The Systems Thinking Tool Box

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".. bump, bump, bump, on the back of his head. It is, as far as he knows the only way of coming downstairs, but sometimes he feels that there really is another way, if only he could stop bumping for a moment and think of it."

Winnie the Pooh - A. A. Milne

Systems Map (SM)

What is it and what does it do?

A Systems Map is a tool to create a simple high-level diagram of the situation under investigation to:

- Define system boundaries.
- Indicate the major components (subsystems) that lie within the boundaries.
- Indicate the major items in the system's environment.
- Identify relationships between components.

Figure 1 shows and example Systems Map for a submarine constructed to identify its major subsystems and external elements.

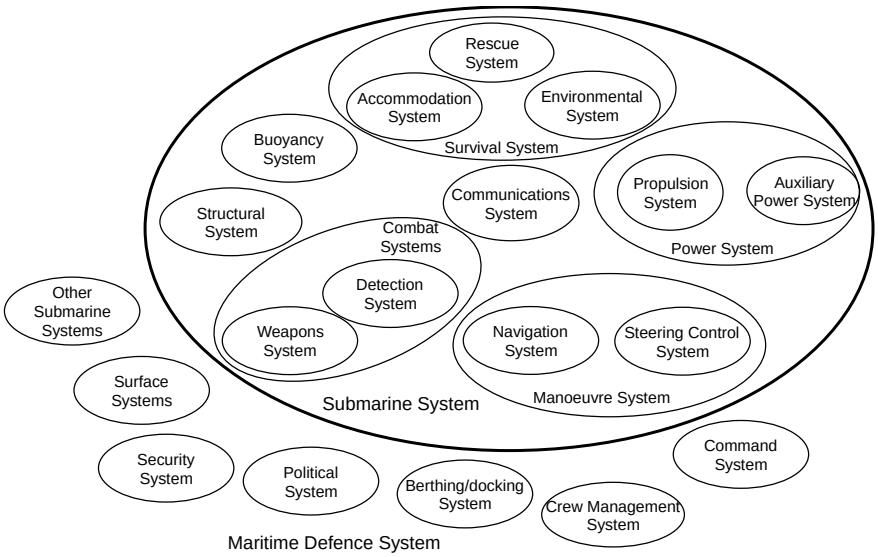

Figure 1

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Why do it?

System Maps exploit the concept of hierarchy to capture and manage complexity through sub-division. It is particular useful in Systems Thinking as it is a representation convention that is intuitive to most humans and therefore provides a powerful way of conveying information. The basic principle behind hierarchy is sub-division of higher or bigger "things" into a number of lower or smaller "things". There are three basic representation conventions that are shown in Table 1.

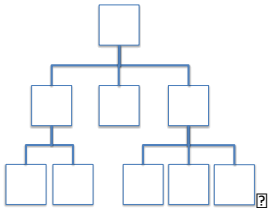
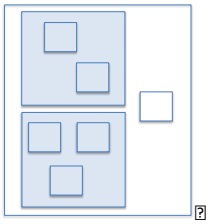
Trees	Nests	Lists
		Top Item Item A Item A_1 Item A_2 Item B Item C Item C_1 Item C_2 Item C_3

Table 1: The three hierarchical representations

As is clear from Table 1, the three basic representations are interchangeable; it is a relatively trivial task to change from one representation to another. Systems Maps exploit the use of nests in order to represent complex situations.

Figure 2 shows the basic notation used in constructing a Systems Map.

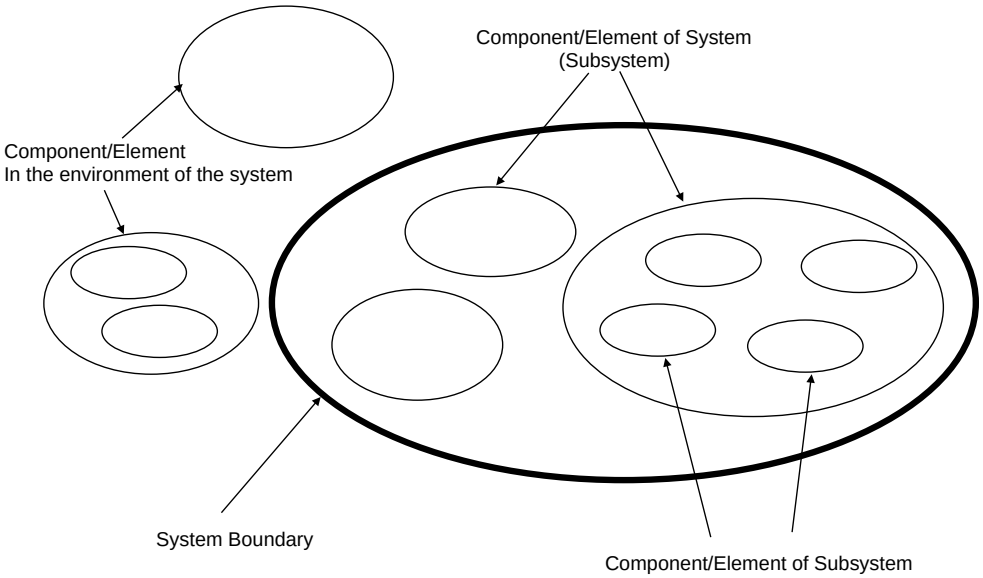


Figure 2: The Notation of a Systems Map

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The use of ellipses is not essential; squares and rectangle are equally common. A Systems Map captures both internal and the external components/elements that sit in the environment of the system of interest. It is usual to draw at least three levels of detail:

- The System and its environmental elements
- The subsystems
- The components of the subsystem

For complex environments the environmental elements can also be nested.

Where and when to use it?

Systems Maps can be constructed as part of the effort to understand a situation through the identification and organization of the key elements. A Systems Map is particularly useful in exploring and defining the boundaries of system of interest and to uncover the major components. They can be particularly useful if the situation under investigation actually exists and thereby capture the views and/or understanding of several people about the situation and how, they think, it is organized.

Who does it?

An individual or team can undertake the construction of a Systems Map. In general, the outcome is more complete if a team performs the Systems Map construction.

How to do it?

A Systems Map is actually a type of Affinity Diagram where the team brainstorm and then organize all the system components. This can be achieved by the simple 3-step process:

Step 1: Start by defining the purpose and context of the system of interest. With reference to the context it is important to ensure that you define the phase of the system's lifecycle – typically "operation" i.e. you construct the System Map for the day-to-day operation of the system of interest.

Step 2: Brainstorm system components/elements – this is often best done using sticky notes, cards or alternatively writing on a white board

Components/elements can be:

- things/objects (nouns) that are in the system or its environment.
- functions/actions (verbs) that the system has to perform to achieve its purpose.

Components can be a mixture of things and function – but my experience is to be consistent; it is best to stick to one or the other.

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Step 3: Look for natural groups of components/elements. This should done for both internal and external elements. Once groups have been identified, determine suitable names for them. For large groups that have more than seven elements, look within each group for further sub-groupings. The aim is for at least three levels of hierarchy and at any one level, aim for seven or less items.

Illustrative Examples

Figure 3 shows a Systems Map for a Systems Engineering led organization.

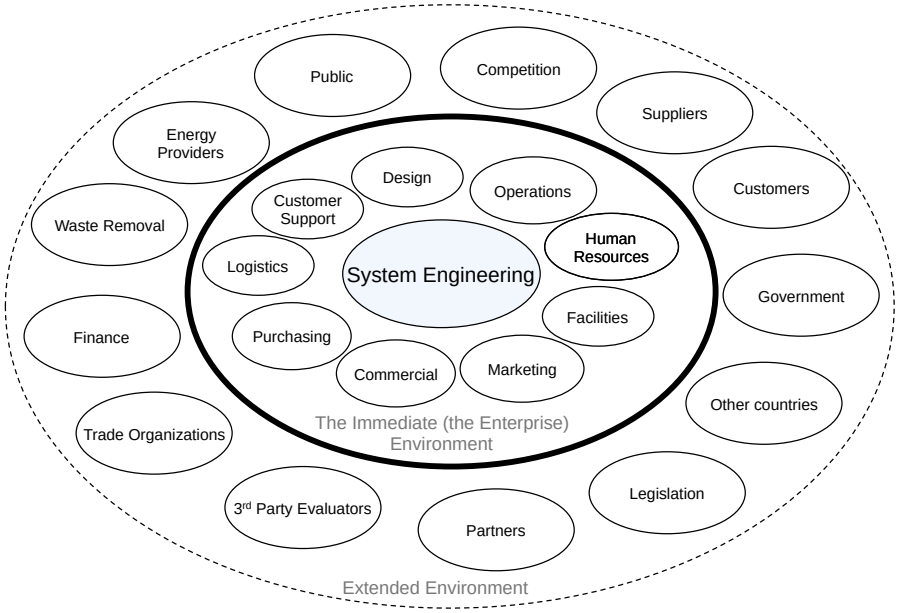

Figure 3: A Systems Map of a Systems Engineering led Organization

The Systems Map shown in Figure 3 was drawn to provide a simple view of activities undertaken by a Systems Engineering led organization. In this case, it shows two levels of system environment:

- The immediate environment that covers all the other organization functions
- The extended environment that shows elements outside the organization that might interact with the Systems Engineering function

Figure 4 shows a Systems Map of a domestic kitchen. This particular Systems Map has been constructed around the activities or functions of the kitchen. Note that all the boxes contain a function as a verb noun phase that describes the activities of a typical domestic kitchen. This particular type of Systems Map is often useful for new systems as it focuses the team to think about what has to be done rather than how things are done. It is a level of abstraction that can be very useful as having identified the system functions or activities, alternative ways or means of achieving them can be explored. Here tools like Morphological Box or Function Means Analysis can capture potential solution options.

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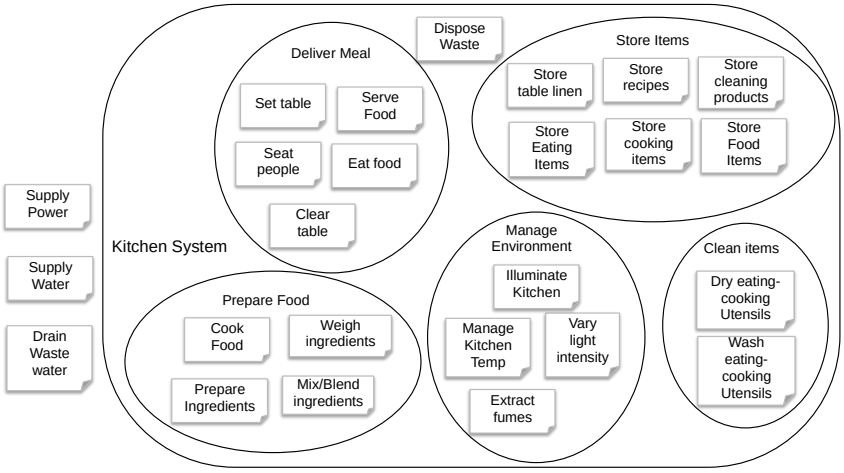
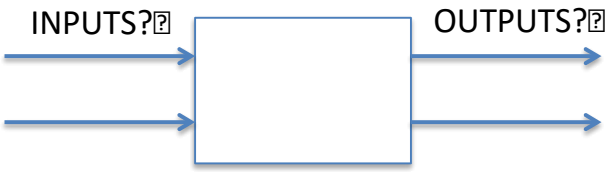


Figure 4: A Systems Map of a Domestic Kitchen

What Goes Wrong: The limitations of a Systems Map

Unclear Definition of Purpose. While a Systems Map is very useful in defining the boundary of a situation or system of interest, the boundary is affected by the choice of purpose. For example when running training courses in Systems Thinking I often ask people to debate and decide upon the purpose of a television. The most frequent answer is “entertainment”. I then draw the following diagram and ask the question what are the inputs and outputs?



The usual answers are:

Inputs: TV signal, Electricity and User Commands
Outputs: Sound and Picture

Hence the purpose of a television is to convert a TV signal to sound and pictures! Of course both are right, it’s all a matter of boundary. It is important to recognise that the system boundary affects the purpose and the system purpose affects the boundary. We need to be prepared for iteration and hopefully convergence to a agreed understanding.

Unclear View of Lifecycle Stage. All human designed/built systems have a lifecycle. Some are very explicit with clear phases for design, development, implementation or realisation, operation, support, and ultimately disposal. When constructing a Systems Map it is very important to be clear what phase of the system’s life cycle you are looking at. If you don’t then the team will mix the phases up and get very confused. The usual starting point is to construct a Systems Map of the day-to-day operation of the system first; even if you are considering the design of a new system.

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Grouping the Systems or Environmental Components. The expression “there are many ways to skin a cat” always come to mind at this point. If a team is struggling then suggest that we draw two (or more) Systems Maps. Usually when we examine the “finished” items the choice can become clear.

Success Criteria

The following list represents a set of criteria that have been found to be useful when constructing a Systems Map.

- Team size between four and seven (if more than seven people present split into two groups and combine the results).
- Team constitution has expertise and experience in the situation of interest but can (and perhaps should) include members with limited experience and expertise.
- Use an experience independent facilitator.
- Plan for one hour’s effort.
- Define clearly what we are trying to do.
- Define the system’s purpose. If this does not exist at the point draft a purpose statement using the 18 Word Statement tool. Remind the team that this could, and probably will, change.
- Define the lifecycle phase. For most situations, you will consider the day-to-day operation of the system.

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