

HOW TO CONSTRUCT FORM LOGICALLY BASED ON HUMAN DESIGN TECHNOLOGY AND FORM CONSTRUCTION PRINCIPLES

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Abstract: This paper describes a new method to construct a form logically based on form construction principles and Human Design Technology which is a systematic design and products development method. A basic form is constructed based on the structured concept, seventy design items of HDT. Next, the form construction principles transform the basic form into a final form which is very attractive. The form construction principle comprises (1) the flow of plane of a form, (2) simple form, (3) accent for a form and (4) greatness of volume on a plane. The procedure: 1. The structured concept is constructed based on user requirements. 2. A basic form is designed based on the structured concept, the seventy design items. 3. A basic form is transformed into a final form using the form construction principles. The color and feel of a material and so on are decided at the same time according to the structured concept.

Keywords: *Human Design Technology, structured concept, form construction principle*

1. Introduction

Industrial designers have constructed forms of products intuitively. Although they calculated the psychological and aesthetic effect of form logically in their brain, their thinking process of form is not CLEAR and LOGICAL. They usually drew a lot of sketches in order to create a new and good form without making strict concept. The level of design are changed by their ability, skill and experience. Although their effort to create a new and good form is very important, their activities take a lot of times and are ineffective and useless. They should construct forms logically and systematically in order to make good forms and work efficiently. HDT(Human Design Technology) (Yamaoka,2003,2011) provide logical and systematic method to design with designers, and so the level of design becomes to be constant. As users in advanced nations are conscious highly of design or quality of products, the design of products should be developed strictly based on user needs, cost and functions in 21 century,

This paper describes the logical and systematic method to construct forms of products based on the form construction principles and HDT.

2. Related study about design process

Famous “Analysis, Synthesis and Evaluation” is traditional, basic and used very well in the world as the design process such as industrial design, information design, graphic design and so on. The process was proposed and constructed logically and systematically by R.D.Watt (Watt,1966) , Cristopher Jones (Jones,1970) and so on. However the weak point in the process is that it does not define the design concept logically and strictly. Designers usually create design based on unclear design concept which they produce using the traditional process in their brain. They cannot explain their design concept clearly and the form logically and strictly without some logical designers. HDT creates new form and design based on design concepts structured logically. Namely creativity is produced based on the concept. Another weak point is that the traditional method cannot separate logical part and visualization part of design work. As designers always think functional idea and usability and so on and then create the form based on them, it takes a lot of time to complete the design. However, after a design concept is constructed strictly, a form is narrow down based on the design concept easily. Designers need not draw a lot of sketches. HDT method is more effective than the traditional method according these results.

3. What is Human Design Technology?

HDT is defined as technology that scientifically analyzes human beings and uses various information related to humans (i.e. physiology, psychology, cognition and behavior) as design conditions. HDT is also a new design and product development method namely.

The following steps comprise the HDT process.

- a) Gathering user requirements
- b) Grasping current circumstances
- c) Formulating product concepts
- d) Designing (synthesizing)
- e) Evaluating the design
- f) Surveying usage conditions

3.1. Formulating product concepts (Yamaoka,2003)

The structured concept is constructed based on user requirements at this step. List the condensed user needs (defined as user requirements) appropriately at the top or bottom to form a product concept (Figure 1). The weighting of the different concept elements is particularly important as a measure to ensure logical continuity among them. This is also significant for revealing the elements that are important. Since the weighted values also serve as a ratio for manufacturing costs, items of lower weighted value can be excluded when cost requirements aren't met.

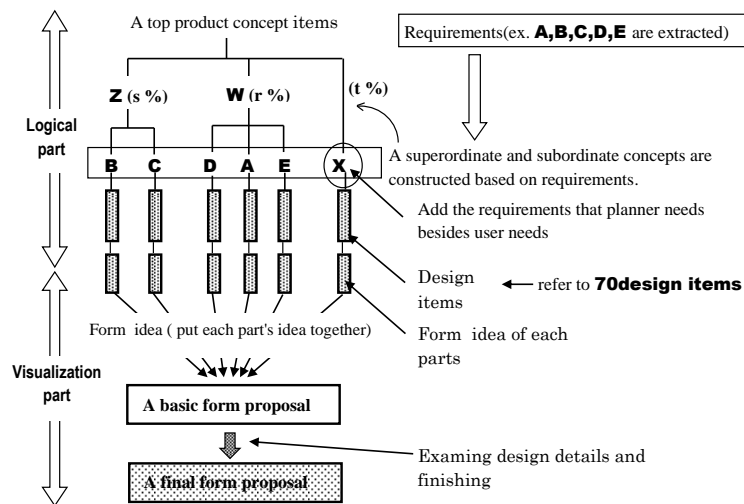


Figure 1. Visualization based on a structured design process

(1) A bottom-up product concept method in structured product concept

Problems and needs acquired in the gathering user requirements step are converted into user requirements, classified by function and placed in hierarchies. Since the requirements originally arose from problems, any necessary and sufficient elements of a product that are omitted, or elements whose addition may be desirable from a planner's point of view, can be added to the concept as the occasion demands.

(2) A top-down product concept method in structured product concept

Important keywords of a product that the planner wishes to develop are created for a superior concept. They are then broken down into their individual components, and those necessary for putting the concept into practice are selected to form a group of elements of an inferior concept, thereby giving them structure.

3.2. Designing (synthesizing)

The design is visualized based on the product concept. HDT requires that the design is done based on the seventy predetermined design items (yamaoka,2003). Seventy design items are as follows.

(1) User Interface design items (29 items)

- 1) Flexibility, 2) Customization for different user levels, 3) User protection, 4) Universal design, 5) Application to different cultures, 6) Provision of user enjoyment, 7) Provision of sense of accomplishment, 8) The user's leadership, 9) Reliability, 10) Clue, 11) Simplicity, 12) Ease of information retrieval, 13) At a glance interface, 14) Mapping, 15) Identification, 16) Consistency, 17) Mental model, 18) Presentation of various information, 19) Term/Message, 20) Minimization of users' memory load, 21) Minimization of physical load, 22) Sense of operation, 23) Efficiency of operation, 24) Emphasis, 25) Affordance, 26) Metaphor, 27) System Structure, 28) Feedback, 29) Help

(2) Kansei(sensitivity) design items (5 items)

- 1) Color: Color elements like peaceful colors and unconventional colors.
- 2) Fit: A sense of human and machine integration such as comfortable shape or an enveloping sense.
- 3) Shape: Elements like a simple shapes or smart shapes.
- 4) Functionality and convenience: Elements related to function and convenience such as good

functions and usability.

5) Sense of material: Elements that have a sense of material such as the richness of a material the novel use of a material.

6) Design images: Design image elements like contemporary, nostalgic and chic.

7) Ambiance: Elements like nice interior and relaxing atmosphere

8) New combinations: The effect of completely new combinations such as image and audio combinations or harmonizing contradictory items.

9) Unexpected application: Although this is closely tied to new combinations, it is a basic item that evokes a Kansei reaction.

(3) Universal design items (9 items)

1) Adjustability, 2) Redundancy, 3) Understanding function and feature at a glance, 4) Feedback, 5) Error tolerance, 6) Acquisition of information, 7) Understanding and judgment of information, 8) Operation, 9) Continuity of information and operation.

(4) Product liability (PL) design items (6 items)

1) Elimination of risk, 2) Fool proof, 3) Tamper proof, 4) Guard, 5) Interlock, 6) Warning label.

(5) Robust design items (5 items)

1) Strong material, 2) Examining shape, 3) Strong structure, 4) Design reduced or avoided stress, 5) Design for unconscious behavior.

(6) Maintenance items (2 items)

1) Keeping space, 2) Easy operation.

(7) Ecological design items (5 items)

1) Durability, 2) Recycling, 3) Very few materials, 4) Most suitable materials, 5) Flexible design.

(8) Other (5 items)

Five aspects of the human machine interface: 1) Physical aspect, 2) Information aspect, 3) Temporal aspect, 4) Environmental aspect, 5) Organizational aspect.

4. The basic form is transformed to be sophisticated using the form principles

The basic form which is created by the structured concept of HDT is transformed into the final form by the form construction principles.

4.1. Form construction principles to create and visualized products

Designers can analyse and create forms using the form construction principles. The principles make the basic form sophisticated and attractive. The form construction principles are as follows.

(1) The flow of plane of a form (Figure 2 and 3)

- a) The flow of plane of a form
- b) The no flow of plane of a form : The plane of forms is not related to another plane of a product
- c) The combination of a) and b)

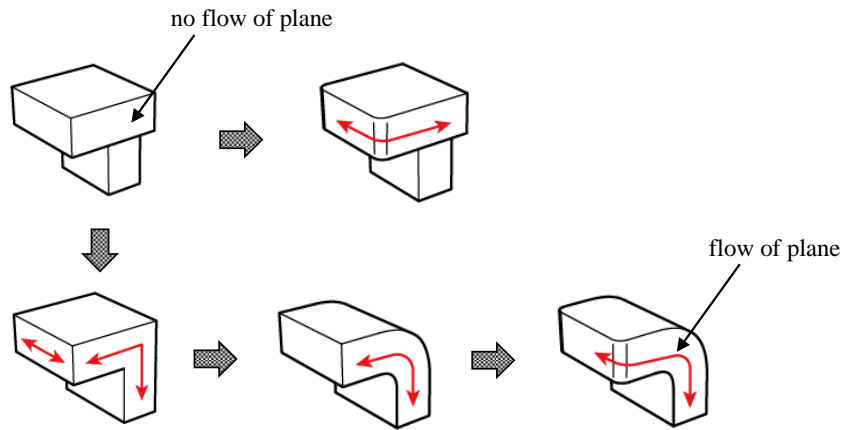


Figure 2. Example 1, the flow of plane of a form

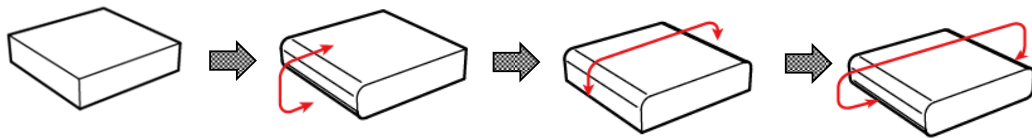


Figure 3. Example 2, the flow of plane of a form

(2) *Simple form (Figure 4)*

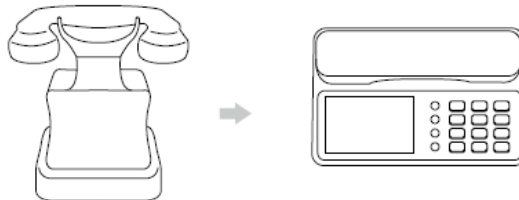


Figure 4. Simple form

(3) *Accent for a form (Fig.5)*

The accent for form comprises the following items.

- a) Change the form
- b) Uneven form
- c) Round off the corners of form
- d) Use parts
- e) Use color

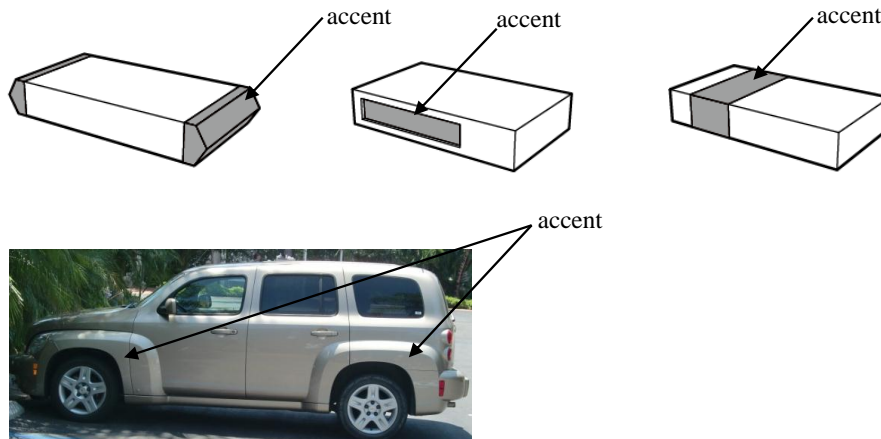


Figure 5. The accents form

(4) Greatness of volume on a plane (Fig.6)

- a) Convex plane
- b) Round off the corners of form
- c) Feel a material

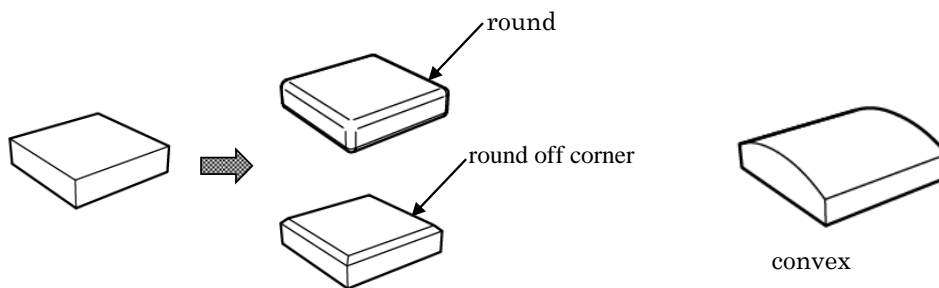


Figure 6. Greatness of volume on a plane

4.2. The procedure of proposed method

The procedure of proposed method is as follows.

- 1) The structured concept is constructed based on user requirements.
- 2) A basic form is designed based on the structured concept and the seventy design items of HDT.
 - a. In case of function decided in advance (Figure 7)
 - i. A form is constructed based on the function at first.
 - ii. The form is transformed from view point of design concept, especially usability, aesthetic aspect using the form construction principles.
 - b. In case of function undecided in advance
- 3) A form is constructed based on the design concept, especially usability, aesthetic aspect using the form construction principles.
- 4) The color and feel of a material and so on are decided at the same time according to the structured concept.

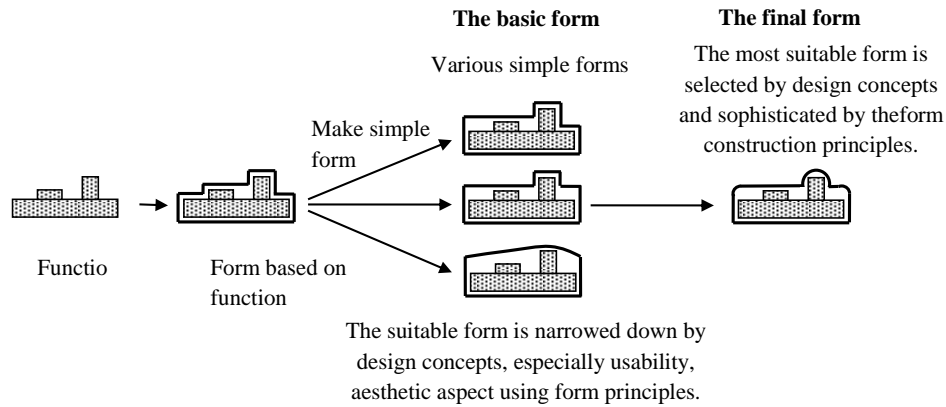
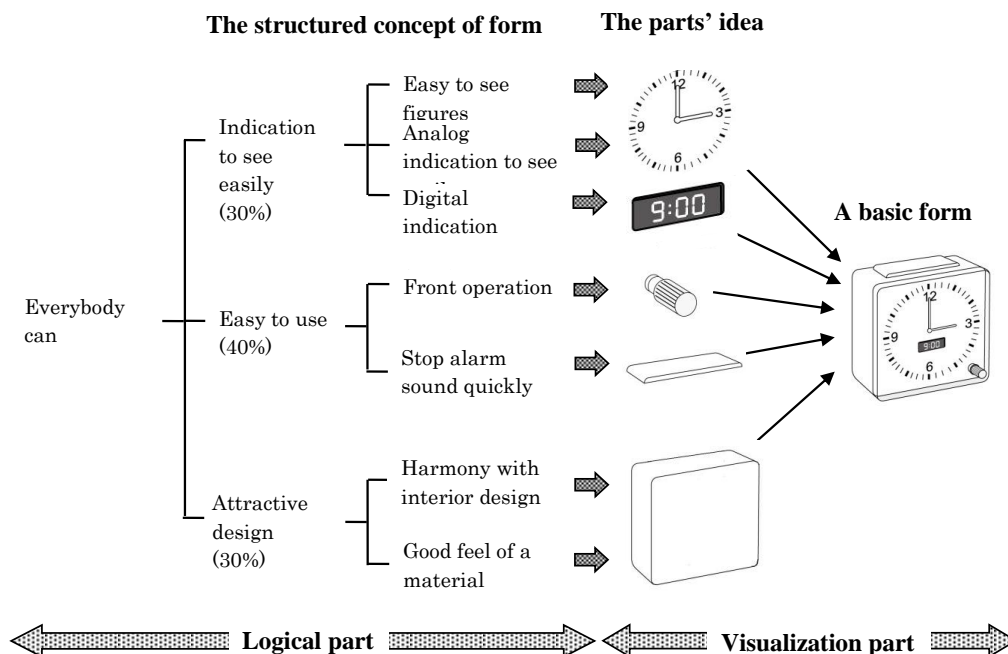


Figure 7. Relationship between function and form

5. An example using the proposed method

A form of alarm clock was constructed as an example using the proposed method (Figure 8).

- 1) The structured concept was constructed based on user requirements. The target users and the design specification were decided.
- 2) A basic form was decided according to the structured concept. The outline of form was narrowed down as the basic form.
- 3) The basic form was also examined from view point of ergonomics and the form construction principles. The flow of plane, Simple form, Accent and Greatness of volume on a plane make the basic form attractive. Ergonomics makes the basic form usable.
- 4) The material and color were also decided based on the concept.
- 5) Finally the proposed form was evaluated from view point of target user's preference and marketing research and so on.



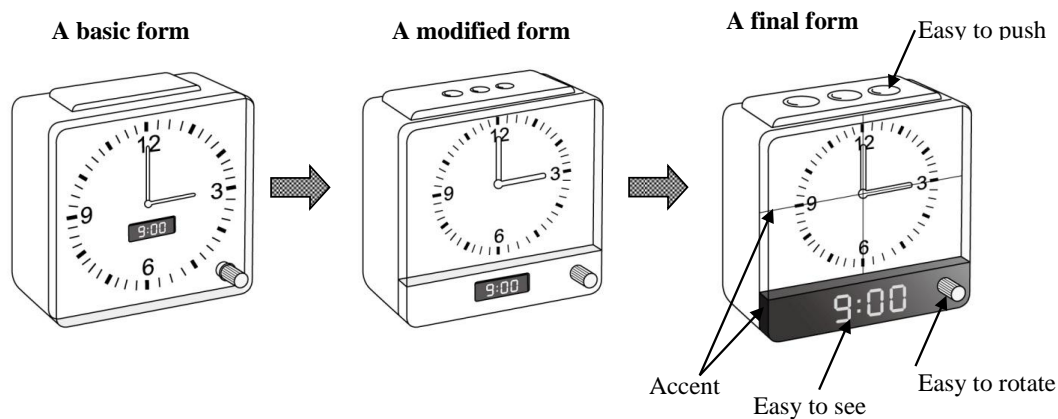


Figure 8. The form of alarm clock created logically based on the concept and form principles

6. Verification, validation and conclusion

This paper described the logical method to create form based on the structured concept. Usually designers create a lot of ideas of form without a strict concept. Such works are not efficient and make designers tired. As shown in Figure 9, the proposed design method is more efficient than the traditional design method. A GUI design based on HDT without using the form construction principles was compared with a GUI design based on the traditional design method (Hirata et al.,2011). The results are as follows:

- 1) HDT is efficient and effective for GUI designing.
- 2) It's effective to introduce HDT to small business.
- 3) It's convenient to examine analysis and remedy of product because of the structural concept.

HDT was evaluated by 19 specialists including designers and engineers (yamaoka,nishimura, 2002).

The results were “completely good:2”, ”mostly good:9”, “slightly good:5”, “so-so:2”, ”slightly bad:1”, “mostly bad:0” and “completely bad:0”. As these results show HDT efficient and effective, HDT with the form construction principles can show that the new method is more efficient and effective in constructing form than the traditional design method.

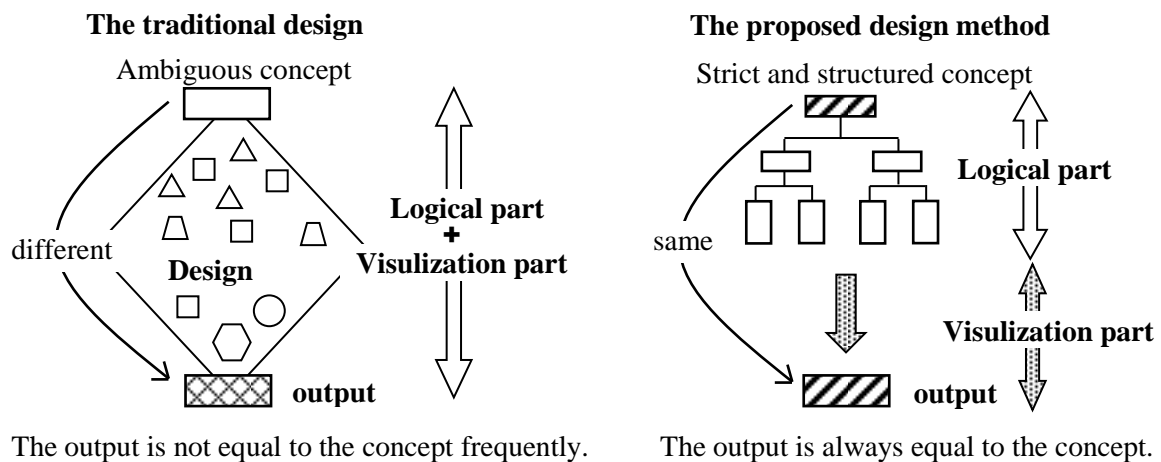


Figure 9. The difference between the traditional and the proposed design method

To sum up the proposed method, the procedure and the advantages / disadvantages are as follows.

The procedure:

- 1) The structured concept is constructed based on user requirements.
- 2) A form is designed based on the structured concept, especially using the seventy design items, the form construction principles.
- 3) The color and feel of a material and so on are decided after constructing a basic form.

The advantages and disadvantages:

- 1) As it is logical and systematic method, it is very efficient.
- 2) The stakeholders can share the information based on the structured concept.
- 3) As it is logical method, most designers should accustom themselves to the new method.

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