From Novice to Expert – User's Search Approaches for Design Knowledge

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Abstract. As the arrival of the individual creativity era, innovation needs user creativity from the general public, nowadays, the enterprise provides the components or tools of products for users to utilize their creativity, and thus, users can be viewed as another form of designers. This research is based on the concept, "user is innovator", using LEGO bricks and its players with high design capability as the research subjects, proposes a qualitative method on users' design knowledge, the procedure includes five steps: user subject identification, status attribute classification, design knowledge categorization, search approach analysis, and knowledge model construction. This article proposed the design knowledge connotation and search approaches of four statuses of highly-involved users (junior expert, exhibition participator, business manager, award winner). When users possess the needed design knowledge and search approaches, it does not only fulfill individual creativity, also indirectly expands the creativity origin of the enterprise and increases its economic value.

Keywords: User as innovator, Design knowledge, Information search, Knowledge management.

1 Introduction

Nowadays, as we enter into Web 2.0 era, the main concept being "Let the user contribute his/her own individual value", the citizen pattern has substituted the former expert pattern [1]. Users are receptive of various information stimuli and enter into an individual creativity era, users show great interests in "design behavior," expecting to exhibit individual unique creativity through personal design. More enterprises are willing to open up more design space (for example: product components, tools or methods) for users to decide on the final appearance and function of the product [2]. Redström (2006) observed the products that have developed on the market which can realize users' own creativities, users can "utilize self-educated design knowledge" to successively design or redevelop the purchased products [3]. To be the participant in the enterprise's product development, the enterprise no longer independently produce and design a product, it creates the new product together with the users. Therefore, users can be viewed as innovators during the product development process. Sanoff

(2007) pointed out that the willingness of the enterprise to open up the design authority and the assistance of technology, allows users to participate in design and to share their design thoughts and knowledge with others at the same time, this span goes beyond the traditionally classified professional boundary [4], design knowledge does not solely belong to designers and has expand to users. In knowledge management, the user has transformed from knowledge receptor to knowledge provider. Therefore, the design knowledge connotation of the users has become the new design domain and an important topic.

Although users possess creative energy that should not be looked down upon, but realistically there is a big difference between their design capabilities, only a small portion of the users are capable of solving design difficulties. These users differ from designers with professional design training; they have acquired design capability and design knowledge on their own. Following "user-participated" idea, the design knowledge and search approaches of highly-involved users have potential to expand the creative origin of enterprises. Therefore, this research proposes a procedure to construct highly-involved users' search approaches for design knowledge, which is to discuss the needed design knowledge content and its search approaches during users' design creation process.

2 Literature Review

2.1 Design Knowledge

The two most common categorizations found in literature for knowledge are tacit knowledge and explicit knowledge [5,6]. "Explicit knowledge" means techniques and facts that can be recorded in writing, or in any tangible forms, and past down to others; and "tacit knowledge", the skills, judgment and instinct of human are hard to describe [7]. Design knowledge emphasizes on qualitative exchange and tends towards a knowledge integration of multiple disciplines. Design knowledge includes theory, judgment and design activity, as well as the various outcomes from the activity; design thinking is not independent outside of design activity that is a kind of comprehensive knowledge [8].

Recent design management researches have focused on deposit and access of design knowledge among individual designers or between designer and design company [9,10,11]. However, the more users are involved in design as the raise of user self-consciousness, the more design knowledge are needed to support it, design knowledge no longer exists between individual designers and design groups (e.g. design company), design knowledge has expanded to users. In the user knowledge management aspect, Su, Chen, & Sha (2006) proposed a knowledge management model (E-CKM model) that is applicable to innovative product development, to manage product knowledge and consumer knowledge from the perspective of the enterprise through web-based surveys and data-mining to separate consumer groups [12]. However, this consumer knowledge refers to the consumer behavior and product expectation of the consumer instead of to discuss the "design knowledge" and "knowledge search approaches" from the user's perspective. Moreover, for designers, inspiration is highly related to design presentation, Claudia & Martin (2000) believed inspiration is the most important within the design thinking process, the source of

inspiration stimulates ideas, and from this the inner representation of designer's work is formed [13], thus, this research assumed that inspiration is a kind of design knowledge. According to above-mentioned reviews, this research defines design knowledge as "comprehensive knowledge implicated in design behavior," and assumes design knowledge involved in user's design process includes explicit knowledge: "product knowledge, technical knowledge, design method and skill," and tacit knowledge: experience and inspiration.

2.2 Information Searching

Wilson's (1999) information search behavior model points out that, information search behavior is caused by the user's sense of the information needs, in order to fulfill the needs, the user searches for formal and informal source of information until successfully finds the related information, or gives up [14]. Luh & Lin (2007) proposed the factors that affect designers search of design knowledge, and established designer information search behavior framework, its construction method and procedure [15]. Franke, Keinz, & Schreier (2008) discovered that in the initial selfdesign development stage, users can be positively encouraged in the problem-solving process when they receive design suggestions from the fellow group [16]. In the enterprise attitude aspect, Berthon, Pitt, McCarthy & Kates (2007) pointed out the importance of "customers with creative ability" to product innovation [17]; enterprise should establish proper response methods and propose a framework regarding enterprise's standpoint on consumer creativity. When "enterprise" takes the initiative and provides positive resources in supporting consumer self-design, it will be helpful to product promotion and development, such as on-line games. According to above theories, this research's information search subject developed from "taking users themselves as the core", in searching for design knowledge, will firstly learn to solve the problem by themselves, then ask for assistance from fellow groups, and find resources provided by the enterprise. Besides, design are representations of living experiences, nowadays the government or social organizations put many effort into promoting the life aesthetics activity, social resource has become one of the sources to acquire design related knowledge. Therefore, four aspects of search approaches for design knowledge in this research are self-learning, fellow group, enterprise resources, and social resources in order.

In current markets, whether it is the physical product or on-line virtual product, increasing number of enterprises provide "Design it by yourself" experiences. Luh & Chang (2006) proposed four major characteristics of this type of product and named it "User Successive Designing" product [18], LEGO is a representative product for providing ample of creation space and allowing users to utilize their individual creativity to design freely with simple components. LEGO Company has recruited works designed by users for sell. For enterprises, user creativity always brings new surprises for product and potential business opportunity at the same time.

Previous literature reviews rarely study the design knowledge and search sources belong to "users". This research aims at high-involved users, through a qualitative method, can be viewed as a preceding study in design knowledge management at user end. Through the "model of users design knowledge and search approaches," this research expects to discuss knowledge connotation and search approaches needed in course of design and creation for highly-involved users.

3 Method and Procedure

Interview is a method to acquire useful information about subject's personal experiences, opinions and thinking during a short amount of time. "Semi-structural questionnaire" is using structured questions and some open-ended questions in an attempt to induce subjects to recollect and think. With consideration of the uniqueness of this research topic, an "interview with semi-structured questionnaire" was used as the main research method. The methods and procedures are introduced as follows:

(1) User subject identification. Due to the variation in user's design ability, presently there is no clear determination standard, nowadays, to train a professional designer requires at least four years of college training, and it takes about one year after entering the work place to be able to have a stable design outcome, this article refers to "highly-involved users" as ones that have nearly normal design ability, therefore having at least five continuous years of engagement with design behavior as the basic threshold when selecting subjects. In addition, the general public thinks designers with good design works generally are invited to participate in public activities and exhibitions, received design related contest awards, and even be responsible for some management jobs or manage related businesses, because exhibitions, contests, managements and such experiences are different from simple creative work in nature, therefore, having at least one or more of the above experiences can be listed as an ideal subjects. For the above reasons, the subjects in this research, highly-involved users, and the definition must be qualified for one of the four requirements: (a) have at least five years of creation experiences, (b) have been invited to participate in public exhibitions, (c) have managed design related groups, and (d) have received related creative contest awards. Through two LEGO player groups in Taiwan, at least four persons who are qualified for each of the four requirements above were recommended for interviews. Two interviewees were selected from each requirement based on completeness of the interview content, making a total of eight subjects.

(2) Status attribute classification. Based on the subjects' design experience, they can be categorized into four types of statuses, including: Junior Expert, Exhibition Participator, Business Manager, and Award Winner. Based on their design experiences, the results of their status attributes can be generalized as below: all interviewees have at least six years of creation experience; highly-involved subjects without exhibition, organization management or competition winning experience are categorized as "Junior Experts." The ones concurrently possess two or more identities take the relatively unusual status as representation. As far as interviewees in this research are concerned, it can be found that business managers all have exhibition experiences, otherwise is untenable; award winners all possess the experiences of organization management and exhibition, otherwise is also untenable.

(3) Design knowledge categorization. According to literature reviews, the five main categories of design knowledge are further subdivided. Product knowledge is based on product component characteristic; technical knowledge is based on the component's operating characteristic and the structure principle; design method and skill are based on the design skill and basic thinking training that have been focused on during institutional design education. Moreover, design emphasizes the intuitive

feelings and experiences, therefore, this research has proposed the item "object operation intuition" under the experience category, and depends on the experience relation between the different subjects, from inside out having "personal practice experience", "fellows' experience exchange", "expert instruction". In the inspiration aspect, this research has divided according to "intentionality" into "active" and "inactive" inspiration." The inactive inspiration is idea that flashes in one's brain related to the predetermined goal, which is called "intentional inspiration." The active inspiration is the idea that suddenly came across one's mind without any predetermined goals which is called "unintentional inspiration." Five categories of design knowledge, a total of 23 items are defined as Table 1. The interviewees are asked to select important knowledge items and to propose items that should be added onto the list, and to further point out the items that are comparative important (more than 50% as a rule). All interviewees stated that the list is comprehensive and all items are important. The selected results from the four types of interviewees represent the design knowledge constitution of four statuses of highly-involved users.

A. Product	B. Technical	C. Design method	D. Experience	E. Inspiration
knowledge	knowledge	and skill	-	-
A1.Component shape	B1.Component connection method	C1.Freehand sketch representation method	D1.Object operation intuition	E1.Intentional inspiration
A2.Component color	B2.Component connection step	C2.2D representation method	D2.Personal practice experience	E2.Unintentional inspiration
A3.Component size	B3.Object construction technique	C3.3D representation method	D3.Fellows' experience exchange	
A4.Component material characteristic	B4. Auxiliary tools application method	C4.Form esthetics concept	D4.Expert instruction	
A5.Component price	B5.Structure constitution principle	C5.Color coordination skill		
		C6.Design		
		C/.Design thinking		
		memod		

Fable 1. Desig	n knowledge	categories	and items
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(4) Search approaches analysis: The four aspects of searching information then subdivided accordingly: (I) self-learning is based on the normal information search approaches used by the general public; (II) fellow group is based on the information exchange and methods of interaction among LEGO-player groups; (III) enterprise resource is mainly the information search approaches provided by LEGO Company; (IV) social resource is referred to the design related information search approaches provided by the government and social organization, a total of 41 approaches are defined as Table 2. Interviewees were asked to recall the knowledge search approaches used during their design process and to check the design knowledge items that can be acquired through these search approaches.

I.Self-learning	II.Fellow group	III.Enterprise resource	IV.Social resource
11. Instructional manual	II1. Joining fellow group	III1. Themed books	IV1.Themed books
Related books	II2. Fellow exhibition	III2. Regular magazine	IV2.Contests
 Newspaper and magazine 	II3.Themed books	III3. Membership club	IV3.Educational training
 Internet knowledge 	II4. Fellow group's	III4. On-line	IV4.Expert on-site
search	electronic bulletin	simulation/test sample	demonstration
15. Physical /Internet store	II5. On-line interactive forum	III5. Electronic newspaper	IV5.Expert on-line teaching
16. Expert's blog	II6. Fellow group's blog	III6. Contest	IV6.Design exhibitions
17. Related television program	II7. Personal communication	III7. Training course	IV7.Design related website
18. Advertisement	II8. Group gathering	III8. Expert on-site demonstration	IV8.Themed museum
 Personal past experience 	II9. Regular magazine published	III9. Expert on-line teaching	IV9.Creative market
110. Leisure activity	•	III10. Upload system	IV10.Patent resource
-		III11. Themed exhibitions	
		III12. Themed museum	
		III13. Themed park	

Table 2. Design knowledge search aspects and approaches

(5) Knowledge model construction: Collect the design knowledge items and its corresponding search approaches of four status users, and analyze design knowledge connotation based on the convergence situations to construct the model of design knowledge connotation and search approaches for high-involved users.

4 Result and Discussion

4.1 Design Knowledge Connotation of Highly-Involved User

It is difficult to discuss the standpoint of quantification statistics based on a qualitative research method, the result analysis of the significance of "the phenomenon and nature" is greater than that of "quantity and proportion." According to this framework, from the item selection situation (Table 1), within the "same status type," if the design knowledge item was selected by any subject, that means that user with this status recognizes the importance of that item, thus, this research views the knowledge items as design knowledge connotation of this particular status. The design knowledge connotation of the four types of user statuses is shown in Figure 1.

All 23 design knowledge items have been selected by subjects, that demonstrated the validity of the "design knowledge items" established by this research, and discovered that design knowledge produced four kinds of combination ways and can be the basis to determine the importance level of design knowledge. The convergence of design knowledge among the four types of statuses are called "Essential knowledge"; convergence among three types of statuses are called Main Knowledge; convergence between two types of statuses are called Secondary Knowledge; the ones without convergence are "Peculiar Knowledge", which can be viewed as the unique

design knowledge exclusive for this status user. Essential knowledge coexists within four statuses of users and different statuses have different main, secondary and peculiar knowledge.



Fig. 1. Design knowledge connotation of four types of highly-involved users

"Essential knowledge" contains nine items, can be viewed as the design foundation knowledge for highly-involved users. One needs to know component shape (A1) and component color (A2); one needs to be familiar with object construction technique (B3) and structure constitution principle (B5); integrity of works mainly relies on form esthetics concept (C4) and color coordination skill (C5); personal practice experience (D2) and fellows' experience exchange (D3) are essential for designing of the highly-involved users; unintentional inspiration (E2) is the power that pushes highly-involved users to design continually. These essential knowledge dispersed throughout the five main design knowledge categories, they do not belong to any particular categories, this result demonstrates that in order to become a highlyinvolved user, one must grasp "interdisciplinary" design knowledge. This research found that only junior experts do not have their own exclusively peculiar knowledge, which explains that junior experts are the preliminary threshold before becoming highly-involved users.

As mentioned above, this research found "inspiration" is a design knowledge category that is valued by three statuses: junior experts, exhibition participators, and business managers. The design knowledge constitution of the four statuses of users could be acquired in Figure 1.

4.2 Design Knowledge Search Approaches of Highly - Involved User

According to Table 2, compares it with the design knowledge categorization in Figure 1, one may find different design knowledge items and search approaches of the various

types of status users. Collect the four types of status users' search approaches for essential design knowledge; the extract method is also the significance of "whether there is the phenomenon" in the opinion of the subjects (Figure 2).The convergence in search approaches of four statuses of users has eight items: instructional manual (I1), internet knowledge search (I4), personal past experience (I9), leisure activity (I10), joining fellow group (II1), visiting exhibition held by fellow group (II2), on-line interactive forum (II5), group gathering (II8), which can be viewed as the necessary search approaches for entering into highly-involved users.



Fig. 2. Design knowledge search approaches of four types of highly-involved users

Table 3.	Highly-involved u	ser design knowledge a	and its search approaches
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Knowledge type		Junior expert	Exhibition	Business manager	Award winner
			participator		
Peculiar	connotation	n/a	A5	A4,C2	B4,C1
knowledge	approach	n/a	I (4,5)+II (7,8)	I (1,4,6)+	I (4,6)+
				II (5,9)+IV3	II (1,2,6,9)
Secondary	connotation	A3,C3,D4	D4	A3,C3	n/a
knowledge	approach	I 4 + II (1,5,9)+	II (1,2,7)	I (1,2,4,6)+ II 5	n/a
		III 10+IV(1,2)			
Main	connotation	B1,C7,E1	B1,B2,C6,C7,D1	B2,C6,C7,D1,E1	B1,B2,C6,D1
knowledge			,E1		
	approach	I (1,4,5,7,9)+	I (1,4,6,9,10)+	I (1,2,4,6,9,10)+	I (1,2,4,6,9) +
		II (1,2,5,8)+	II (1,2,5,7,8)	II (1,2,5,8,9)+	II (1,5,6,9) +
		IV (1,2,6,7,9,10)		III(8,11)+IV3	III 11+IV2
Essential	connotation	A1,A2,B3,B5,C4	A1,A2,B3,B5,C4	A1,A2,B3,B5,C4,	A1,A2,B3,B5,C4
knowledge		,C5,D2,D3,E2	,C5,D2,D3,E2	C5,D2,D3,E2	,C5,D2,D3,E2
_	approach	key search approaches: $I(1,4,9,10) + II(1,2,5,8)$			
		other search approaches:			
		I(2,3,5,6,7,8) + II(6,7,9) + III(6,8,10,11,13) + IV(1,2,3,6,7,8,9,10)			

It can be summarized that the search approaches of highly-involved users centered on two aspects: "self-learning and fellow group". In other words, only if the user is willing to learn on his/her own initiative, eager to participate in activities with other players for exchange of design knowledge, then one can grasp the essential knowledge for becoming a highly-involved user. According to Figure 1, the knowledge connotation and the degree of importance for highly-involved users are shown under the knowledge type's "connotation" column in Table 3. The "approach" column's extract method is also the significance of "phenomenon" in the opinion of the subjects.

Four types of highly-involved users have nine essential knowledge items and eight key search approaches, and columns are not separated due to their commonality. For example: Junior Expert's main knowledge are B1, C7, E1, them are obtained through the fifteen search approaches: I (1,4,5,7,9)+ II (1,2,5,8)+ IV (1,2,6,7,9,10). Besides essential knowledge, four statuses of users possess some knowledge items and approaches alike; therefore, various status type users can have additional identity type as they wish in order to increase the knowledge items and know search approaches that one does not originally possesses.

5 Conclusion

Web 2.0 has facilitated an "all people expert" era, users have transformed from pure knowledge receptors to knowledge provider or knowledge developer. High-involved users are the utmost "emerging creative resource" that enterprises need to develop. In order to understand highly-involved users' design knowledge connotation and search approaches in the design process of the, this research takes LEGO bricks and its players as the subjects and proposes:

- 1. A procedure to construct the high-involved user design knowledge and search approaches model.
- 2. The questionnaire tools for qualitative research usage, including: design knowledge categorization chart, and search approaches for design knowledge.

Based on analysis of highly-involved LEGO users, the conclusions can be obtained:

- 1. User experience attribute categorization may be separated into four statuses: junior expert, exhibition participator, business manager, and award winner.
- 2. Nine essential design knowledge items and eight key search approaches of highlyinvolved users.
- 3. Junior expert does not have one's exclusive peculiar knowledge; it is the preliminary threshold to become highly-involved users.

Academically extends the "user-centered design" concept, proposes a qualitative research procedure on studying user's design knowledge. In the industry aspect, able to assist enterprise to develop new service model, become design knowledge service consultant through the understanding of "user design knowledge search behavior," wish to raise enterprises' production value, expand competitive advantage, and increase its economic value and upgrade its professional image.

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