

Morphological Chart

Keywords
 Function
 Analytica
 Morphological method
 Combination
 Principal solution

What Is a Morphological Chart?

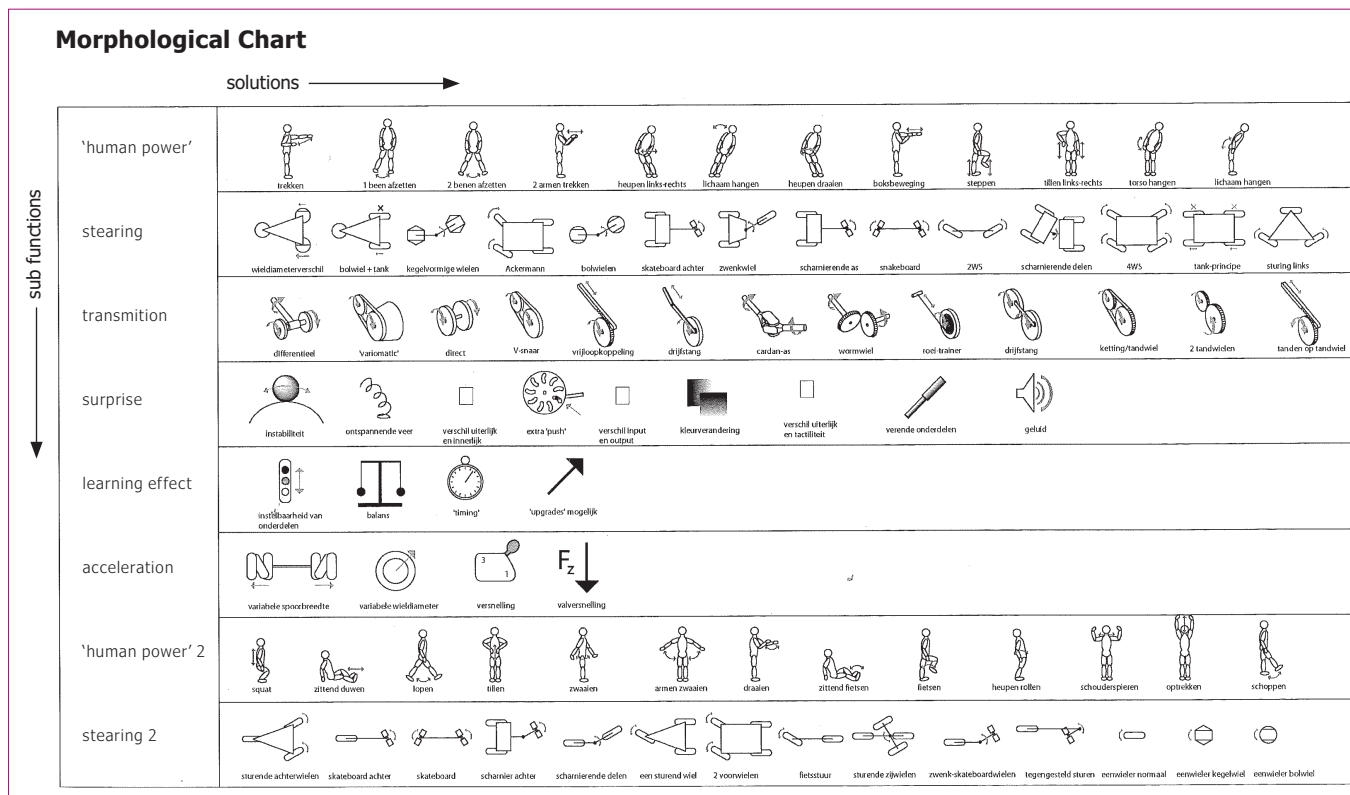
The morphological chart (see figure 2.32) is a method to generate ideas in an analytical and systematic manner.

Usually, functions of the product are taken as a starting point. The various functions and subfunctions of a product can be established through a function analysis (see 'Function Analysis' in this section).

However, function analysis does not guarantee that all the relevant (sub) functions are identified. Often a number of solutions to these (sub) functions are already known, while others are thought up by yourself. These solutions will form the components in the morphological chart. The morphological method thus yields a matrix of functions and components. Possible components are listed on the basis of their functions. The components are concrete and specific, specifying the elements that belong to a category (i.e. parameter). These components are already known partially from existing solutions: analogous products. Functions are listed in columns, and components are the means that realise the functions and are listed in rows.

The parameters are identified by focusing on the commonalities of components, and describing them as the characteristics which a product should have, thus indicating what the product should be; they are essential to the solution. The parameters are independent and abstract, and indicate a category (with no reference to material features). By means of the morphological chart, the product's purpose is split into a set of (sub)functions. For each of the (sub)functions ideas are generated and combined into an overall solution. Through careful selection and combination of a set of components, an idea comes about. This idea should be seen as a principal solution: a carefully chosen combination of components that together form a conceptual solution.

fig. 2.32 Example of a Morphological Chart
 (from student report)



New components are found by making the abstract parameters concrete through the establishment of technical principles. In this way, the morphological method is an evolutionary method: parameters and components are evolved in parallel until the final morphological chart is made.

In the end, solution principles are found by choosing one component from each parameter. In other words, each combination of components (one component being selected from each parameter) suggests a solution to the problem. The generation of solutions is thus a process of systematically combining components.

However, the larger the morphological matrix, the larger the amount of possible solutions (theoretically, a 10 x 10 matrix yields 10,000,000,000 solutions), which takes much time to evaluate and choose from. In order to limit the number of options, two evaluation strategies are helpful: (a) analysis of the rows and (b) grouping of parameters.

- a Analysis of the rows is based on rank ordering the components per parameter in a first and second preference. The rank ordering is done against (a part of) the criteria or design requirements. Using only the first and second preferences brings down the number of components and thus reduces the number of solutions.
- b The second evaluation strategy is grouping the parameters in groups of decreasing importance. As a first step, only the most important group of parameters is evaluated. After one or more combinations of components have been chosen, only these are involved in the evaluation.

When Can You Use a Morphological Chart?

The morphological chart is usually applied in the beginning of idea generation. Function analysis is used as a starting point. Not all design problems are suitable for using the morphological method. The morphological chart has been successful in particular for design problems in the field of engineering design.

How to Use a Morphological Chart?

Starting Point

The starting point of a morphological chart is a well-defined design problem. A function analysis of the product that needs to be designed forms another starting point: the product should be described in terms of function and subfunctions.

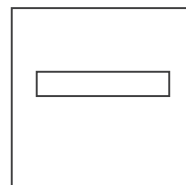
Expected Outcome

The expected outcome of the morphological method is a number of principal solutions (consisting of components) for the initial design problem.

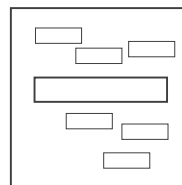
Possible Procedure

- 1 The problem to be solved must be formulated as accurately as possible.
- 2 Identify all the parameters which might occur in the solution (i.e. functions and subfunctions).
- 3 Construct a morphological chart (a matrix), with parameters as the columns.

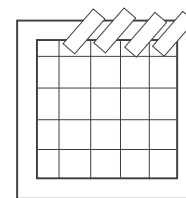
How to Morphological Chart



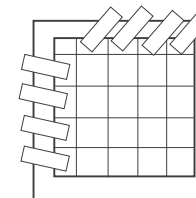
formulate the problem



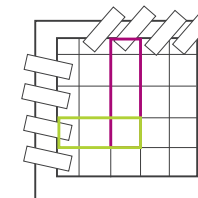
identify parameters



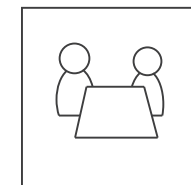
create matrix with parameters in columns



fill rows with components



create principle solutions



analyse principle solutions

- 4 Fill the rows with the components that belong to that particular parameter. Components can be found by analysing similar products or thinking up new principles for the parameters (functions).
- 5 Use the evaluation strategies (analysis of rows and grouping of parameters) to limit the number of principal solutions.
- 6 Create principal solutions by combining at least one component from each parameter.
- 7 Carefully analyse and evaluate all solutions with regard to (a part of) the criteria (design requirements), and choose a limited number of principal solutions (at least 3).
- 8 The principal solutions selected can be developed in detail in the remaining part of the design process.

Tips and Concerns

- When a combination of components has yielded a principal solution, be sure to draw all the components when developing the solution principle in sketches.
- You may be tempted to choose the 'safe' combinations of components. Challenge yourself by making counter-intuitive combinations of components.
- Do not describe the components in words, but use pictograms or symbols to indicate them.

References and Further Reading

Roozenburg, N.F.M. and Eekels, J. (1995) *Product Design: Fundamentals and Methods*, Utrecht: Lemma.

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