Function Follows Form:  
A Reverse Process Design Project

Jason A. Morris  
Assistant Professor of Industrial Design  
Western Washington University

How can we encourage our students to be truly creative? How can we teach them not to just follow the styling of the latest design magazine but, instead, push themselves to levels of creativity they didn’t imagine were possible? One answer lies in process, the process that they use to solve a design problem. It’s the road that they take to arrive at their solution. If they follow the same old route, they’ll arrive at the same old place.

But, how do we inspire our students to use alternative processes? There is more than one way to approach an industrial design (ID) problem. The traditional design method works, however, many students shut down when given a list of requirements and constraints. The introduction and use of alternate processes opens their creativity to new paths. This reverse design project uses one alternative process that was used with success with third year ID students at Western Washington University (WWU) in February of 2005.

The following lists outline the sequence of steps for traditional design process and the alternative sequence used in this project.

The traditional route for ID:

1. Design brief and introduction to the purpose  
2. Research  
3. Sketching (two dimensional)  
4. Concept rendering (two dimensional)  
5. Refinement drawings (two dimensional)  
6. Model making (three dimensional)  
7. Detail design (in digital three dimensions)

The route taken in reverse process design project:

1. Model making form studies (three dimensional)  
2. Sketching of models (two dimensional)  
3. Design brief and introduction to the purpose  
4. Research  
5. Revisions of form (three dimensional)  
6. Final model making (three dimensional)  
7. Detail design (in digital three dimensions)

How does this work? How can students begin with model making if they don’t know what it’s for? In order for this to work the instructor and the students need to do some background preparation.

The process is only reversed from the student’s perspective. The educator still needs to know the designs purpose and objective. The design is broken down into essential elements and the labels are removed. The names of objects carry a load of associative preconceptions. The instructor translates the objects into its three-dimensional form description. For instance, instead of requiring two AA batteries, we call them two cylindrical volumes. Instead of calling it a graphic display, we call it a dynamic planar element. Instead of a table, it’s a horizontal planar element. In
This example, a racecar is called a rectilinear volume. However, the students need to understand this three-dimensional form language.

This understanding begins with abstract form theory, a structure of abstract visual relationships. Prior to this project, the third year ID studio class at WWU had been studying and doing the exercises of Rowena Reed Kostellow's three dimensional design form theory. These exercises were developed by Ms. Kostellow during her celebrated career as a professor at Pratt Institute from 1938 to 1972. The goal is to develop a student's sensitivity to form: to create it, analyze it, and understand it based on this formal theory of spatial relationships.

“We introduce the student to an ordered sequence of purely visual experiences by which an artist may develop his understanding and his recognition of the abstract elements in any design situation.” —Rowena Reed Kostellow (Hannah, 42.)

Rowena’s form theory describes form in terms of character, axis, balance, dominance, and position. Students learn about dominant forms and axes through the first rectilinear exercise. They then create dynamic compositions with curvilinear volumes such as cylinders, ovoids, and cones. They wrestle with elements that have linear, planar, or volumetric character. Through this process the student is learning to “see.” This visual sensitivity is the fundamental core strength of a designer. Without it, designers may as well be creative engineers, or intuitive ergonomics experts, or savvy market researchers.

“All three-dimensional projects should be designed three-dimensionally. You can't develop a good three-dimensional design on paper. That's like drawing a piece of sculpture.” —Rowena Reed Kostellow (Hannah, 40.)

Here is how the project was introduced to the students:

“The next project is going to be done with a different process. We are going to investigate a form, and study it independent of its function. We will do these exercises with no knowledge of their purpose. We will then bring in the purpose and function and refine our concepts appropriately.”

Students were then given a list of rules that their form exercises must follow:

**Plane and space study guidelines:**

1. Make five studies out of foam core and paper (all white)
2. Fit each within an 11 x 11 inch base
3. Include a rectilinear volume of 9" x 5" x 2"
4. Include 2 to 4 other elements in the composition, stay with odd number of pieces
5. Make others to be planar and linear in character, they can be curvilinear and/or rectilinear
6. Express motion and speed in your composition
7. Make the studies to be self supporting
8. Think about negative space, create an organization that expands the negative volume, activates the negative volume, make it come alive
9. Use all of your axes
10. Use space as a design tool
11. Make form elements should be complementary and should vary in character and proportion
12. Consider how planes pierce and intersect
13. Place the first element with great consideration
14. Establish dominant, subdominant, and subordinate relationships
15. Use the movement of the axes and the tensions among the surfaces of the planes to activate the space
16. Use the curvilinear language of the wire problem
17. Establish unity in the composition
The students have five days to complete this assignment. They are to make five abstract form studies, photograph them, and draw each one as a still life with charcoal on large paper (18 x 24). This assignment serves the purposes of aesthetic focus, drawing versatility, and the study of light and shadow.

The students are able to focus on the beauty of their design, independent of the constraints of purpose. They concentrate on the proportions, the relationships, the axes, and the visual interest. Most importantly, they are learning how to be visually sensitive to form and space.

They were asked to photograph each one partly to get them in the habit of documenting all of their work, but also so that they can study how light and shadow effects the perception of their form.

The students draw each form with charcoal on large format paper to break them out of their conventional drawing methods. Many of them are used to making little thumbnails in their little sketchbooks with pen. Charcoal is a very tactile form of drawing media. Large paper forces them to be more active and use their entire arm in the drawing. It’s also important for them to realize that there is a big difference in going from form to paper rather than from paper to form. The question is asked, “Would you have arrived at that 3-D form by starting with a drawing?” (Figure 1) It’s unlikely, because drawing is inherently a 2-D medium. How many times has one seen bad design that is simply an extrusion of a designer's drawing?

Figure 1: Charcoal drawings of the form studies.

Five days later, the students present their form studies and charcoal drawings. We critique them using the guidelines given and discuss our favorites and why they work. Which one expresses motion and speed? Which one has the most dramatic character? Which one activates the negative space around it? Which one would you want to be inside and walk around? (Figure 2) After this critique, we then visit our “client” to discuss our design project and the function of our forms.
The Vehicle Research Institute (VRI) is a program within the Department of Engineering Technology at Western Washington University that teaches engineering by designing and building working vehicles. The VRI is entering the Society of Automotive Engineers (SAE) formula car competition and needs a way to present their car in an exhibit type display. The following is their design brief:

**Formula SAE Competition VRI exhibit**

**Length:** 2 weeks  
**Objective:** Design an exhibit space for the Vehicle Research Institute (VRI) to present their SAE Formula car in the national competition.

**Design requirements:**
- Car is 9.5’ x 5’ x 4’ high (visit VRI to see example)  
- Space for exhibit is about 11 x 11  
- Must be easily transported  
- Must be easy to manufacture and construct  
- Must display Formula car dramatically  
- Must display text, data and photographs about the vehicle  
- May be outdoors, consider weather protection (wind/rain)  
- May allow observers to view and inspect car from all angles

The class visited the lab full of cars of all types in various stages of construction. The ID students talked with Professor Eric Leonhardt and the student SAE team about their car and the competition. (Figure 3) How do they display it? Where? When does it happen? Who’s judging the car? What kind of information do you want to show?
After this discussion and much note taking we go back to the studio. “Now, let’s look at those form studies. The large rectilinear volume of your form studies represents the formula car!” We laugh at some of the solutions. “My car is standing up on it’s nose!” a student remarks. But for many of them, a light goes on. Strange and wonderful solutions have presented themselves.

The designs are then reviewed for ideas, inspiration, and possibilities. A selected form study is then refined by applying the realities of the design objective. Further refinement then brings the design down to earth. (Figures 4 and 5) The final design is modeled as close to actual construction as possible with color and graphics applied. (Figures 6-9) This model was presented to the entire Formula SAE vehicle team (about 30 vehicle design and engineering students). Here we reviewed the design to get feedback on from the VRI students as they consider how each design could be made, used, and transported. (Figure 10)
What did the client think? Professor Eric Leonhardt and his students were enthusiastic about the design and how it would present their vehicle in a way no other school has done. The Formula SAE project manager, Brian Seiler said:

We were stoked to see the designs. It’s a great idea to flip the car up to view the engine and other components. We’d like to build it this summer and use it for the other cars, like Baja, in the other competitions. We need more multi-disciplinary projects like this.
What did the ID students think? The students admitted that the final designs were by far more
different and interesting than what they would have done using traditional methods. The process
presented challenges that the student’s had to contend with and make practical. But, in the end, it
resulted in highly creative solutions that caused excitement with the client as well as the students.
The following are some comments from the students in the class.

What did you learn or take away from this reverse process design project?

“It was a super cool way to come at a project. By not having a final product in mind, your creativity
wasn’t tainted at all and some super cool forms and ideas came of it. We are so programmed to
what certain objects look like and it is very hard to overcome those preconceptions. But working
backwards and finding out what you are making at the end of the project really allows your
pure creativity to show through.” —Ryan Jorgensen

“It was really interesting to design a form around words [motion and speed].” —Doug Groenveld

“I also used the lines from the drawings of the forms to inspire the final design.”
—Adran Nakagawa

How did it feel to not know what the project was for?

“I loved it, it could have been an MP3 player, a car, a water bottle, anything. No matter what it
turned out to be, those form studies would have turned up in the final product. With knowing what
it was before hand every form study you made would have been tainted by the known forms of
the final product.” —Ryan Jorgensen

Most of the reaction was positive, however a couple of students essentially threw the form studies
away and started over after hearing the real project design description. They seemed to have
difficulty making the translation from abstraction to reality. The result of their final design was
consequently less interesting, and got less attention from the client.

So is this “design for the real world?” Well, Victor Papanek might not think so. But alternative
creative process can be used on any real world design problem. The real world of professional
industrial design requires highly creative people who can bring desirable objects to the market.
The development of a student’s creativity and visual sensitivity is therefore paramount to design
education.

Reference

Gail Greet Hannah, Elements of Design: Rowena Reed Kostellow and the Structure of Visual Relationships, Princeton