Evolving a Holistic Design Process of Experiential Design

- Focus on the Cognitive Interaction in Design Process -

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Abstract: The primary purpose of this study was to evolve integrated design process for Experiential Design which is based on the former study, 'The Influence of Cognitive Factors on the Creative Abilities in Design'. Experience is a transformation factor to all of the design processes, which has three phase of problem solving; Input, Process, and Output. We regard Experiential Design is a transforming process from concept to experience, and set up a model of Holistic Design Process (HDP), which consists of four domains: Four Causes, Thinking Modes, Sensory Modalities, and Creative Abilities. Revolving Sensory Modalities (SM), Creative Abilities (CA), and Thinking Modes (TM) around Product Design Specification (PDS) through a design process, Design Concepts ripen and mature into Externalization. Each component of Experiential Design (TM, SM, and CA) turns around the PDS. Here, experience is first perceived by the five senses. Then, the knowledge is formed, and the CA works for a problem solving. And TM controls all of these procedures. We regard these are a phenomenon of Experiential Design. The HDP can be helpful to develop valuable solutions and create a good experience.

Key words: Holistic Design Process, Cognitive Interaction, Experiential Design

1. Introduction

How can we extract good experience from our daily life? This might be a true question for the quality of our life. Here, the experience is important and meaningful factor for human life.

The most important concept to grasp is that all experiences are important and that we can learn from them whether they are physical, offline experiences or whether they are digital, online experiences. We used to develop new solutions and create valuable experience through related disciplines. What these solutions require is for their developers to understand what makes a good experience first, and then to translate these principles, as well as possible, into the desired media without the technology dictating the form of the experience.

Design is a typical case of creative problem solving. For the problem that is being considered, we want

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to bring about a desired solution that is something new and valuable.[1] For that reason, design is a more open-ended problem solving activity that requires greater creativity, and the typical style of the designer's behavior underpins their creativity.[2] We are able to change the current situation into better one by design. Meanwhile, design is an evolutionary process, with each new step uncovering unexpected problems and subtleties. Initial assumptions become invalid, leading to the negotiating of proposed changes and the creation of new tasks. Moreover, customers continually redefine their goals in midstream. Budgets and perceived markets change and customers begin to verbalize requirements which had previously been only implicit. Finally, advances in technology offer solutions not previously possible.[3]

We regard design is a creative and experience oriented process. Facing a new design case, a designer will recall their memories and imagine the ideas, which were accumulate from their experience and knowledge. Then, the designer will attempt to find a solution which is new experience, from these similar cases in a way of adaptation or synthesis.

As a discipline, though, Experiential Design (ED) is still somewhat in its infancy, and has become newly recognized and named. It consists of diverse disciplines as digital media, theater, graphic design, storytelling, exhibit design, theme-park design, online design, game design, interior design, architecture, and so forth. Collaboration among design teams is necessary because each part of a design constrains the others. It can help for connecting the related many disciplines.

At the core of Experiential Design, argues Cain, are methods for examining, interpreting, and organizing everyday experience in a way that is useful to the people involved in all aspects of design development, including business strategists, product and brand managers, designers, marketers, and engineers.[4]

Experience Design is not driven by a single design discipline but instead requires a truly cross-discipline perspective that considers all aspects of the brand/business - from product, packaging and retail environment to the clothing and attitude of employees. For the Experience Design, we need to deal with collaborative and cognitive approaches, and take note of cognitive interaction under the holistic viewpoint of the design phenomena.

2. Cognitive Interaction in Design

2.1 Four Causes

We adapted the Aristotle's Four Causes (FC), as a philosophical basis of design phenomena. These are responsible for the existences of an object: Material Cause, Formal Cause, Efficient Cause, and End

[1] During, D., Intuition in Design: A perspective on designers' creativity, *Asia Design Conference*, (1999). pp2-3.

[2] Cross, N., Designery ways of knowing, *Design Studies,* 3(4), Elsevier Science, Oxford, (1982). pp221-227.

[3] Fox, M. S. KNOWLEDGE-BASED DESIGN, http://www.eil.utoronto.ca/kbd/, (2004).

[4] Cain, J., Experience-Based Design: Toward a Science of Artful Business Innovation, *Design Management Journal*, (1998). pp10-16.

Cause.[5] The Material Cause is the basic stuff out of which the thing is made. Their inherent qualitative properties are also transferred to the object in question. This has a close relationship to physical sketch modeling in the early phases of design. The Formal Cause is the pattern or essence in conformity with which these materials are assembled. This is the blueprint or the idea commonly held of what an object should be. The Formal Cause is the form, shape, idea, or concept of the completed whole as a result of design. The Efficient Cause is the agent or force immediately responsible for bringing this matter and that form together in the production of the thing. It constitutes the means and manner in which a thing actually comes into being. Lastly, the final cause is the end or purpose that something is supposed to serve. The End Cause is an entity's, object's, or system's purpose. In Aristotle's terms, it is the function a thing is intended to serve once completed. All the causes are necessary elements in any adequate amount for the existence and nature of the thing; Aristotle believed that the absence or modification of any one of them would result in a different thing.

As a complex of the Four Causes (FC), we consider that design is a cause of cultural generation. We noticed that the core object of design is the shifting from goods and services to experience, and experience is a key value differentiator.

2.2 Cognitive interactions in design

We focus on the Sensory Modalities (SM) in the germinal phase of design, which entails Mental Process (MP). We set up a model of cognitive interactions in design, which consists of four domains: Concepts, Experience, Five Senses (FS), and Thinking Modes (TM). We regard design as a transforming process from Concept to Experience. First, the experience is perceived by FS and then recognized by the Intelligence. Next, the Concept is coined by the intelligence. Finally, we change the concept into an object through design process (Fig.1). This paper will take note of the influences of Sensory Modalities (SM) and Thinking Modes(TM) and the relationship in Experience Design. These provide the basis of a new approach to a cognitive interaction in design.

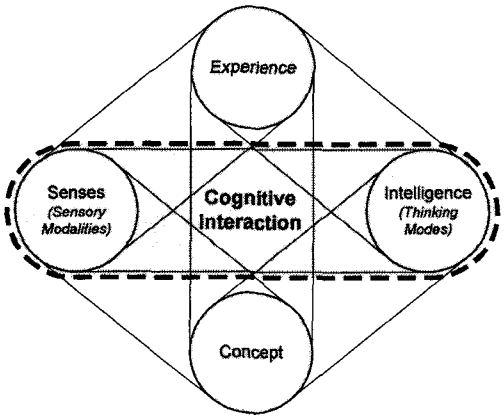

Fig.1 Cognitive Interaction in Design

[5] Velasquez, Manuel, Philosophy, Wadsworth Publishing, (1999). p153-154.

2.3 Visual/Tactile Thinking

Design work starts with a mental construct rather than a physical one. From our previous study, we argued that design process is a Visual/Tactile Thinking Processes (VTTP). A Cognitive Map (CM) is a mental device that codes and simplifies the way our spatial environment is arranged. We use imagery for a wide variety of different cognitive activities. Imagery is the mental representation of stimuli, which are not physically present. Mental imagery is immensely helpful when we want to solve spatial problems or work on a task that requires creativity.[6]

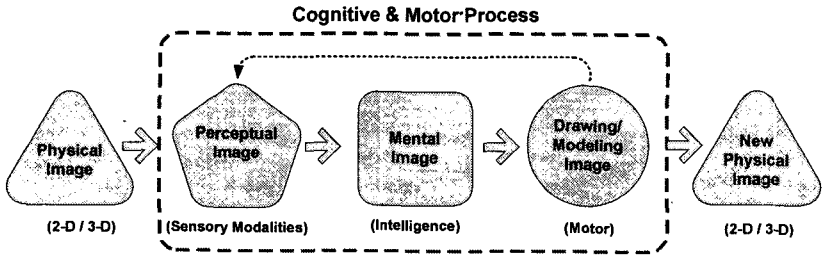

Fig.2 Visual & Tactile Thinking Process

As shown in Fig.2, there are three types of images: Graphic/Physical, Perceptual, and Mental Images (MI). When we start idea sketching, we just draw an image on the paper, which is a two-dimensional (2-D) graphic image. We model an image with clay, which is a three-dimensional (3-D) physical image. As pointed out by Paul Laseau, depending on our experience, interests, and what we are trying to do, we will see certain things take and/or leave something in the sketch, which is a Perceptual Image (PI). Next, we form a MI to further reference and give them orientation from this PI. When this MI is transferred to paper or space once more through motor processes, it goes through yet other changes for the design development.[7]

Many theorists-such as Stephen Kosslyn, Roger Shepard, and Ronald Finke-argued that information about a MI is stored in an analog code. An analog code is a representation that closely resembles the physical object. According to the analog-code approach, mental imagery is a close relative of perception.[8] During the conceptual design phase in product development, sketching enables designers to concentrate on essentials and leave out distracting details thus allowing right-brain activities such as intuitive and creative thinking, and idea synthesis.[9] Moreover, we should not pass over these Visual/Tactile Thinking Processes (VTTP) for surveying the Creative Abilities (CA) in design. Applying the VTTP is expected to facilitate cognitive thinking process for Experiential Design practice.

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[6] Matlin, Margaret W., Cognition, Harcourt Brace & Co., Orlando, (1998). p183.

[7] Laseau, P., Graphic Thinking for Architects & Designers, John Willey & Sons, (2000). p8.

[8] Matlin, Margaret W., Cognition, Harcourt Brace & Co., Orlando, (1998). pp184-185.

[9] Lumsdane, E., Lumsdane, M., & Shelnutt J. W., Creative Problem Solving and Engineering Design, McGrawHill, (1999). pp.30-73.

The sensation of interaction with a product, service, or event, through all of our senses (VTTP), over time, is on both physical and cognitive levels. The boundaries of an experience can be expansive and include the sensorial, the symbolic, the temporal, and the meaningful.

3. Cognitive Dimension in Design

3.1 Four Thinking Modes

Exploration on how thoughts by brain modes show different results is expected to bring important implications for design practice and design education. We have adopted Ned Hermann's Whole Brain Model in order to support collaborative thinking.[10] He described that the brain can be visualized as a circle divided into four quadrants. The four quadrants describe different processing modes that we all have access to. Hermann's model shows the left and right sides of reason (Cerebral System), and the left and right sides of emotion (Limbic System). These four are the "thinking" areas of the brain because they are associated with the neural cortex (area believed to be involved in thinking). The Whole Brain Model is involved in high-level cognitive functioning for design creation, and has four major modes of human brain-quadrants: A, B, C, and D.

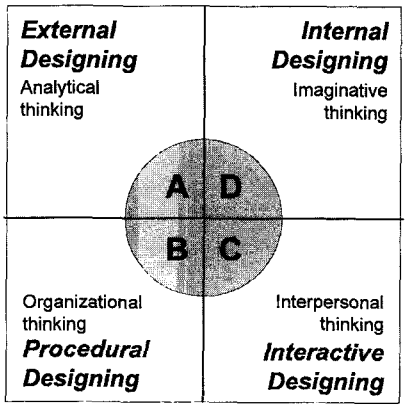

Fig.3 Four Thinking Modes in Design

Design can be regarded as a typical interdisciplinary activity, which involves all the four quadrants (Fig.3). External designing uses analytical thinking i.e., deciding through analyzing (quadrant A). Procedural designing uses organizational thinking of what is being designed, as well as practice and repetition to improve skills (quadrant B). Interactive designing uses interpersonal thinking such as discussions, and sensory experiences where we try, fail, and try again after considering verbal feedback and encouragement (quadrant C). Finally, internal designing uses imaginative thinking such as insight, visualization, synthesis, or a sudden holistic and intuitive understanding of a concept (quadrant D). By incorporating all of these modes into design strategies, effective designs can be created. When we consider the corporative design project, this model is helpful to set up a project team and to perform the project.

3.2 Creative Abilities (CAs)

Creativity is reflected in the generation of novel, socially valued products. There are many definitions

[10] http://www.hbdi.com/uploads/100021_resources/100186.pdf (2007)

of creativity arising from various psychological studies. Creativity is best described as the human capacity to solve problems or to fashion products in a domain in such a way that it is initially novel, but ultimately acceptable in a culture. It is an effective resource that resides in all people.[11]

There are three components in Creative Behavior: Abilities, Skills, and Motivations. A high level of creative achievement can be expected consistently only from those who have Creative Abilities (CA). The person who has a high level of CA and Skills may become a creative achiever, if the creative motivation can be aroused. Similarly, the person who has CA and Motivation can become a creative achiever with the acquisition of the necessary Creative Skills.[12] Here, we consider Skills as a processing quality in Whole-brain Mode, and Motivation and Skills activate the Creative Abilities. As a result, we are able to achieve creative accomplishments.

The relationship between creativity and problem solving is very close according to many investigators. Mumford et al. refers to creative thought as a form of problem solving.[13] Feldhusen and Treffinger combine creativity and problem solving into "a single complex concept," arguing that "CA such as Fluency, Flexibility, and Originality...are indispensable components of realistic and complex problem solving behavior."[14] We draw four major CA from former studies: Flexibilities, Fluency, Originality, and Elaboration. (Table 1)

Table 1 The Four Creative Abilities: Fluency, Flexibility, Originality and Elaboration[15]

Creative Abilities	**Contents**
Fluency	The number of interpretable, meaningful, and relevant responses to the stimuli
Flexibility	The variety of categories of relevant responses.
Originality	Responses which are unexpected, unusual, unique, or statistically rare.
Elaboration	The addition of pertinent details.

While fluency certainly increases the chance that original ideas will be produced, there is no guarantee that this will occur. It is important to consider some of the special qualities of original alternatives and

[11] Gardner H., The theory in practice, *Multiple Intelligence,* Basic Books: New York, (1993). p14.

[12] Raina, M.K., E. Paul Torrance's Voyages of Discovering Creativity: *The Creative Passion,* Alex Publishing, (2000). pp35-36, pp157-158.

[13] Mumford, M. D., Connelly, M. S., Baughman, W. A., & Marks, M. A. Creative and problem solving: Cognition, adaptability, and wisdom. *Roeper Review*, (1994). p16, pp241-246.

[14] Nikerson, R.S., "Enhancing Creativity" in *Handbook of Creativity* Robert J. Sternberg ed., Cambridge University Press, New York, (1999). p394.

[15] Kim, K. H., Critique on the Torrance Tests of Creative Thinking: Figural Forms A and B, http://www.arches.ga.edu/~kyunghee/portfolio/review%20of%20ttct.htm, (2002).

methods for increasing the chances that such ideas will occur.[16] A core of the CA is Originality which is supported by the Flexibility. Elaboration can be quite expensive, not only financially, but in regard to other qualities that have to be sacrificed. Even though the high Elaborator sacrifices Fluency, Flexibility, and Originality for the creative thinking.[17]

For organizing the Collaborative Design Team (CDT), we adapted a measuring tool, the Test of Creative Abilities of Design Thinking (TCADT)[18], from our previous studies. It consists of both 2-Dimensional and 3-Dimensional Tasks. 2-Dimensional TCADT has two types of tests: figural and verbal tests. 3-Dimensional TCADT consists of modeling Tasks. This TCADT can be used to organize a design process and team.

3.3 Sensory Modalities

Cognition, or mental activity, involves the acquisition, storage, transformation, and use of knowledge. Based on experience, an idea or concept is empirical if it is derived ultimately from the five senses, to which introspection is sometimes added.[19] Cognitive approach is often contrasted with several other current psychological approaches.[20] We regard design as a typical cognitive approach with human Sensory Modalities (SM).

People think using internal representations of their five senses, which consist of Visual, Auditory, Kinesthetic, Olfactory and Gustatory. Of these, Visual, Auditory and Kinesthetic are the ones most often used. Examples of each include the following:[21] We are aware of the physical plane through our five senses. We see, hear, feel, taste, and smell things in our environment. When we process this information we represent it back to the external world using these same senses.[22]

The success of the visual process requires that some form of object identification based on size, shape, color, and experience take place; that movement of objects be detected; and that recognition of objects be possible in the full range of lighting conditions normally experienced by the individual in its habitat.[23] Although not all products can or should be touched, the quality of tactility cannot be avoided. The roughness and smoothness still evoke the "feel" of the solid material form through vision. The Haptic experience is therefore bi-directional, its reciprocality stemming from the possibility of our touching an

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[16] Torrance, E. P., & Safter, H.T., Making The Creative Leap Beyond, Creative Education Foundation Press, (1999). p87.

[17] Torrance, E. P., & Safter, H.T., Making The Creative Leap Beyond, Creative Education Foundation Press, (1999). p108.

[18] Woo, H.R., Creative Abilities in Design: Relationships between Brain Dominances and Creative Abilities of Design Thinking, The Korean Journal of Thinking & Problem Solving, (2005). pp101-113.

[19] Honderich, Ted ed, The Oxford Companion to Philosophy, Oxford University Press, New York, (1995). p261.

[20] Matlin, Margaret W., Cognition, Harcourt Brace & Co., Orlando, (1998). p2.

[21] Smart, J. The Five Rep-Systems, http://www.saladltd.co.uk/salad%20pages/Nlp%20tips/nlp_tip_6.htm, (2005).

[22] Stower, M. Neuro-Linguistic Programming, http://www.hypnosisworld.com/nlpmain.html, (2007).

[23] Bear, Mark B., etc, Neuroscience, Lippincott Williams & Wilkins, (2001). p281.

object or a surface, while simultaneously producing effects of the object touching us.[24]
Here, experience is first perceived by the five senses. Then, the knowledge is formed, and the CA works for a problem solving. And TM controls all of these procedures. These could be repeated several times. We regard these are a phenomenon of Experience Design.

Through this CA, successful experiences for people could be created. Here, designed experiences can be in any medium, including spatial/environmental installations, print products, hard products, services, broadcast images and sounds, live performances and events, digital and online media, etc. We regard that Experience Design is driven by consideration of the 'moments' of engagement between people and brands, and the memories these moments create.[25]

4. Evolving A Holistic Design Process

4.1 Cognitive Design Map

From our previous study,[26] we examined cognitive interaction in design, which has four components; Senses, Intelligences, Concepts, and Experience. On this basis, we developed a Cognitive Design Map (CDM), which has four layers; four Causes (FC), four Thinking Modes (TM), five Senses (FS), and four CA. With the Cognitive Map (CM), we can effectively develop the Experience Design Methods. For the measurement the CAs, we have developed a testing system (TCADT), which consists of 2-D and 3-D types for testing CA. From the former study related with this, we found there are close relationships and mutual influences among thinking modes, sensory modalities and creative abilities. Fig.4 shows the cognitive design map, which consist of FC, TM, SM and CA.

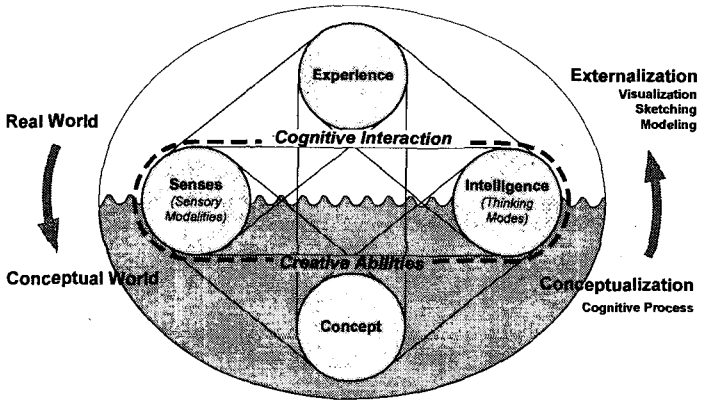

Fig.4 Cognitive Design Map (CDM)

[24] Paterson, M., Haptic Spaces, http://www.ggy.bris.ac.uk/postgraduates/ggmp, (2007).

[25] Ardill, R., Experience Design, http://www.designcouncil.org.uk/en/About-Design/Design-Disciplines/Experience-design/ (2007)

[26] WOO, H. R., The Influence of Cognitive Factors on the Creative Abilities in Design, Proceedings of 2005 International Design Conference.(2005).

From our review and discussion of cognitive interaction in design, we found the multi-layered cognitive design complex, which is a case of cultural generation and is based on human experience. The four layers interact with each other from start to end in design process in this Cognitive Design Map (CDM). We can approach the Experiential Design, and apply this map to other problem-solving fields as well.

Any kind of experience may, in principle, be transformed into knowledge. Kolb emphasizes the relationship between experience and knowledge as a dynamic process of continuous reproduction and regeneration. It contradicts the static model of learning as acquiring knowledge external to and independent of the learner. Information and facts are external to and independent of the learner. Knowledge inheres in human beings and the specific form of knowledge is often contingent on the learning process.[27] Because knowledge is human, developing knowledge requires thinking and practice, mind and body both.[28]

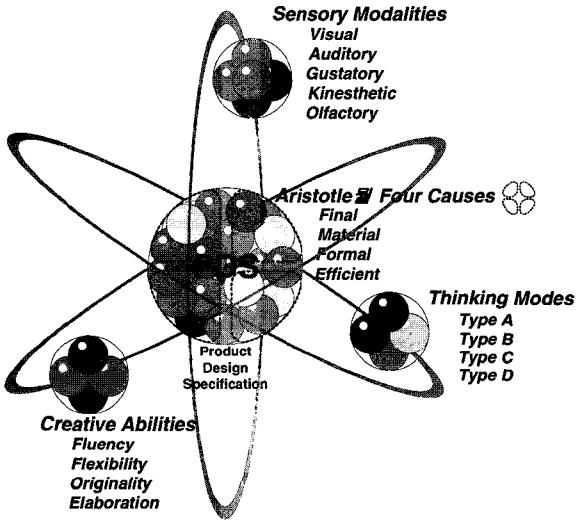

Fig.5 Holistic Design

Generally, a design project has 3 phases of problem solving; Input, Process, and Output. Human experience has close relation with these 3 phases. The experience to the Input and Process phase is one of major influencing factors to the project. But the designer(s)' experience on the Output is aimed for the user(s). Experience has an attribute of interaction among these phases. At the same time, it influences directly and indirectly upon the design project. Therefore, Experience Design is a phenomenon resulted from the Cognitive Interaction in Design. From the view point of the Cognitive Interaction, we set up a model of Holistic Design (HD) in Fig.5. It shows dynamic interaction among Thinking Modes (TM), Sensory Modalities (SM), and Creative Abilities (CA) under a specific PDS (Product Design Specification).

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[27] Atherton, J. The Experiential Learning Cycle, http://www.learningandteaching.info/learning/experience.htm, (2007).

[28] Friedman, K. Creating design knowledge: from research into practice, http://magpie.lboro.ac.uk/dspace/bitstream/2134/1360/1/Friedman2000.pdf, (2007).

The TM, SM, and CA turn repeatedly around the core of FC. Here, we regard the FC as Product Design Specification (PDS). Then experience and knowledge are formed and design project is affected with these components. We should not consider these as the fragments of these objects. It should be considered the organic whole of the experience and knowledge. We argued the organic whole of the design phenomena as a Holistic Design.

4.2 Cognitive Design Process

We adapted Pahl and Beitz's design process to develop Holistic Design Processes from the model of Holistic Design.[29] These are summarized as followings:

① Specification Process: we clarify the task and elaborate the specification.

② Concept Process: we identify essential problems, establish function structures, search for solution principles, combine and firm up into concept variants, and evaluate against technical and economic criteria.

③ Preliminary Process: we develop preliminary layouts and form designs, select best preliminary layouts, refine and evaluate against technical and economic criteria.

④ Definitive Design Process: we optimize and complete form designs, check for errors and cost effectiveness and prepare the preliminary parts list and production documents.

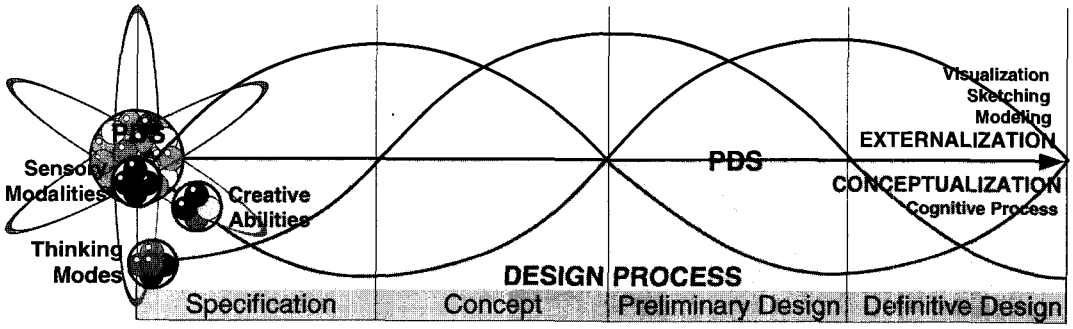

Fig.6 Holistic Design Process (I)

We apply the Pahl and Beitz's design process into the model of Holistic Design in Fig.6. Design is a process. The design process is rooted in and involves both theoretical disciplines and fields of practice. As all fields of practice do, design knowledge involves explicit knowledge and tacit knowledge. Disciplines also involve explicit knowledge and tacit knowledge both.

Revolving SM, CA, TM around PDS through a design process, Design Concepts ripen and mature into Externalization. Each component of Experience Design(TM, SM, and CA) turns around the PDS, Four Causes (FC). It shows a sine curve like Fig.6, creates a base of new experience and repeats its rotation between Conceptualization and Externalization. When we observe from the direction which the PDS moves forward, it draws a spiral curve toward the front (Fig.7). Here, the spiral curves are generated during their rotation around the PDS.

[29] Roozenburg, N.F.M. and Eekels,J., Fundamentals and Methods, *Product Design*, Wiley, (1995). pp102-111.

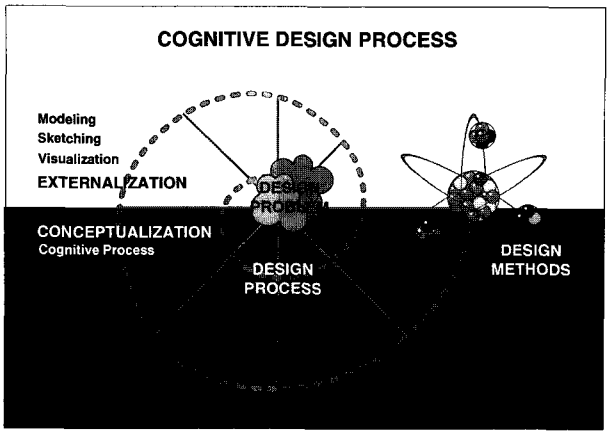

Fig.7 Holistic Design Process (II)

5. Conclusion

In this paper, we argued that the integrated design process for Experience Design, and set up a model of Holistic Design Process (HDP), which consists of four domains: Four Causes (FC), Thinking Modes(TM), Sensory Modalities (SM), and Creative Abilities (CA).

Here, experience is first perceived by the five senses. Then, the knowledge is formed, and the CA works for a problem solving. And TM controls all of these procedures. These could be repeated several times. We regard these are a phenomenon of Experience Design. For the result of this study, the HDP can be helpful to develop valuable solutions and create a good experience.Even though this study does not offer a practical and specific design process, but these Holistic Design approaches are helpful frameworks for a design management.

In this study, we concluded that Experience Design is a holistic, multi-disciplinary and multi-sensory way of bringing to life the essence of a brand, product or service. For the future of research on the Experience Design, we need to study the detailed design processes and elements of the Holistic Design.

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