# HUMAN DESIGN TECHNOLOGY AND KANSEI DESIGN KEYWORDS

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Abstract

This paper describes the basic concept and processes underlying human design technology, and outlines Kansei design base on this logical approach.

## 1. Human design technology and its background

Human design technology integrates fields like marketing research, ergonomics, cognitive science, industrial design, usability evaluation and statistics (multiple variable analysis) in order to design user friendly products that have broad popular appeal. It is defined then as technology that scientifically analyzes human beings and uses various information related to humans (i.e. physiology, psychology, cognition and behavior) as design conditions.

The technology not only applies to all processes ranging from product planning to design and evaluation, but its logical, quantitative approach can also be applied all the way through the upstream end of goods production.

In the past we relied on intuition as we reviewed processes as analytically and quantitatively as possible to make sure there were no design condition oversights in the drive to produce sound goods based on user needs.

The situation that precipitated human design technology was the fractionalization of work at upstream stages of product development where individual supervisors focused solely on their own specific area entirely for show and thus crippled their ability to generate products with broad-based appeal. Then came a change in thinking in goods production from an emphasis on material requirements to an

emphasis on user requirements that necessitated an ability to grasp the overall situation.

## 2. Human design technology process

The following steps comprise the human design technology process.

(1) Gathering user requirements

(2) Grasping current circumstances

(3) Formulating product concepts

(4) Designing (synthesizing)

(5)Evaluating the design

(6) Surveying usage conditions

The range of studies includes gathering and analyzing user requirements, formulating product concepts and then condensing and evaluating the designs. The next step is production and sales which are followed up by surveys on usage conditions for the consumer product.

### 2.1. Gathering user requirements

The very first step is to extract user requirements using various methodologies like task analysis, group interviews and direct observations. Task analysis and direct observations are stressed in human design technology because they can uncover latent user requirements by analyzing unconscious user behavior.

**(1) Direct observation method**

The following describes direct observation in more detail.

1) Observe based on five aspects of the human machine interface (physical aspect, information aspect, temporal aspect, environmental aspect and organizational aspect).

2) Find vestiges of user behavior because incompatibilities between users and system will always turn up in some form or another.

3) Consider possible operational and behavioral cues.

4) Consider recognizable differences.

5) Examine limitations on user operation and behavior imposed by the system.

**(2)Task analysis method**

Consider a typical scenario where the product being surveyed will be used. Write down the tasks that will be performed in each scenario in the order that they come up. If a task is comprised of subtasks, then enter these subtasks in the task column as well. Write down real and anticipated user problems in the data processing sequence consisting of effective acquirement of information --> ease of understanding and judgment --> comfortable

operation. The cues when you are looking at problem areas are 1) emphasis, 2) simplicity and 3) consistency for effective acquirement of information and then 1) terminology, 2) cues, 3) mapping, 4) consistency, 5) feedback and 6) system structure (whether the operating principle of the device is understood) for ease of understanding and judgment and then 1) posture, 2) fit, 3) torque for comfortable operation. Finally consider proposals for resolving the real and anticipated problems that were extracted (Fig. 1).

It is a good idea to refer to the resolution proposals when they come up because they present opportunities for working out solutions. A rough design proposal can be developed by condensing the resolution proposals. Since the product concept is still undecided at this point however, they will be used strictly for reference.

**2.2. Grasping current circumstances**

This step determines how users perceive products currently on the market. Make note of the results and use them to come up with remedies. The very simple correspondence analysis method is generally used here.

**2.3. Formulating product concepts**

This step takes the user requirements that have been gathered and condenses them down into 10 items or less based on like functions. List the condensed user needs (defined as user requirements) appropriately at the top or bottom to form a product concept (Fig. 1).

This method is sufficient in most cases, but it does not reflect the cognitive pattern of users. If you want to look at the patterns systematically in more detail based on real users, ask target user groups of 10 to 20 people to rank the requirements you have extracted and condensed. The analytic hierarchy process (AHP) is a good way to rank (that is to weight) items. Compare the item groups ranked at the top and bottom, and then ask the target users why they ranked the items as they did (this is called laddering). Continue asking the target users why they answered as they did until they run out of answers. Use the same procedure to ask about the item ranked number 2 and all subsequent item groupings until you reach the item ranked at the bottom.

This data represents the cognitive pattern of the target users and you organize it to look at it systematically. Since it is merely a summary of the cognitive patterns of users toward the requirement groupings at this level, the goal of planners must be

added to it along with additional items representing purpose. Appropriate design items are added to the items at the very bottom of these system views to complete the system view for a product concept. The user interface, Kansei, universal and physical design items are condensed into these design items for your convenience. Use the AHP process to weight each item in the system view. This weighted value will also be used for the production cost ratio, so items weighted at the low end can be cut if the cost is not right.

**2.4.Designing (synthesizing)**

Condense the design items at the very bottom of the product concept system view as design proposals on par with the top product concept items. Since item groupings have already been established as shown below for design study areas like the user interface and universal design, use these design items.

1) Interface and ease of use considerations: Usability and user interface design items (32 items)

2) Kansei related considerations: Kansei design items (5 or 9 items)

3) Elderly and disabled considerations: Universal design items (5 items)

4) Safety considerations: Product liability (PL) design items

These design items were extracted for the product concept, so create a visual representation, using words if visual representation proves difficult, for each design item as you did with the top item.

Bring together all the tentative design items that were visually represented and use them to form a design proposal (Fig. 1).

Design items are usually narrowed down at this stage, but if that is not the case, then propose designs that incorporate undecided product attribute levels, let target users rank the proposals, and then apply conjoint analysis to narrow down the design items. Since you can calculate the rate of contribution for an attribute and the utility value of a level, you should select a design item with a high score.

**2.5. Evaluating the design**

At this step, let target users evaluate the design proposals using the AHP process in order to study the feasibility of the proposals (meaning that you verify the specifications). You then validate the efficacy of the proposals by applying task or other analysis to a product mockup (product model). You should compare the proposals with rival products monitored in the market using a design rendering and mockup, and you might want to analyze the proposal

using the correspondence analysis mentioned earlier as well.

If you want to study the relationship of design items to the overall evaluation of design proposals, then you can give out questionnaires to target users and perform multiple regression analysis on the results to calculate the relative importance of the design items as a weighted value.

**2.6. Surveying usage conditions**

The usage condition survey is based on the concept of the post occupant evaluation (POE) survey for architects and owners in the building industry. The method determines how a person uses a product once it has been purchased and it allows the user and the person taking the survey to jointly extract problem areas. It therefore relies heavily on direct observation and task analysis, but questionnaires are used as well.

**3. Extracting Kansei design items**

The preceding sections described human design technology and introduced Kansei design items through the design steps, but the following section will focus on the design items.

Young engineers were asked to submit several examples of sensory sensations (using vision, touch and hearing) in the world around them. The authors converted the total of 61 examples into Kansei keywords, and used the KJ method to condense the examples as Kansei design items into 9 item groupings. The items were then connected in a cause-effect relationship and were organized hierarchically using the interpretive structural modeling (ISM) method.

The Kansei design items were organized into the following item groupings.

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

2) Color: Color elements like peaceful colors and unconventional colors.

3) Fit: A sense of human and machine integration such as comfortable shape or an enveloping sense.

4) Shape: Elements like a simple shapes or smart shapes.

5)Functionality and convenience: Elements related to function and convenience such as good functions and ease of use.

6)Ambiance: Elements like nice interior and relaxing atmosphere

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

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

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

The hierarchy for Kansei design items shows ambiance at no. 1, design image at no. 2, color, fit and shape at no. 3, functionality / convenience and sense of material at no. 4, and new combinations and unexpected application at no. 5 (bottom of the hierarchy). These nine items were then grouped in terms of function to form broader groupings first with new combinations and unexpected applications forming the basic constituent elements of sensation, then with functionality / convenience, sense of material, color, fit and shape forming the interface elements, and finally with design image and ambiance forming elements that evoke sensations. It is not hard to understand that the basic constituent elements of sensation are elements that evoke sensations for a design target and that Kansei interface elements are those elements that facilitate the relationship between humans and machines.

**4. Kansei design items and Kansei design in human design technology**

The point of Kansei design in human design technology is to provide designs that apply Kansei design items to all the items at the bottom of a systematic product concept. The Kansei design items extracted were the basic constituent elements of sensation (new combinations and unexpected applications) and the interface elements (functionality/convenience, sense of material, color, fit, and shape). Since sensations can be raised to a higher level even without the basic constituent elements however, we are basically looking at the five interface elements as study items in design work.

These items are weighted in design work using one of the following methods.

1) AHP

2) Multiple regression equation

3) Questionnaire

A Kansei design concept is developed by narrowing down product development targets until they are 60% fuctionality and convenience, 10% color, 10% shape and 20% sense of material if the product is an actual product for example. These percentages may also be thought of as distributed cost expenditures. Once you have a grip on critical design items, they become the basis for a design.

This is usually sufficient at this level, but a more specific approach is sometimes needed and then you determine sub-items within Kansei design items in order to design the product. If the number of sub-items is kept in check and their relationship to cost is also clarified, then a number of quantitative approaches are possible.

Since products contain Kansei design elements along with other product design elements like cost and performance, a multiple regression equation can be created using the Kansei design elements and other product design elements as explanatory variables if a criterion variable is used for product competitiveness (sales volume).

It is then possible to develop accurate simulations at the design level because the equation will clarify the relationship of Kansei design elements to cost and product competitiveness. On the other hand, it is not a bad idea to conduct simulations on product competitiveness under the same conditions using neural networks. Naturally neural networks can also be used in studies on Kansei design elements in place of the aforementioned multiple regression even though the scope of this application is limited.

## 5. Conclusion

In the present paper, we described the concept and design procedures underlying human design technology, we extracted Kansei design elements that are used in Kansei design, and we examined Kansei design methods. The point of Kansei design in human design technology is to provide designs that apply Kansei design items to all the items at the bottom of a systematic product concept.

## 6. Reference

(1) Toshiki Yamaoka and Akira Okada: User interface design in actual practice, Kaibundo Publishing, 1999

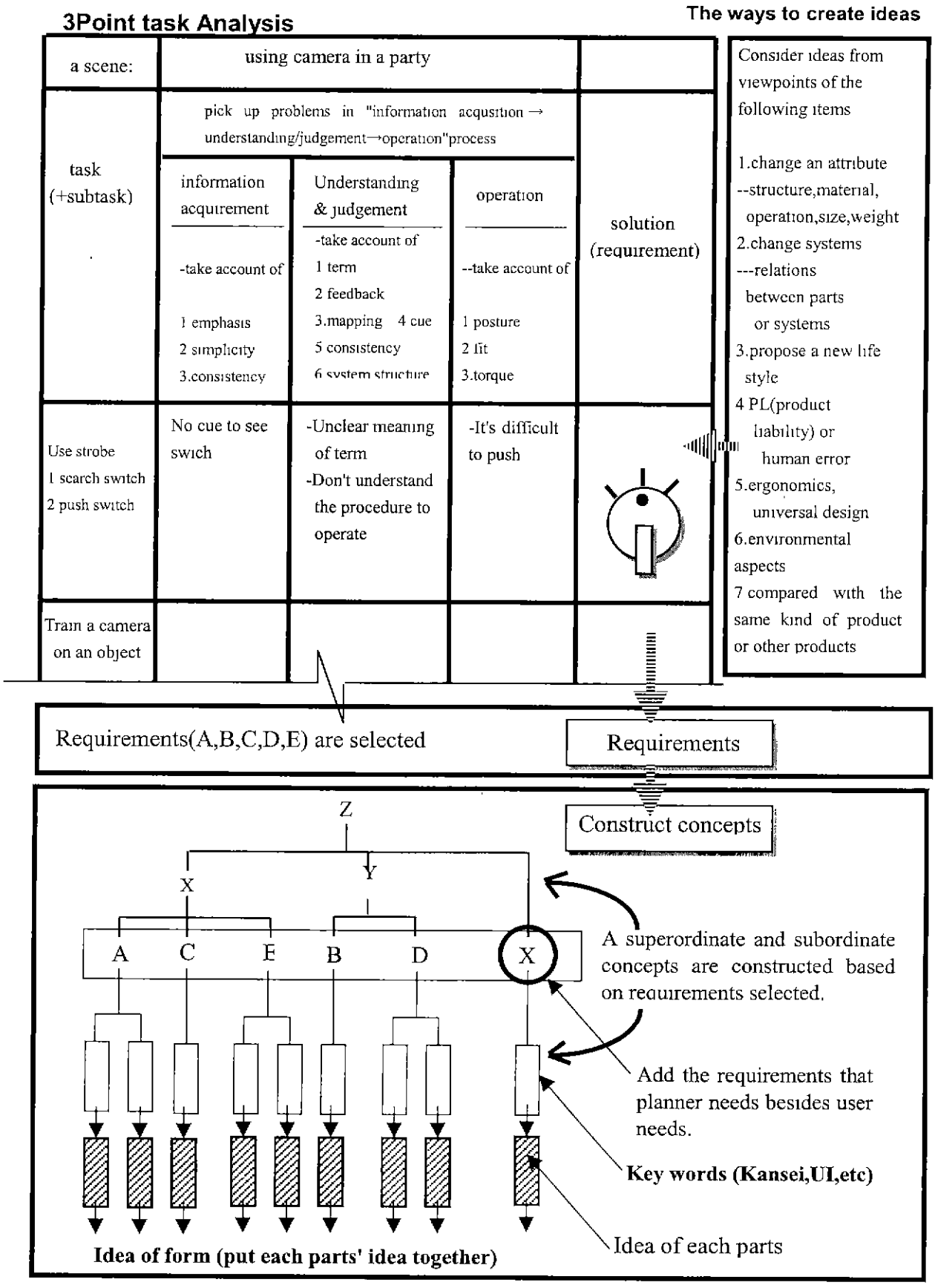
3Point task Analysis
The ways to create ideas
a scene:
using camera in a party
pick up problems in "information acqusition → understanding/judgement→operation"process
task (+subtask)
information acquirement
-take account of
1 emphasis
2 simplicity
3.consistency
Understanding & judgement
-take account of
1 term
2 feedback
3.mapping 4 cue
5 consistency
6 system structure
operation
--take account of
1 posture
2 fit
3.torque
solution (requirement)
Consider ideas from viewpoints of the following items
1.change an attribute --structure,material, operation,size,weight
2.change systems ---relations between parts or systems
3.propose a new life style
4 PL(product liability) or human error
5.ergonomics, universal design
6.environmental aspects
7 compared with the same kind of product or other products
Use strobe
1 search switch
2 push switch
No cue to see swich
-Unclear meaning of term
-Don't understand the procedure to operate
-It's difficult to push
Train a camera on an object
Requirements(A,B,C,D,E) are selected
Requirements
Construct concepts
Z
X
Y
A
C
E
B
D
X
A superordinate and subordinate concepts are constructed based on requirements selected.
Add the requirements that planner needs besides user needs.
Key words (Kansei,UI,etc)
Idea of each parts
Idea of form (put each parts' idea together)

Fig. 1