Basic Skills In Study Of Form (Styling)
Generating different styling proposals based on variations in surface orientation.

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Abstract
Product development or industrial design is a complex process. A process in which the product developer will have to play a different role, depending on the process stage: the role of manager, engineer, visualiser or creator of a shape for the future product.
Within this multidisciplinary approach, the phase of styling of a design concept, and presenting and considering different possible form alternatives is a necessary step in the decision-making process.
This paper describes a methodological approach in creating different design proposals based on a prelimanary determined volume. This approach is aimed at first year students industrial design or product development. Although these basic skills may seem obvious to experienced designers, our teaching experience has taught us that many students struggle with the ability to create valuable form alternatives.
The underlying foundation of this study of form is the step-by-step approach. The design process is divided into consecutive and comprehensive manipulations of a basis geometric mono volume.

First generation design:
The objectives of the first stage are focused on the insight that a mono volume is composed of a number of surfaces, and that the principle of unifying surfaces by replacing ribs by a radius, can already generate a large number of form variations. By varying the sizes of the different radius, the orientation of the volume itself will alter as well.

Second generation design:
The objectives of the second stage are centred on the insight that the results of the first generation design process are not an end point, but can be a starting point for further manipulation.
Firstly, we consider how the overall visual impact of the form will change into a more dynamic character by replacing the remaining (straight) ribs by curves, or by replacing the flat surfaces by curvatures. Secondly, by chamfering the new created ribs, by adding new surfaces, or by a combination of these manipulations.

Since it does not consider proportion or product details, this step-by-step approach does not guarantee aesthetical results, but provides insight into how the consecutive manipulation method can help students more easily generate form alternatives, based on different surface orientations.

Keywords: design education, modeling, form generation, study of form

1 Introduction
The Higher Institute of Integrated Product Development in Antwerp (Belgium) educate design students to become inter-disciplinary product developers. This integrated approach prepares the student for the realistic work environment, where a product developer should be able to think as and to communicate with managers, marketeers, engineers, cost-calculators, designers, etc.
A specific methodology is applied to integrate all relevant disciplines during the early stages of the design process [2].

Within the entire and complex process, the styling of (giving a form to) the design concept is an important phase. Sense for aesthetic proportion and detail and presentation skills have to be combined in order to persuade potential consumers or company decision-makers.
Most designers present different proposals for the styling of a product, comparing and considering the pros and cons of each proposal, to finally decide which one is the best.
As such, generating different valuable form alternatives is an important design skill.
Training these skills can be taught early in the educational programme, and to students with relatively little experience in drawing techniques (because of the heterogeneous inflow of students, they are only assumed to possess a basic knowledge in drawing). Good abilities in spatial thinking and insight in 3D, combined with basic skills in perspective drawing and rendering techniques, are sufficient to understand the basics of how form alternatives can be generated. Teaching this basic skills in the study of form is integrated in an overall course 'Spatial and Visual Thinking', and is programmed in the first semester of the study.

Completeness is not the aim of this paper. Styling and form study cover more aspects than considered in the approach below. Semantics, meaning of form, emotional connotations, aesthetic proportions, harmony, color, materials are only a few examples of form related issues that are extremely relevant to design, but less relevant to the limited methodological approach in this case. These topics are subjects of other training programmes in the curriculum of the institute.

2 Basic skills in the study of form

The basic idea in this study of form is the step by step approach (fig. 1). The design process is divided into consecutive and comprehensive manipulations of a basis geometric monovolume.
Thanks to this systematic design method, the students can keep a clear overview over the different steps of a design process (design process here understood as 'the form-giving process) and can gain insight into the composition of more complex designed objects.

Figure 1: scheme of the step-by-step approach

2.1 First step: Design of the First generation

The objective of the first step in the manipulation process is the insight that a geometrical mono volume is composed of a number of surfaces.
When unexperienced design students start creating shapes, they spontaneously draw mostly basic geometrical volumes: cubes, rectangular blocks, cylinders, pyramids, or in a second stage "extruded" irregular ground- or side surfaces. Those extruded volumes could be described as 'two dimensional volumes'. Irregular surface compositions (based on a more three dimensional approach) are rarely generated in a first quick design sketching session.

Replacing edges by a radius
Introducing the design principle of unifying surfaces by replacing edges by a radius, can already generate a large number of form variations. Depending on which edges are being eliminated, results can vary from extruded volumes to some totally other and more three dimensional surface orientations.

To illustrate the first step, a simple rectangular block is used as a starting point. This block is composed of six planes or surfaces, the borders between these surfaces are called edges.
By eliminating edges en replacing them by a radius, the initial six surface volume will be turned into a five, four, three, two or one surface volume. Looking for as many different possible solutions, eg. a

four or three surface volume, stimulates the spatial thinking and will automatically result in a variation of surface orientation. (figure 2).

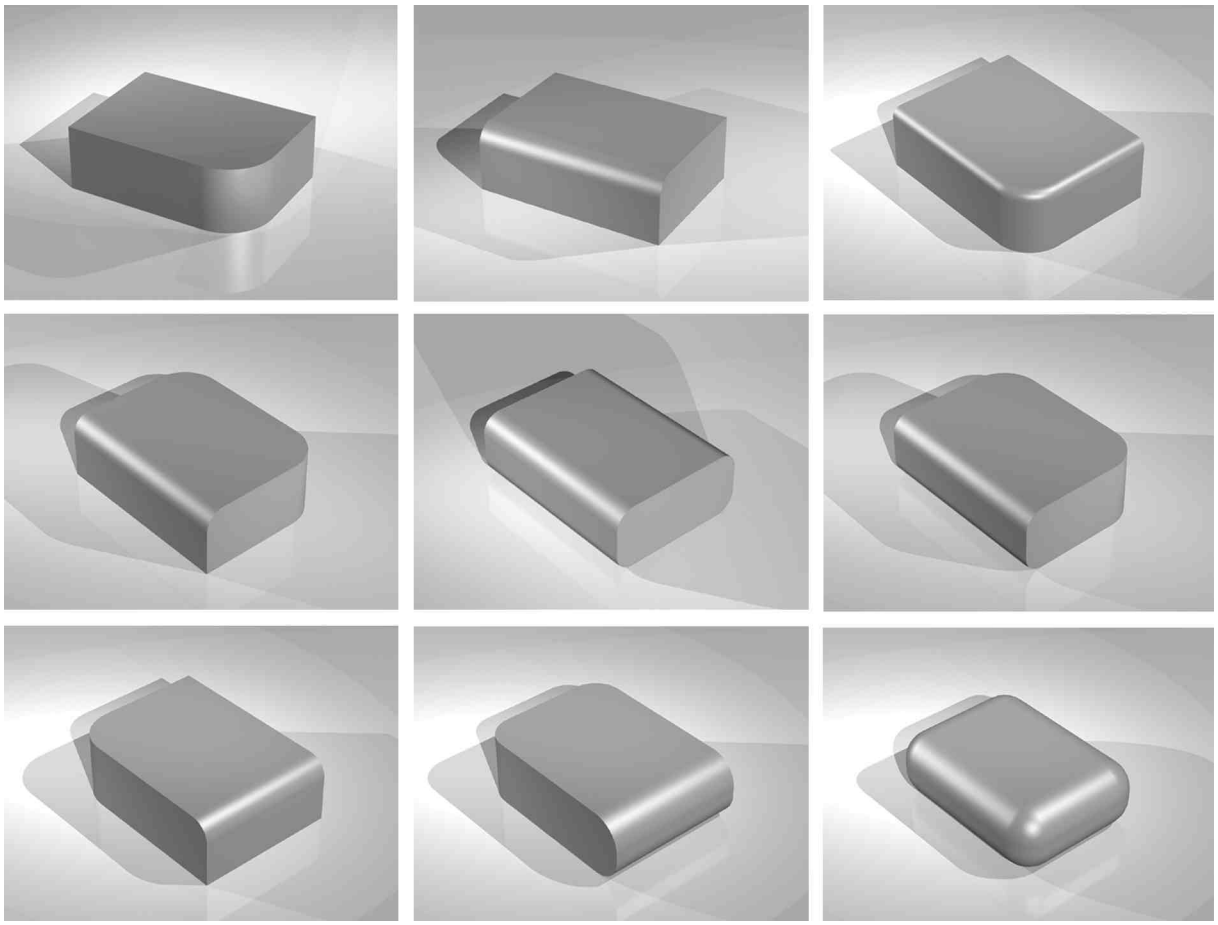

Figure 2: variations in form as a result of the first generation design.
The six surface volume is changed into a volume consisting of less surfaces.

In a first stage students are asked to sketch (in perspective) as many different surface orientations as possible. These sketches will show that some students have difficulties in imagining the 3D shapes, and since paper is patient, students sometimes draw impossible configurations, mixing sharp edges with a radius in the same view.
In the second stage, students have to produce foam models of the different generated forms, and study the impact of different sizes of radius. By varying the size of the radius, the orientation of the volumes alter.

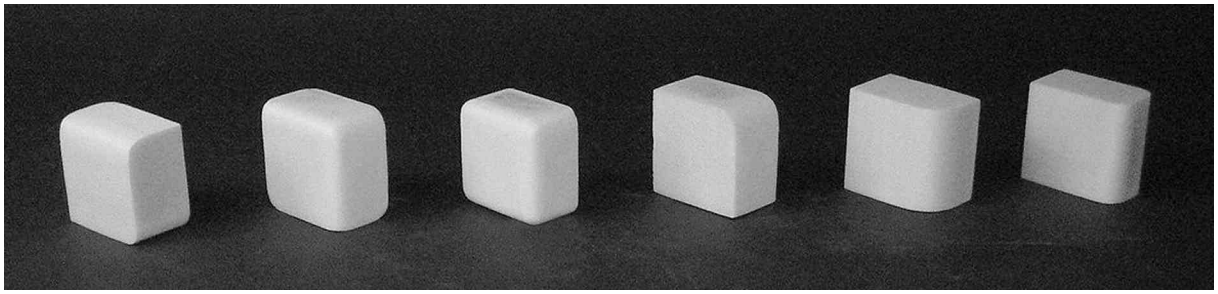

Figure 3: Example of student's work: a series of first generation form studies realised in Polystyreen foam.

2.1.2 Conclusion of the first step

The results of the first step can be described as designs of the first generation: the original volume is still very recognizable, the newly generated surfaces stay flat, edges between a radius run straight, radius are circular.
Looking at design history, one will notice that a lot of the industrial design products from the 60s and 70s, refer to this design of the first generation. Design historians and specialists call this formal language “Functionalismus” or “German Design”
The objectives of the HFG from Ulm (The ‘Hoghschule für Gestaltung’, a design school evolved from the Bauhaus) was to achieve a new aesthetic synthesis: product had to satisfy physical and psychological needs, questions about aesthetics were based on psychological grounds.
A rational form approach was one of the cornerstones of the Ulm School. This ‘exact mathematical geometry’ design principle became very popular and influenced a lot of European designers at that time. Products of this generation had a recognizable styling language, were simple, geometric, with a lot of mutual uniformity.
Under the infleunce of Braun (an electronical appliances company) and the Ulm Highschool, the Deutsche Design standard became so widely spread, that even today products with a strictly geometrical styling (design of the first generation) are referred to as having a German styling (fig. 4).

Figure 4: A few examples of products designed according to the German - Ulm design principles.

2.2 Second step: Design of the second generation

Looking at most contemporary products, and analysing the styling, one can conclude that the surface composition of most of the monovolume-products can be converted into one of the basic surface orientations from the first phase: a five, four, three, two or one surface volume.

The objective of the second step in the process is the insight that the results from the first step are not an end point, but can be a starting point for further manipulation. A few simple techniques are introduced to refine the generated volumes from the first generation.

2.2.1 Replacing the straight edges by curves

By curving the remaining edges, and/or the remaining surfaces, or a combination of both, and by varying these curves in dimension, the overall character of the initial surface compositions can be changed dramatically. An edge can obtain more tension by replacing it by a curve, a plane can obtain, literally, an extra dimension by curving, or double curving it. As the illustration (fig 5) shows, starting from the same planar orientation, in this case a two-surface volume, many different shapes of overall design can already be imagined.

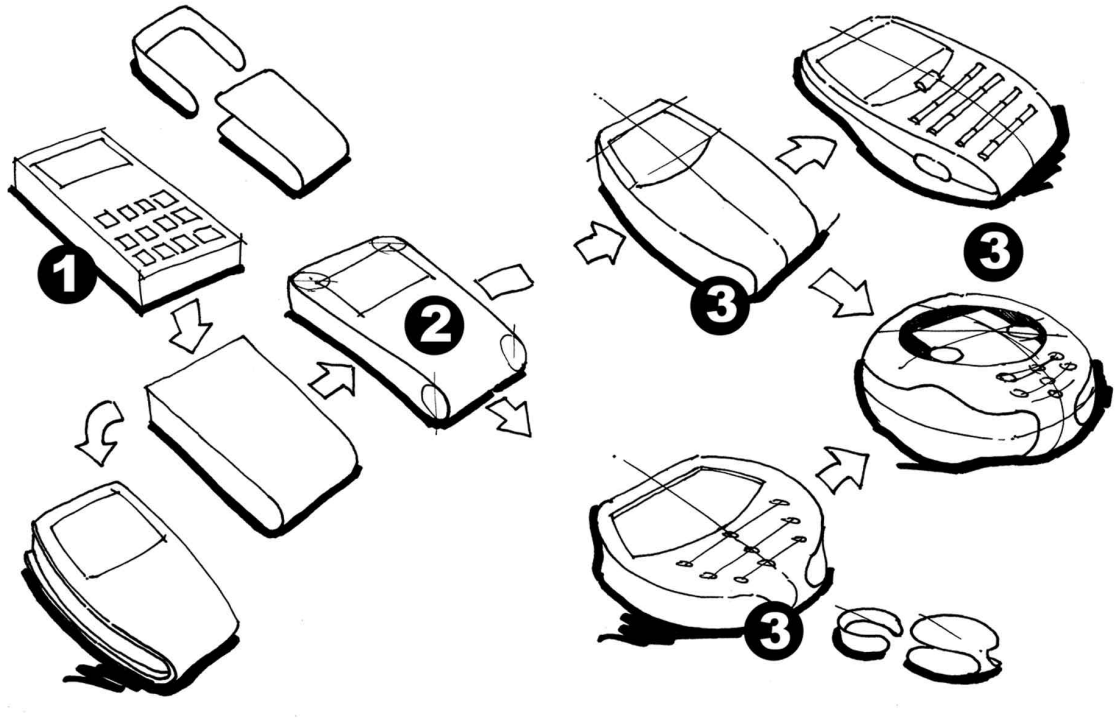

Figure 5: the original basic volume (1) is turned into a design of the first generation: a two surface volume (2). By replacing the straight edges by curves, different designs of the second generations can be generated (3).

2.2.2 Adding surfaces

Another possible technique to upgrade a form to a design of the second generation, is by adding surfaces.

Adding surfaces by replacing edges by a chamfer.

Again two possibilities: firstly, starting from the original basic geometrical volume, instead of replacing an edge by radius, one can replace an edge (or several) by a chamfer. Replacing one edge leads to a seven surface volume, replacing more ribs can lead to complex faceted volumes.
Secondly, the chamfer technique can also be applied to the results of a first generation design. In this case, the new surface (chamfer) will replace a remaining edge after the fist manipulation of the basic volume (and thus having an advanced 3-dimensional course).

Figure 6: adding surfaces by chamfering
left starting from a basic geometrical volume, in the middle starting from a first generation design, right adding a surface by making a cut.

Adding surfaces by making cuts (principle of substraction of volume).
Although chamfering an edge can be strictly considered as a cut as well, this technique is based on making cuts in other parts of the volume besides the edges, or by making non parallel cuts. Depending on the number of cuts made, or the shape of the cut, one or more surfaces are added. Also double- curved cuts are possible. The results of this manipulation can be totally different than the results obtained by the former techniques.

Adding surfaces by adding volumes (principle of addition of volume)
A third possibility to add surfaces to a monovolume is by adding one or more volumes and joining them. Depending on the size of the added volumes, the original monovolume can no longer be considered as a monovolume, but is now turned into a multivolume (fig. 7). The study of form of multivolumes is more complex and goes beyond the basic skills explained is this paper, although global surface orientation can be studied in the same way, and the techniques of a second generation design can be applied as well.

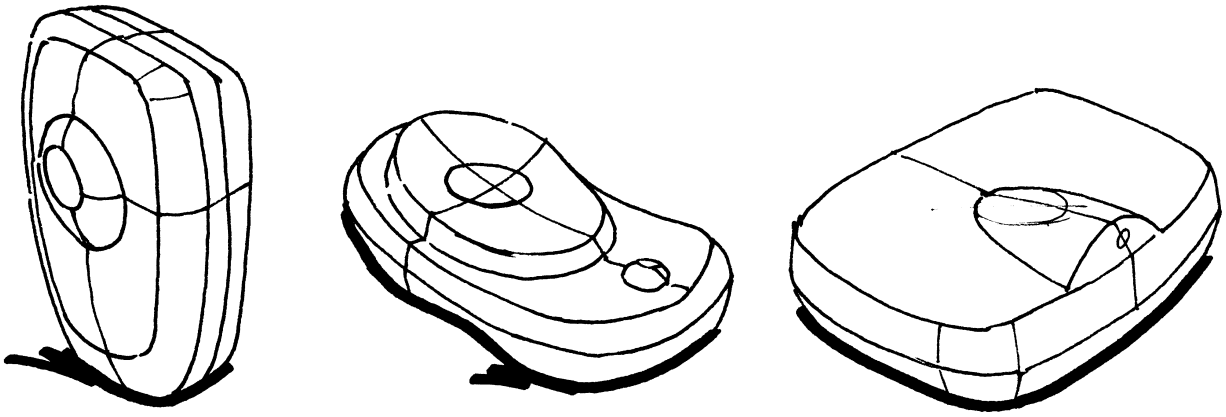

Figure 7: adding surfaces by adding volumes.

2.2.3 Conclusion of the second step
The results of the second step can be described as designs of the second generation.
Based upon the different surface orientations of the first generation designs, the forms are brought to a higher level. By replacing straight edges by curves, or by judiciously adding surfaces, the overall perception of the forms can become more refined and sophisticated. Trained designers will automatically combine the different techniques in one design.

Merely applying the different techniques does not guarantee aesthetical objects, therefore insight into composition, harmony, mutual relations in dimensions and an aesthetic ‘sense’ are required. Good design in terms of a beautiful shape is also more than a equilibrated planar orientation with well balanced curves. Integration of formal details, general interface layout, or the choice of materials and colours are only a few of the additional aspects that are of great importance to the overall perception of a product.

3 General Conclusion
Controlling basic skills in the study of form, is just one step on a long road to becoming a fully fledged designer.
The underlying foundation of this study is aimed at first year students industrial design or product development. The step-by-step approach, dividing the process into consecutive and comprehensive manipulations of a basic geometric monovolume, gives students a clear overview of the different steps in a design process (design process here understood as ‘the form-giving’ process) and provides insight into the composition of more complex designed objects.

The methodological educational approach to the rational study of form, combined with an integrated teaching method (spatial thinking, visualization by means of perspective drawing and rendering techniques, and verification by means of foam model making) has proven to be effective. The course clearly provides the students with a good base for further form study in the educational programme in industrial design.

As a designer you are never fully qualified, because the urge to explore new boundaries, and the search for new applications will always be present, therefore, every new design will form a new challenge.
If students end up analysing each form in function of the composition of the surfaces and the application of the curves at the end of a basic skills training programme, it will have achieved significant progress towards the awareness of the study of form.

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