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

Morphological Box (MB)

What is it and what does it do?

Morphological Box is a Creative Thinking tool for generating whole solutions to complex problems. The approach is to logically decompose the problem into a number of variables/factors for which solutions or ideas can be identified. From the resulting table of part-solutions (morphological box) the various alternative whole solutions can be explored. To illustrate the process, Figure 1 shows a morphological box for a torch.

Power Supply	Lighting method	Light intensity	Size	Style	Finish	Shape
Rechargeable battery	Tungsten filament	Very Bright	Very small	Modern	Metallic	Flat
Alkaline battery	Halogen bulb	Bright	Small	Victorian	Natural	Cylinder
Lead Acid battery	LED	dim	Medium	Art deco	Wood like	Cube
Fuel cell	LCD	Very dim	Large	Industrial	Ceramic	Cone
Mains operated	Naked Flame		Very large	Hi Tech	Soft	Sphere
Solar				Heath Robinson	Plastic	Animal
Wind-up				Gold plated	Paper	

Figure 1: Morphological Box for a Torch

Figure 1 was created by a team of people who initially determined the attributes of a torch as "power supply", "lighting method", "light intensity", "size" etc. The second step involved brainstorming, for each attribute, all possible variations they could they could think of. This is the basic "morphological box" from which "complete" solutions can be derived by selecting one entry for each column. For example, we might have a wind-up (generator), LED, dim, small modern, plastic, animal shaped torch. This is not a million miles away from a torch my daughter was given as a child as shown in Figure 2.

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Page **1** of **4**

Figure 2: A tiger shaped hand generator LED torch

There are of course multiple combinations of the Morphological Box allowing for the creation of multiple while system concepts that can be evaluated to find the "best"

Why do it?

Many of the Creative Thinking tools like Brainstorming, affinity Diagrams and Similarities and Difference cannot be easily used to generate complex system solutions. They are very good at generating ideas for parts of the complete system solution but the not whole thing. The Morphological Box or Analysis, overcomes this issue by decomposing the whole problem into meaning elements for which solutions or ideas can be generated. These ideas can them be combined in multiple ways to create whole solutions.

Where and when to use it?

We use a Morphological Box whenever we are attempting to generate solutions to complex problems that are too big for the classic Brainstorming type tool.

Who does it?

Constructing a Morphological Box is best performed by a team to draw upon the experience and expertise in that team, but also to allow the freeform thinking necessary to be creative. Time size is only important when we get to around seven members, at which point the team is getting too big and some members will stop contributing.

How to do it?

The process for constructing and using a Morphological box is shown in figure 3.
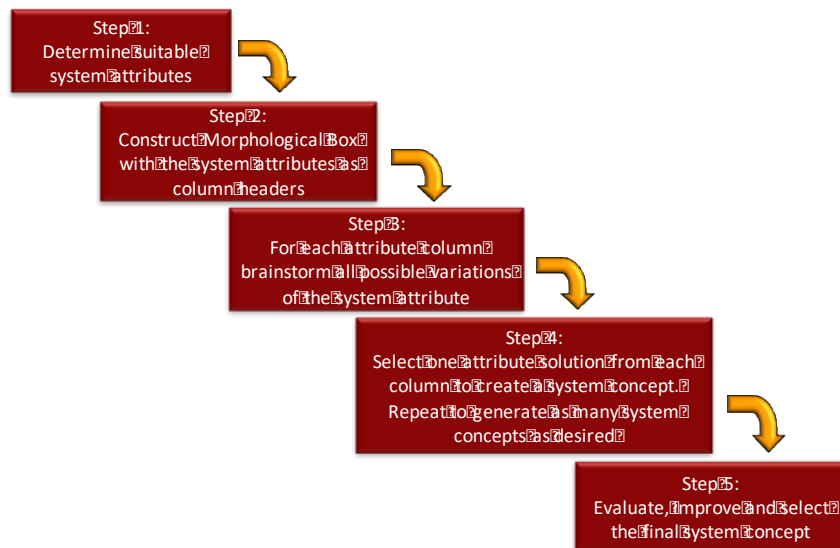
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Figure 3: Process for Constructing and Using a Morphological Box

Step 1: Using a small team identify by brainstorming the attributes of the system (product, process or service) you are examining. The attributes are parts, functions, properties, qualities or design elements of the system of interest. For example:

- The attributes of a pen could be: material, retraction method, ink type, flow control, quality, colour, size, feel, weight and price.
- The attributes of a hotel would be: type, style, service level, star rating, price, location, facilities.

In generating the attributes, it is important to define each clearly. For example, what is meant by "hotel type"? what is meant by "hotel style"?

Step2: Construct the Morphological Box using these attributes as column headings.

Step 3: For each attribute column brainstorm and write down as many variations of the attribute as possible.

- If you are struggling to generate options/variations, consider changing the attribute
- If you find the same options/variation appearing in another column consider combining the attribute columns

The table, the Morphological Box, should now show all possible variations of each attribute.

Step 4: Select one entry from each column to create a whole system concept solution. This can be done systematically (every combination!), randomly or by selecting what are interesting combinations. It is at this point the team can create truly imaginative system concepts.

Step 5: The aim is to arrive at a single practical but innovative system concept solution. This will require a mix of evaluation and improvement of the various system concepts. It is often important at this point to be disciplined in the approach using decision tools like N/3, Decision Matrix or Pugh Matrix

What Goes Wrong: The limitations of Morphological Box

Poorly thought through attributes. The attributes are very important in constructing a Morphological Box. They must be relevant and clearly defined. I will typically think about customer/user requirements as the attributes.

Not exploring possible whole system concepts. Morphological box works, but we often do not explore the more extreme possibilities.

Success Criteria

The following list represents a set of criteria that have been found to be useful when using Morphological Box.

- Team size between one and seven.

- Use an experience independent facilitator.

- Plan for one half-days effort. Irrespective of the system under consideration, a Morphological Box will take about ½ day to construct and use.

- Ensure the attributes are relevant, realistic and clearly defined.

- Consider all variations of the attribute – particular those that are considered to be "currently not possible".

- Record rationale in selecting and evaluating potential whole system concepts.

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