

THE MEANING OF CONCEPT IN DESIGN METHODOLOGY

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Abstract: On the field of design methodology concept and conceptual design do not sound unfamiliar. However, if we try to deepen into the topic, we may encounter polemics in some cases, one of which even the word concept itself. The aim of the paper is to present a kind of order in connection with designing a concept.

Keywords: *design methodology, design process, conceptual design, concept, mock-up*

1. INTRODUCTION

We can come across the word concept not only in the field of design methodology, but also in everyday life. Even within this field of science, the word concept and conceptual design are not clear. Authors do not always mean the same thing by conceptual design, which in many cases leads to polemics. The typical reason for this is the different languages researchers use. For an example Hungarian literature is based on German-language publications, the vocabulary of which is not easy to adopt. (Feldhusen & Grote, 2013) (Ulrich & Eppinger, 2012) The purpose of the publication is to reveal what can be called a concept and to point out the nuances of the word concept by systematizing the properties of these concepts.

When the designer begins to design a new equipment, considering the methodological recommendations, he or she usually finds functions from which he or she generates solution variants. These principal solutions are the concepts. During their evaluation, one, or in some cases a few, are selected and further developments are made on them.

Major car manufacturers present their concept cars at car shows (e.g., the famous Geneva Motor Show). In many cases, these vehicles are working models, which are made so that the manufacturers can see the reactions of visitors and critics of the exhibition in relation to one of their innovations. It is like a poll. If the response is good, the manufacturers will continue to deal with the given concept. But is that really all what the concept means?

2. THE PROCESS OF THE DESIGN

The steps of the design process based on VDI 2221 are shown in *Figure 1* (VDI, 1986). It can be seen in the flowchart that during the design process, every single step affects all the steps before and after it. There is continuous iteration, while the plan is constantly moving forward in the direction of product documentation.

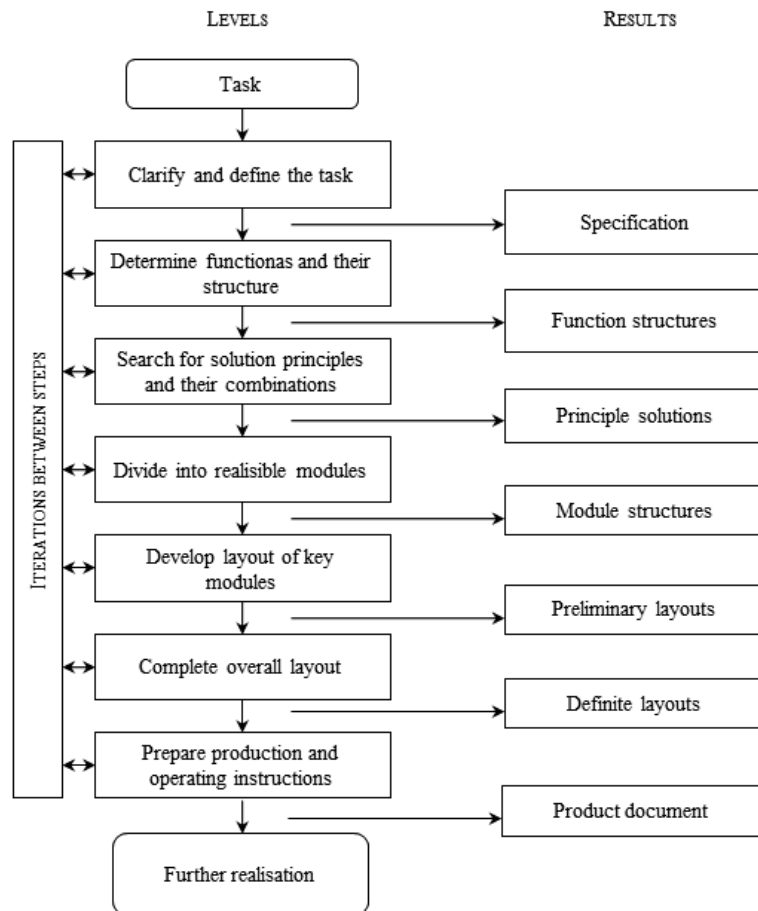


Figure 1. *The process of the design (VDI, 1986)*

According to the classic design methodology, conceptual design is the early phase of the entire design process, when the functions and form of the product are outlined after assessing the previous experiences, results, and user needs. Looking at the work phases in *Figure 1*, this lasts until step 4 ‘Divide into realisable modules’, the result of which are ‘Module structures’.

This can be called a principle solution or a study plan. However, the concept or study cars of the Geneva Motor Show mean more than that, they are obviously at a higher level of design. The concept according to classical design methodology only exists on paper, it has no real spatial extent, it is not tangible, even if the designer makes a sketch of it. On the contrary, a concept car is already a life-size model, some parts of which may even be functional units. Such models are theoretical models. During the evaluation of these theoretical models (e.g. critics' comments, or specific measurements, wind tunnel tests, etc.), mistakes and weak points are revealed, so they can be improved and developed. The result of this development is a working model. Every part of it fulfils its task, even though it is not perfect. If the errors of the working model can be corrected, a prototype is made, which is already an almost perfect model, and is also called a concept. *Table 1* clearly summarizes the difference between the various concept levels.

Table 1
Concepts in the different phases of the design – comparison

	principle solution	theoretical model	working model	prototype
model	no tangible	tangible	tangible	tangible
operation	principle	theoretical and real	real	real
pieces	one/a few	one	more	more/one
embodiment design	no	partly	totally	totally
size	–	not always 1 : 1	not always 1 : 1	usually 1 : 1

After all, the concept types summarized in Table 1 are built on each other: there is no prototype without a principal solution. Examining the design phases of technical creations, examples can be found of each of the concept types presented.

3. CONCEPT LEVELS

Designing a vehicle is a very long process. It often takes years to fully design a type, and during these years it is essential that engineers create different models in each phase of the design. So as to be able to show examples of the various levels of concepts described above in relation to a specific product, let's take the car body as an example.

Due to the complex nature of the car as a system, the path that the engineers take together consists of countless phases, each of which measurements, calculations, and simulations should be done. In order to carry out these tasks, different models should be defined.

3.1. Principle solution – hand drawn sketch as an example

Freehand drawing is very important in any field of design. Technological development is continuous, thanks to which more and more advanced versions of digitizing

tools are available for professionals, so freehand drawing is also changing, but its importance cannot be neglected, even if it is done on a digital board.

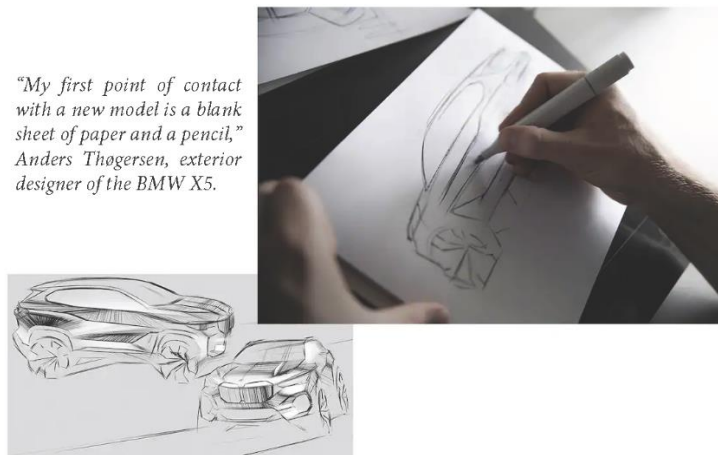


Figure 2. Hand drawn sketch from the shape [F2]

3.2. Theoretical model/Mock-up – clay model as an example

Study models or mock-ups serve the purpose of carrying out various tests and measurements on them. *Figure 3* shows the creation of a car body clay model. It is apparently a detailed work, but with its help designers can collect a lot of important information about the 1 : 1 scale model of the dreamed form. The importance of the procedure developed by GM chief engineer Harley Earl is so much unquestionable as it is still used today. For example, on a 1 : 1 sized clay model of a car body we can make aerodynamical experiments in a wind tunnel. From this point of view, we are now talking about the clay model as a mock-up.



Figure 3. Creating a car body clay model [F3]



Figure 4. Renault Morphose [F4]

3.3. Working model – Concept Car

Working models allow designers to examine certain parts of the design in action. In terms of cars, concept cars are of great importance. These are the models that are exhibited at various car showrooms, and those that can be taken for a test drive by interested possible customers, or which the main character of a movie races with on a cinema screen. These are the models with which car manufacturers can test the reactions of potential users or on which they can test certain experimental technologies. *Figure 4* shows the Renault Morphose concept car. With the help of the QR code that can be seen in the figure a video introducing the concept can be watched. *Figure 5* shows the Toyota Concept-i series concept.



Figure 5. Toyota Concept-i series [F5]

3.4. Prototype – Car crash cars

In some cases, prototypes are only almost fully functional versions, however, in many cases, e.g. in the case shown in *Figure 6*, functional, finished models are examined. The crash test shown in the figure serves precisely the purpose of allowing manufacturers to see how they comply the safety regulations of various agencies. For such tests, a preliminary series of 4-6 pieces is produced.



Figure 6. Side impact test [F6]

4. SUMMARY

Above it was presented at what levels the concept can be realized during the design process. It was introduced how different the concepts are in the meaning of how deep they are carried out through the examples of the automotive vehicle industry. It can be stated that a designer needs models and concepts in each step of the design process.

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SOURCE OF FIGURES

- [F2] <https://www.bmw.com/en/design/car-design-in-7-steps.html> (last open: 29. April 2023)
- [F3] <https://axleaddict.com/auto-industry/Sculptural-car-design> (last open: 29. April 2023)
- [F4] <https://www.renault.co.uk/concept-cars/morphoz-concept.html> (last open: 29. April 2023)
- [F5] <https://mag.toyota.co.uk/toyota-defines-the-future-of-mobility-with-concept-i-series/> (last open: 29. April 2023)
- [F6] <https://www.carscoops.com/2022/08/only-one-mid-size-car-got-a-good-score-in-new-iihs-t-bone-test-simulating-crash-with-suv/> (last open: 29. April 2023)