Application of Co-creation Design Experiences to the Development of Green Furniture

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Abstract. With the trend of environmental protection around the globe, the development of most green furniture in the past emphasized on the production processes and technical applications and more particularly on material selections and functional improvements. However, the user demands which keep pace with the times have seldom been considered. Thus it is difficult to satisfy the diversified demands for green furniture's creativity and functions by modern consumers whose motivation of buying is thus reduced. Moreover, with the rise of the creativity generation nowadays, people of the fresh new generation always have ever-changing creativity. Enterprises and those who develop products should collaborate with consumers and give users the room for product creation so as to satisfy the concept of user creation and fulfill the design experiences.

Based on the ideas of "value co-creation with users" and "experience service", the topic of "co-creation design experience" was investigated in this study with discussions on the possibility for an enterprise to develop products in joint cooperation with users. Enterprises should no longer develop products independently but should view users as the co-workers for product development. This allows users to participate in design processes and own design experiences so that it is possible to co-create products' new values with users. This study connects users' creativity in series for considering the balancing point of the co-creation between enterprises and users on product values. A "development procedure for products co-created with users" was proposed. Paper pallets were used as the material and a set of innovative eco-friendly furniture was successfully developed for satisfying the co-creation design experience between an enterprise and its users. For the meaning of this innovative eco-friendly furniture, it resembles LEGO toy blocks, which let the users enjoy the design experience by bringing their creativity into play and assemble the parts of the eco-friendly furniture without the need of additional learning or tools.

Keywords: Co-creation · Design experience · User innovation · Green furniture

S. Yamamoto (Ed.): HIMI 2016, Part II, LNCS 9735, pp. 235–243, 2016.
DOI: 10.1007/978-3-319-40397-7_23

1 Research Background

With the trend of industrial competition and globalization, the concept which strives for production manufacturing in the industrialized era is gradually getting unpopular. The economic era that succeeded it emphasizes more on personal creativity and environmental awareness. Nowadays, the creativity generation has emerged and the younger group accepts diversified stimuli from the external world via various types of channels. These have triggered kaleidoscopic types of creativity and they expect the products that they buy can better display their own uniqueness. As a result, a product of a single form or a single function can no longer satisfy their preferences and creativity demands. More and more users exhibit a higher degree of interests in the design behaviors and they pay close attention to the products that can present their own creativity. Therefore, most of the enterprises have acknowledged that any product development should no longer be limited within an enterprise. They should extend outward and collaborate with users, bring user creativity into designs, and even open up the room for product creation so that users are allowed to have freedom in creation. That is, enterprises no longer develop product independently. Instead, they view users as co-workers on product developments. They let users participate in the design process and collaborate with users on developing products. At the same time, this approach can enhance product adherence and diffusivity which allows creating new values for products together with users.

Under the worldwide trend of environmental protection, the development of most green furniture in the past emphasized on the production processes and technical applications and more particularly on material selections and functional improvements. However, the user demands which keep pace with the times have seldom been considered. As a result, though many eco-friendly furniture designs have a good intention, it is hard for them to satisfy modern users' diversified demands toward product creativity and functions and this causes the degraded motivation in buying. The marketing strategy failed to last longer for keeping the market competitiveness. This result instead loses the meaning and value of green product designs and developments (Tu and Wu 2005). On a modern market, a product can be viewed as having the true substantial value only when it is able to promote consumptions with a success (Magnusson 2001). Therefore, this study proposed that an eco-friendly product should also comply with the trend of user innovation and open up the room for product creation to users. As a result, the purpose of this study is to introduce the concept of "co-creation thinking" into the development of eco-friendly furniture so as to enhance the consumption motivation and the competitiveness for eco-friendly furniture.

2 Literature Review

2.1 Co-creation Design

Co-Creation is a new type of value creation pattern. Prahalad and Ramaswamy (2003) proposed a simple definition for co-creation: The value is jointly created by an enterprise and its customers. Ind et al. (2013) proposed that co-creation is a type of collaboration process that an enterprise and its users create products in an optimistic, creative, and

socialized manner. Via this process, both sides can obtain benefits simultaneously. Co-creation designs adds new dynamics into the relationship between a manufacturer and its customers via having users directly participate in products' production or distribution so that they can jointly implement their creativity on the products (Kambil et al. 1999). As long as a user participates into these activities, he/she can easily generate personal affects so as to enhance the products' uniqueness and they can easily have a higher degree of satisfaction toward the products. When collaborating jointly with users on creating and developing products, as compared to the design personnel inside an enterprise, a user can bring their unique creativity and ideas into play during the self design process without being confined by the enterprises' regulations. This approach allows more design freedom and can help fulfill the eventual development target for products (Schreier et al. 2012).

Roggeven et al. (2012) indicated that, when a product is jointly created by an enterprise and its user, the co-creation design experiences are able to influence customers' satisfaction since the co-creation thinking allows a user to shape personalized features and irreplaceable design experiences on a product. Nowadays, many enterprises from various fields have transformed the original approach of new products development thinking from a single aspect into actually bringing users into the process. This allows users who are related to products/services to participate jointly in the process of products/services developments. This approach can indeed bring positive outcomes and economic interests to enterprises Weber et al. (2012).

2.2 Eco-friendly Furniture Products

Environmental Protection Agency of the Executive Yuan announced the definition of an eco-friendly product as follows. For a product from the beginning of the product life cycle to the end, it is required to reduce as possibly the impacts to the environment. From the aspect of product designs, this means during the process of designing products, it is required to avoid any potential hazard to the environment or increasing the social costs. The goal is to produce products with low contamination, low energy consumption, and low toxicity and to recycle and reuse them as possible. A design which also considers the values in economic development is preferable (Tu 2002). There is a wide range of eco-friendly materials and types. Generally speaking, when manufacturing eco-friendly materials, they can help reduce environmental hazards as possible, can decompose when being discarded, do not release toxic substances, or can be recycled and reused. However, when re-creating and re-designing a product based on a user's consideration, some components might possibly be repetitively used. It is thus required to evaluate whether the eco-friendly materials satisfy the demand of co-creation designs by avoiding the weight being too heavy, strengthening the structure to support heavy objects, and eliminating sharp edges for the users to operate without worries and disassemble/assemble creatively.

Furniture is one of the important export industries among traditional industries in Taiwan, which holds an important position on the global furniture markets and enjoyed a fame of being the dominant country for furniture exports. However since 1989 with the ascending global environmental awareness, woods are hard to acquire and the

environmental statutes are getting stricter. Some of the furniture industry had transformed with the strategic development in eco-friendly furniture (Tu and Wu 2005). For the selection of construction materials with eco-friendly furniture, corrugated cardboards can be used not only on transportation packing but also are very suitable for use in the construction materials with eco-friendly furniture. Since corrugated cardboards are lightweight, of low cost, and good at cushioning, more than 80 % of corrugated cardboards can be recycled and reused. In addition, if viewed from the product design standpoint, they have various features such as being foldable, can be disassembled, recombined, and engaged closely, supporting heavy weights, and transported in flattened form (Chiang 2007). Domestic and overseas enterprises have used corrugated cardboards as the main sheet materials for producing furniture. In addition to the common types that have been developed including tables, chairs, beds, and cabinets, the range of application has be extended to exhibition partitions and screens as shown in Fig. 1.

Fig. 1. Existing applications of corrugated cardboard furniture

The effect of supporting heavy objects is achieved by the combination of corrugated cardboards and there are diversified ways of combination structures. Chen (2009) collected 40 samples of commercially available corrugated cardboard furniture and used the simple integrated KJ method and the cross analysis method to investigate the way of composing commercially available corrugated cardboard furniture. A total of 12 combinations or constituent types were collected and organized.

To sum up, when an enterprise opens up the design rights and collaborate with its users jointly in creating products, this usually brings positive influences to the enterprise's creativity and product sales. This indicates that it is worthy of introducing the eco-friendly furniture development process. However, the attempt of this study is to propose the "co-creation product development model" and the operating instructions are as follows. A case study on the corrugated cardboard furniture was conducted so as to perform implementations and developments.

3 Co-creation Product Development Model

The concept of co-creation products allows users to participate directly in the design and development tasks. However, considering that seldom of the typical users accept professional design training and a "creative" user doesn't equal to a user with the "design

capability", co-creation products are required to cooperate with the most "user design capability" for encouraging users in carrying out designs and processing so as to reduce the feeling of frustration due to design failures. Therefore a co-creation product development model was proposed in this study for the follow-up users to carry out the actions of re-designing or re-creating products. The procedure is described as follows:

3.1 Investigating User Demands for Creativity

Nowadays in addition to the requirements of functions and external forms, users gradually evoke the "creativity" demands for products so as to demonstrate personal features and styles. This is something that was less investigated during the product developments in the past. Therefore the first step is to investigate the user demands for creativity. The existing user analysis methods such as the behavior observational method, focused interviews, questionnaire survey, and ethnography can be used to define user demands for product creativity, which can accordingly be used to set as the product design target.

3.2 Building a Classification of Product Functionality

Based on the design targets that have been established above, the functions required for a product can be determined. These can be classified into two types according to a function's degree of sharing: (1) When a function achieves two or more design targets simultaneously, it is called a "general-purpose function" with a high degree of sharing; (2) When a function is only suitable for a particular target, it is called a "particular function" with a low degree of sharing.

3.3 Components Required for Developing Products

When developing product components based on the stipulated target functions, a component is called the "major component" if it can independently exhibit most of the product's functions; in addition, it is allowed to develop particular components to satisfy other particular functions and it is called a "minor component". A minor component is not able to bring functions into play independently but has to attach to a major component for demonstrating the functions. It is among the particular functions. When a type of unit component can hold the entire product functions, it is required to only develop a type of major components. On the other hand, two or more types of components can be developed based on the product demands so as to extend product functions.

3.4 Developing Creative and Friendly Interfaces

Product interfaces can be classified as: concrete "physical interface" which is responsible for the connective relationship between the major component and minor components; and the mental "cognitive interface" which is responsible for the interactive relationship between products and users. A creative and friendly interface encourages its user to apply the existing knowledge, capability, and skills without the need of extra

learning for continuing the design and creation. A designer can utilize the product semantic perception interface to guide the creativity and friendliness of a physical interface for its users.

3.5 Products' Embodied Design

Based on the major, minor components and the creative friendly interface that have been developed above, the commonly available CAD simulation, 3D printing, mock-ups and functional models can be utilized to apply concrete forms to the product components so as to carry out a diversity of functional and appearance test.

4 Verification by a Case Study

To verify the feasibility of the co-creation product development model, this study invited 4th grade junior college students in the Department of Product Design to carry out a case study on the eco-friendly furniture product development based on this mode. The target group is the young people who move out of home in the age of 18–35 years old. The reasons for this is twofold: (1) The group has a higher frequency of removing behaviors and expects their furniture to be diversified and easy to store; (2) The group has diversified ideas on the requirements of creativity and expects a product to demonstrate the creativity at any moment as compared to other group. The case study is described as follows:

4.1 Investigating User Demands for Creativity

The design team firstly observed the existing eco-friendly furniture. It was found that though the commercially available eco-friendly furniture can be assembled to become products with functionality, the product function is unified and fixed and could not be modified at any moment according to an individual's creativity. The design team also observed the way of storing items for the target group in their houses so as to understand the usage conditions. After the interviews and the open questionnaire survey on the ten target users, the KJ method was used to collect and organize the demands for furniture creativity for the group of people that move out of home: (a) A user can design the furniture appearance and forms in person; (b) A user can freely plan the storage space; (c) A user can adjust product purposes according to his/her demands at will; (d) Expecting the furniture to keep the usual way of using the top surface such as the desk top, chair top, bed topper, etc.

4.2 Building a Classification of Product Functionality

This portion is to propose the functions that the eco-friendly furniture should have for those moving out of home. Based on the above analysis of the top three design targets (a), (b), and (c), the components need to satisfy the general-purpose functions of adjusting the space with flexibility, no limitation on the direction of stacks and storage,

with openness, adjusting product purposes according to the demands at will. It is known from the fourth design target (d) that, a product should provide the function of laminate boards for use as a horizontal plane and this is classified as a particular function.

4.3 Components Required for Developing Products

Based on the above, the major component should have the openness and a degree of freedom. Considering the support strength of a product's structure, the design team developed the "flake-type unit" as the major component for structural support and partitioning. This approach can improve the current problem of eco-friendly furniture not allowing the users to easily and freely plan the storage space and the appearance styling. Moreover, minor components are required to be replaceable at will and the original purpose should be able to change. In order to satisfy the user demands, a "planar unit" was developed accordingly as shown in Fig. 2.

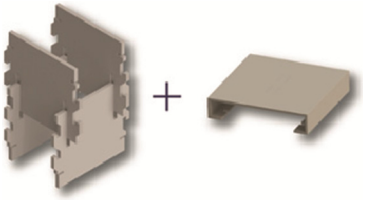

Fig. 2. Major and minor components

4.4 Developing Creative and Friendly Interfaces

The interactions between different types of components include the assembly and extension between a major component and other major components, or a major component and other minor components. The physical interface between components adopts a "sawtooth engagement" for fixing the components. On the cognitive interface, it complies with a user's past recognition model by using the "Yin and Yang" styling semantics to guide the user for the engagement. The user requires no extra learning or training and can achieve creativity interactions with products seamlessly. They can also intuitively design the furniture's forms and purposes. The assembling operation is as shown in Fig. 3.

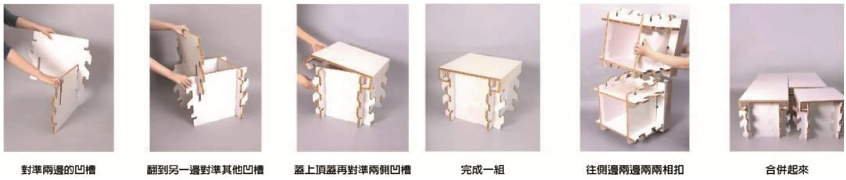

Fig. 3. Procedure of assembling the components

4.5 Products' Embodied Design

Eco-friendly corrugated cardboards were used as the construction materials. Via CAD simulation, the major and minor components and interfaces were embodied one by one for determining the sawtooth angle and the structural strength (Fig. 4).

Fig. 4. Demonstration of assembling purposes

The characteristics of the co-creation eco-friendly furniture that was developed in this study are summarized as follows.

(1) The problem of having a single function for most of the corrugated cardboard furniture can be resolved.
(2) Unit components were simplified so as to reduce the production cost and enhance the production rate.
(3) Components are easy to disassemble. A variety of styling and functions are provided after being assembled.
(4) A type of furniture that changes according to the user creativity and functional requirements is created.

5 Conclusions

The co-creation product development model and operating instructions as follows were proposed in this study. A case study on operating the corrugated cardboard furniture was conducted for performing the implementation and development. The applications and implications are threefold: (1) Users and developers in enterprises jointly participate in product designs to co-create new values for eco-friendly furniture products. Eco-friendly products not only strive for eco-friendliness, but also provide users with design creation experiences. The resulting products are full of affective values and this approach can further create the distinctiveness and differentiation for enterprise brands. (2) When a product can add new components repeatedly according to the functional requirements, product adherence can be enhanced. Users buy eco-friendly furniture no longer just for one time, but will build a sustainable consumption mechanism, which extends the

product life cycle. (3) The relationship between an enterprise and its user transformed from the vertical "host-client relationship" into the horizontal "friend-companion relationship". This approach can greatly enhance the product uniqueness and professional image for an enterprise and resolve the predicament of a saturated market for conventional eco-friendly furniture.

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