

# Product Awareness Between Consumers and Designers – A Family Dining Table Design as Example

Ming-Hsuan Hsieh<sup>1(✉)</sup> and Chia-Ling Chang<sup>2</sup>

<sup>1</sup> Department of Computer-Aided Industrial Design,  
Overseas Chinese University, Taichung, Taiwan, ROC  
mhhsieh@ocu.edu.tw

<sup>2</sup> Department of Education Industry and Digital Media,  
National Taitung University, Taitung, Taiwan, ROC  
idit007@gmail.com

**Abstract.** Recently, consumer-oriented design has become the key for product development. However, due to a lack of effective consumer opinions by designers, leading designers and consumers have differences on product awareness. This study is based on the Cognitive Structure Model, to understand the differences between designers and consumers based on the family dining table. The purpose is to aid designers in obtaining an understanding and consensus with the consumer for their products. This research used Mind Mapping to work with Means-End Chain to perform designers' cognitive approach followed by an implication matrix of consumer awareness survey. The results can be used to divide the designers and consumers awareness into four parts: "positive consensus", "negative consensus", "designer subjective perception" and "subjective perception of consumers". Finally, there is a streamlined Hierarchical Value Map to show the product design guidelines. The family dining table design focused on the steps of product design ideas. The focus is to assist the industry to accurately grasp the designer and consumer awareness of consensus and to work out effective product development direction.

**Keywords:** Consumer-oriented design · Cognitive similarities and differences · Family dining table · Design guidelines

## 1 Introduction

Nowadays, in order to meet the varieties needs of consumers, many manufacturers use consumer-oriented design approach to product development. However, because of different lifestyles and values differences between designers and consumers, resulting in product implied meaning is not exactly the same. The significance of the product come from cognition, it is precisely consumers to buy or not (Zanoli and Naspetti 2002; Kapoor and Kulshrestha 2009). Consumer-oriented design is not only facing designers and consumers cognitive difference (Chuang et al. 2001), but also the majority of consumers are unable to clearly and fully describe their needs, leads designers encounter difficulty truly understand their preferences (Chang et al. 2006). Because of

expression of the views of consumers out there are limits, during consumer research, it is necessary to focus on how to form the understanding of consumer demand, as well as more depth cognitive similarities and differences between designers and consumers.

Kleef et al. (2005) pointed out that the new product development process is divided into opportunity identification, development, optimization and launch. Opportunity identification is the involvement of consumers in unmet needs. It will strongly influence the quality of new product development. Alam and Perry (2002) analysis of consumer the order of importance in various stages of development of new products. Idea generation ranked first, it showed the impact of consumer opinion in this stage. If manufactures can lead consumers' opinions and views in early stages of idea generation, to eliminate the idea is not feasible, it will reduce unnecessary losses.

Although awareness and consumer demand in the product development process is important, but for designers, there are still big differences between consumer awareness, on the major factors causing differences are as follows: (i) Through designers' traditional brain storm, it can only reflect the designer's personal knowledge. It would be too subjective. (ii) When the consumers involved in the design, subject to the limited experience and knowledge of the conditions, it is difficult to have a breakthrough innovation. Therefore, designers should not be limited in the comments made by the consumer directly, but must further guide consumers into unfamiliar or unknown field. (iii) The interpretation of designers sometimes does not meet the same as consumers. It will help filter product ideas by clearly understanding of differences between the two sides on the type of the product awareness. This study will present "Family dinning table" as the theme, the use of Cognitive Structure Model (Hsieh et al. 2013) allows designers product ideas generation obtain the agreement between consumers, to help work out the correct design guidelines.

## 2 Literature Review

In Sects. 2.1 and 2.2, we will review Mind Mapping and Means-End Chain, through these combinations to perform designers' cognition. Section 2.3 is introduction of Implication Matrix, through this matrix to quantify the association between two elements among respondents, in order to obtain consumer awareness.

### 2.1 Mind Mapping

When the design theme is determined, designers can be carried out to develop new product ideas using mind mapping. When drawing a Mind Map, there are several tips (Gelb 1998; Buzan 2002; Reed 2005): (i) Text or image rendering central of the paper, then extending the trunks. (ii) On an extension of the branch, just write a keyword, any ideas are free to play, uncritical. (iii) All of the branches of each node to form a structure, trunks and branches are in different thickness. (iv) There are two ways of brain storming, Brain Flow is a keyword to associate another keyword, then think of the next keyword; and Brain Bloom is a keyword to associate many keywords. (v) Meet thoughts blank, a few lines may be added after the keyword, it will induce

brain tries to fill it. (vi) BOIs (Basic Ordering Ideas) is principle classification through thinking system. Mind Mapping is a release of brain potential graphical tool that can be administered in accordance with the hierarchical classification and association between them conceived to help designers with creative ideas lead to unlimited and reorganized in ideas of creating new thinking structure.

## 2.2 Means-End Chain

Means-End Chain proposes product is stored hierarchically in memory of consumers, as product attributes, consumption consequences and personal values in linkage, if an attribute links to more abstract values, then this property is important (Chiu 2005; Ferran and Grunert 2007; Klenosky 2002). “Attribute” is the characteristic of the product or service physical or observable; “consequence” is the benefits or consequences by using the product obtained; value means a highly abstract motivation to guide usage behavior. Means-End Chain is a good way to find what makes product or service more important, to help investigators appreciate the experience and knowledge of consumers. This method presents the extracts of cognitive structures, an one-to-one linear type links cognitive concepts (Voss et al. 2007). Details from a low level attribute to high level value of the process, explain the motivations of consumers’ view, the product information is interpreted and what elements are important to know.

## 2.3 Implication Matrix

Rekom and Wierenga (2002) considers the Implication Matrix as a link between the concepts, the matrix of rows and columns, are classified as the elements, row-items present means and column-items present ends. Implication Matrix is found as a gap of qualitative and quantitative findings, as to quantify the relationship between the elements, the higher values between the two elements, the stronger connection. (Leão and Mello 2007; Veludo-de-Oliveira et al. 2006). With statistics all respondents mentioned a number of times between two elements of links, it can aggregate implication Matrix (Phillips and Reynolds 2009).

## 3 Cognitive Structure Model Process

Section 3.1 use Mind Mapping to present a product awareness of a designer. These data will be used to guide the consumer as well. Section 3.2 Applying Implication Matrix, so that consumers will pairwise elements rated hierarchically in attributes-consequences and consequences-values. It makes consumers fully express their opinions. Section 3.3 the distinction between the designer and the consumer awareness of the similarities and differences, to obtain the cognitive consensus as to develop products based on the design guidelines.

### 3.1 Development of Designers' Cognition

Establish an effective BIOs (Basic Ordering Ideas) is an important key to draw drawn a mind map. It will allow ideas to go along with others to organize the structure. This method is a keyword association process, broken down into several categories or hierarchically stages, so that the brain's Reflections in a natural structure, which is the main idea after the presentation, followed by secondary ideas which quickly and easily promote the formation. This study applied BOIs Means-End Chain architecture, from inside out for the values-consequences-attributes, the idea for the hierarchical classification, as shown in Fig. 1. Mind Mapping in depicting the relationship between keywords and description, will thin continually, screening and understand information and to support the decision of affection.

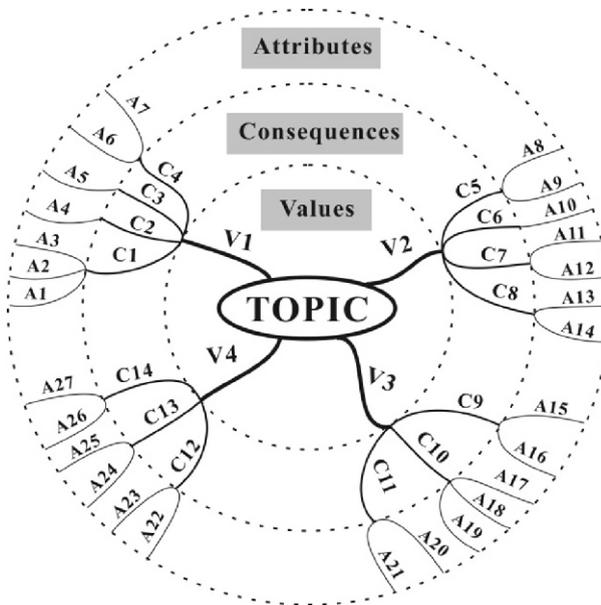


Fig. 1. BOIs of mind map

### 3.2 Understand Consumer Perceptions

Attributes, consequences, values generated from mind maps for the development of attributes-consequences (AC) consequences-values (CV) basic on questionnaires of Implication Matrix. In other words, to investigate the use of a these elements of consumer awareness by Implication Matrix, whereby to guide consumers connect important elements. This study collected Scale questionnaire, directly from respondents rating elements pairwise. Figure 2 depicts the form of AC Implication Matrix, as well as CV Implication Matrix. Application of Implication Matrix contains understanding of consumer awareness, to realize the knowledge of product cognitive structure from Consumers.

		Consequences				
		C1	C2	C3	---	C14
Attributes	A1	1	2	1		5
	---					
	A25	2	3	3		1
	A26	4	2	1		5
	A27	2	3	2		1

Fig. 2. Form of AC Implication Matrix

### 3.3 Consumer and Designers Cognition

Designers and consumers will have the same perception and differences in two types, each of which may be divided into two zones, a total of four blocks as Fig. 3. In Fig. 3,  $A_i - C_j$  presents a attributes–consequences link,  $A_i \nexists C_j$  presents no any attributes–consequences link;  $C_j - V_k$  presents a consequences–values link,  $C_j \nexists V_k$  presents no any consequences–values link. The description of these four blocks as follow:

- (i) Designer and Consumer have same cognition ( $D = C$ ): same cognition two types, one is the designers and consumers are considered this linked ( $A_i - C_j; C_j - V_k$ ) as a “positive consensus”; the other One is that the designers and consumers are no such link ( $A_i \nexists C_j; C_j \nexists V_k$ ) as a “negative consensus”.
- (ii) Designer and Consumer have different cognition ( $D \neq C$ ): there are two different types of cognition, one is that the designers have this link ( $A_i - C_j; C_j - V_k$ ), and consumers thinks that no such link ( $A_i \nexists C_j; C_j \nexists V_k$ ), as “designers subjective”; another One is that the designer has no such link ( $A_i - C_j; C_j - V_k$ ); but the consumers think there is this link ( $A_i - C_j; C_j - V_k$ ), as “consumers subjective”.

Designers and consumers are both considered this link ( $A_i - C_j; C_j - V_k$ ). This block represents designers and consumers to reach a consensus on cognition, which can be used as preliminary product design guidelines. In order to present this Means-End Chain of this block clearer, we will adopt Hierarchical Value Map (HVM). HVM Construction is to contain the resulting of Implication Matrix data analysis. It represents the majority of people in most of the ideas most of the time to help researchers to understand the current market environment.

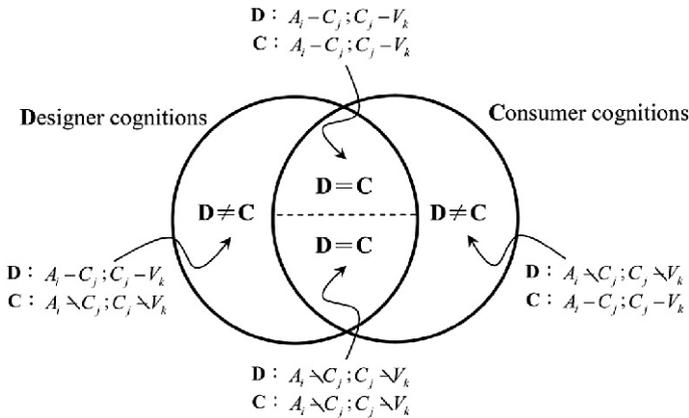


Fig. 3. Consumer and designers cognition

## 4 Practice

In this chapter will use “parent-child table design” as an example. At first, the designer followed mind mapping tips, conduct creative thinking, to produce 20 “attributes”, 10 “consequences” and 4 “values”. Then through Implication Matrix integrate 82 respondents are among the elements associated with the score to clarify designers and consumers in the “parent-child table Design” the similarities and differences cognition link. Win the final with streamlined HVM performance “positive consensus” from designers and consumer awareness. In this block obtain the important link as a product design guidelines.

### 4.1 Designers to Mind Mapping New Product

Used by three designers with mind mapping brainstorming session, which lasted for 1 h. Mind Mapping values for trunk generate levels of “fun”, “inspiration”, “safety” and “Memories”, a branch of extending obtained consequences, then the next layer of branches extending attributes. Designers take their experience and knowledge, combined with keyword stratification and classification principles, creative thinking process to clarify the designer of “parent-child table” cognitive structure, the results as shown in Fig. 4.

### 4.2 Implication Matrix Consumer Awareness Survey

In Fig. 4, the elements can be used to construct AC and CV Implication Matrix. Attributes are listed in the rows, and consequences are listed in columns, it produces an AC matrix. In matrix respondents answer preview all attributes and the connection of consequences. 5-point rating scale, a very strong association 5 points, strongly associated with 4 points, 3 points ordinary, little relevance 2 points, 1 point associates.

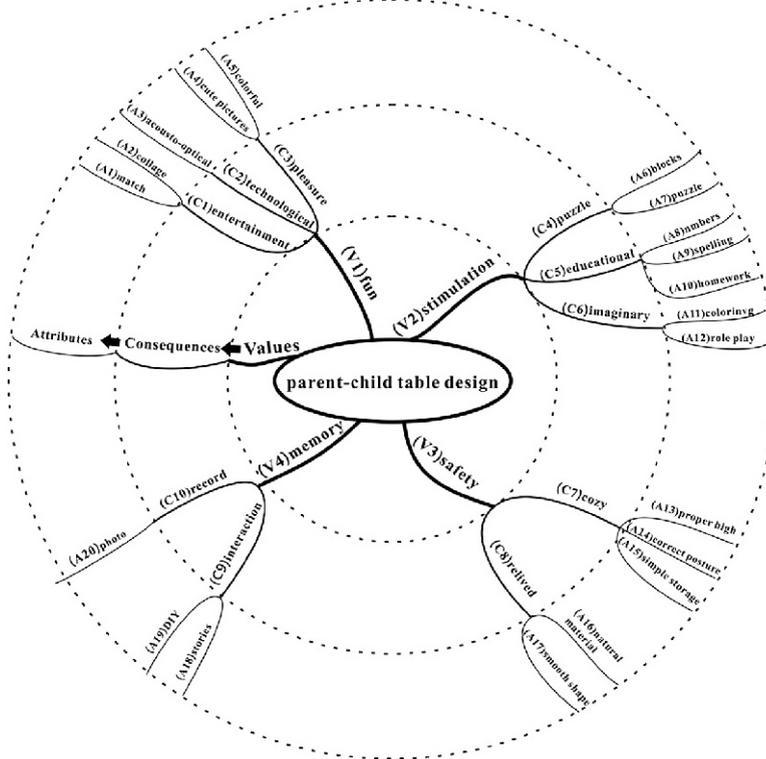


Fig. 4. Mind map of family dining table design

The same, CV matrix lists the consequences and values. Questionnaire (contains AC and CV scales) distributed a total of 101 respondents, the final sample is 82, response to 81 %.

An aggregate Implication Matrix was then produced based on the data provided by the 82 respondents, as shown in Table 1. The formula for calculating the association weight of each cell in the aggregate AC Implication Matrix is as follows:

$$\overline{A_i C_j} = \frac{\sum_{(i,j)=(1,1)}^{(37,18)} A_i C_j}{N} \tag{1}$$

where *i* is the number of attributes, ranging from 1 to 37; *j* the number of consequences, ranging from 1 to 18; *N* the number of respondents, which value is 92;  $\overline{A_i C_j}$  the average association rating between the attribute *i* and the consequence *j*, ranging from 1 to 5.

In addition, Table 1 sums up all the elements' "mean ratings" ( $\overline{X A_i}$ ) to further calculate the intensity of each linkage, which is discussed in more detail in the next section.

**Table 1.** AC Implication Matrix summary of family dining table design

Attributes	Consequences										$\overline{XA}_i$ (To)
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	
A1	<b>4.11</b>	2.53	3.03	<b>3.75</b>	3.77	3.25	2.65	1.63	2.94	2.11	2.98
A2	3.54	2.34	3.34	3.37	3.40	<b>3.62</b>	2.43	1.60	3.19	2.49	2.93
A3	<b>3.90</b>	<b>3.39</b>	<b>3.66</b>	2.25	2.97	2.54	2.88	1.76	<b>3.75</b>	2.37	2.95
A4	3.52	1.88	<b>4.00</b>	2.35	3.15	2.93	2.34	2.11	3.37	1.87	2.75
A5	3.30	2.37	<b>3.85</b>	2.77	3.27	3.34	3.02	2.39	3.09	1.98	2.94
A6	<b>3.88</b>	2.78	3.44	<b>4.21</b>	<b>3.82</b>	<b>3.67</b>	2.93	2.52	<b>3.63</b>	2.46	3.33
A7	<b>3.69</b>	1.90	3.16	<b>3.83</b>	3.50	3.06	2.75	2.40	3.29	2.04	2.96
A8	1.74	2.23	2.29	<b>3.71</b>	<b>4.10</b>	2.35	1.94	2.19	2.22	2.28	2.51
A9	3.16	2.56	2.94	3.49	<b>3.95</b>	2.62	2.21	2.73	2.71	2.51	2.89
A10	1.58	1.74	1.53	3.08	<b>4.26</b>	1.78	1.67	<b>3.71</b>	2.66	2.79	2.48
A11	<b>3.79</b>	1.68	<b>3.78</b>	3.29	3.11	<b>4.18</b>	3.36	2.31	<b>3.89</b>	<b>3.73</b>	3.31
A12	<b>3.86</b>	3.01	<b>3.97</b>	2.94	<b>3.64</b>	<b>4.06</b>	2.94	2.44	<b>3.84</b>	3.03	3.37
A13	1.55	1.52	3.26	1.55	2.03	1.56	<b>3.89</b>	3.47	2.78	1.54	2.32
A14	1.62	1.61	2.99	1.52	2.87	1.52	<b>3.47</b>	<b>3.82</b>	2.48	1.65	2.36
A15	1.67	1.56	3.48	1.66	3.31	2.13	<b>4.08</b>	3.33	2.80	1.59	2.56
A16	1.80	1.69	3.39	1.61	2.73	1.60	<b>3.63</b>	<b>4.23</b>	1.71	1.72	2.41
A17	2.45	1.82	3.33	1.63	2.12	1.50	3.24	<b>3.92</b>	1.98	1.61	2.36
A18	3.42	2.05	3.47	3.09	<b>3.79</b>	3.11	2.91	2.75	<b>4.02</b>	2.39	3.10
A19	<b>3.95</b>	2.73	<b>3.93</b>	3.48	<b>3.96</b>	<b>3.84</b>	3.49	3.00	<b>3.51</b>	3.26	3.52
A20	3.57	2.98	<b>3.86</b>	2.83	2.90	3.13	3.10	3.14	<b>4.01</b>	<b>4.14</b>	3.37
$\overline{XC}_j$ (From)	3.01	2.22	3.34	2.82	3.33	2.79	2.95	2.77	3.09	2.38	

To conserve space, we use code number to represent each attribute and consequence.

$$\overline{XA}_i = \frac{\sum_{j=1}^{18} \overline{A}_i \overline{C}_j}{n} \tag{2}$$

where i is the number of attributes, ranging from 1 to 37; j the number of consequences, ranging from 1 to 18; n the total number of consequences, with the value of 18;  $\overline{XA}_i$  is the mean association rating of attribute i, ranging from 1 to 5.

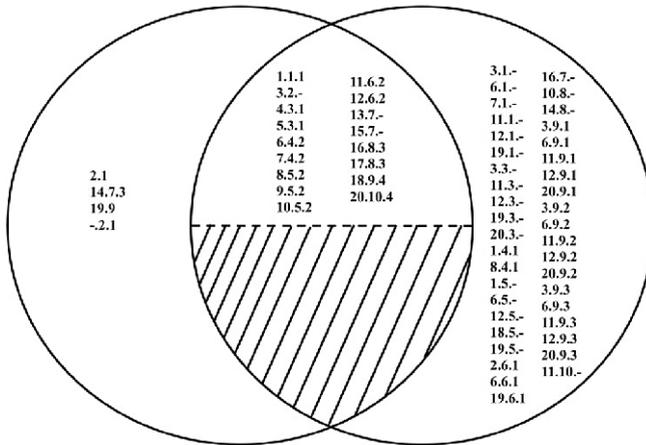
### 4.3 Using Streamlined Hierarchical Value Map Develop Product Design Guidelines

Figure 4 Mind Mapping has a link, in Tables 1 and 2 indicates shaded by representatives designer’s own awareness. On the other hand, referring to Nielsen (1993) mentioned five-point scale of the average (mean) if greater than 3.60 (in Tables 1 and 2 are shown in bold), in this question is “positive” of the score, which means consumers believe that two elements of the association is significant. Both shaded and bold link made both designers and consumers “positive consensus”; just having shade without bold means “designer subjective”; only bold and no shaded stands for “consumer subjective”; neither shaded nor bold represents designers and consumers to achieve “negative consensus”, the result is divided four blocks as shown in Fig. 5. Figure 5 to i.

**Table 2.** CV Implication Matrix summary of family dining table design

Consequences	Values				$\bar{X}_{C_j}$ (To)
	V1	V2	V3	V4	
C1	4.25	2.68	1.83	3.20	2.99
C2	3.40	2.73	2.05	2.31	2.62
C3	4.02	2.51	3.01	3.44	3.25
C4	3.84	4.18	1.99	2.99	3.25
C5	3.13	4.04	2.39	2.61	3.04
C6	3.75	3.93	2.00	2.74	3.11
C7	2.63	1.94	3.48	3.04	2.77
C8	2.01	1.82	4.08	2.07	2.50
C9	3.91	3.77	3.66	3.79	3.78
C10	3.34	2.85	2.94	4.11	3.31
$\bar{X}_{V_k}$ (From)	3.43	3.05	2.74	3.03	

To conserve space, we use code number to represent each consequence and value.



**Fig. 5.** Designers and consumer awareness of similarities and differences (Fig. symbol “-” represents the missing)

j.k Representative  $A_i - C_j - V_k$  link, for example 8.5.2 representative the link of A8-C5-V2. In the block of Negative consensus contains too many links without valuable discussions, we tried to neglect with a slash.

Figure 5 in the “positive consensus” block, there are a total of 14 full Means-End Chain, and three incomplete. The strength of each link can be found in Tables 1 and 2, to link aggregation in each From and To values. For example: A7  $\rightarrow$  C4  $\rightarrow$  V2, A7 From a value of 0, To is 2.96; C4 elements From a value of 2.82, To value of 3.25; V2 elements From a value of 3.05, To a value of 0, therefore, total link strength:

$$(0 + 2.96) + (2.82 + 3.25) + (3.05 + 0) = 12.08$$

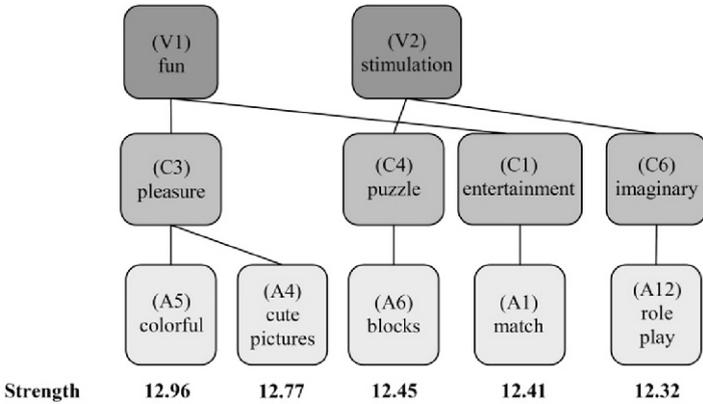


Fig. 6. Streamlined hierarchical value map

It will be too complex and can't really identify the importance of the links if we put all elements in "positive consensus" block. Therefore, designers need to follow their own demand to find out the strength of several former links to define design guidelines. Figure 6 is drawn out the top five of the links, the chain A5 → C3 → V1 is the most critical 1, link strength is 12.96, it can be called critical path, describes the respondents emphasis on "rich colors" attribute, hope to create "pleasure" through this property, and make "fun" between parents and children.

## 5 Conclusion

There were many methods to elicit consumer demand, but these methods are mostly for processing and interface features of the decision. Designers and consumers understand the differences in cognitive structure and factors, and then guide the design approach is a relatively less explored area of research. Therefore, this study focuses on the application of mind mapping to develop the concept of family dining table. The Implication Matrix reads the respondents on a clear definition of designer and consumer awareness of similarities and differences, in order to solve the problems of the designer in the conceptual stage which is easy encounter the ideas are too idealistic and uncertainly consumer demand.

From this study "Family dining table Design" during the practical exercises in the application of cognitive structure can be found the following advantages. (i) The consumer can effectively participate in the design. Consumers in the product development process plays an important role, their views can be understood sooner the better, because the designers can eliminate their own subjective concept. (ii) To divide the similarities and differences between designers and consumer awareness. It's not only understand the cognitive difference, but also to help designers more objective understanding of their own ideas positioning in the consumer market. (iii) Design guidelines have drawn statistical basis. Through investigation and analysis contains in a Implication Matrix by the consumer directly score the elements of connected level,

divided by four blocks, then from the “positive consensus” block calculates the most important links. It can assist the designer more clear and easily to define design guidelines. In this case only take “positive consensus” account. To use this block as a product design guidelines, you can try to discuss “designer subjective” and “subjective consumers” in the future, in order to prevent ignore potential product concept. In summary, this study cognitive structure mode program that allows designers to brainstorm mind mapping to present a perception of a product. Contains Implication Matrix for consumer surveys to clarify the difference between the designer and the consumer’s cognitive structure. Streamlined HVM can see important links, to help designers to have an effective product design guideline.

**Acknowledgement.** This study was supported by the Ministry of Science and Technology of the Republic of China (MOST 104-2221-E-240-001).

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