

Questionnaire survey of customer satisfaction for product categories towards certification of ergonomic quality in design

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Abstract. Customer satisfaction was surveyed for 6 product categories (consumer electronics, daily commodities, home equipment, information systems, cars, and health appliances) by questionnaires based on the Analytic Hierarchy Process. Analyzing weight of evaluation factors, the 6 product categories were reorganized into 4 categories, those were related to 4 aspects in daily living that formed by two axes: home living - mobility life and healthy life - active communication. It was found that consumers were attracted by the actual user test by public institutes for all product categories. The certification based on the design process standard established by authorities, such as EQUID was the second best attractor for consumers.

Keywords: customer satisfaction, analytic hierarchy process, ergonomic quality in design

1. Introduction

Certification of ergonomic quality in design is under discussion in the IEA standing committee (EQUID) and ISO TC159/SC1. It is understood that the certification will be an attractor to consumers, and products with the certification will distribute in the market. Customers may have different evaluation factors for different product categories. The certification should be designed with understanding evaluation factors for product categories. The purpose of the present survey is to clarify the customer satisfaction for product categories in order to establish the certification of ergonomic quality in design.

2. Method

Questionnaire survey was designed to clarify differences of customer satisfaction in product categories. The framework of the questionnaire was formed as paired comparison method based on the Analytic Hierarchy Process. Evaluation factors of question-

naire were selected from "Human Design Technology" proposed by Yamaoka [1]. Products were categorized into 6 segments, such as consumer electronics, daily commodities, home equipment, information systems, cars, and health appliances. The questionnaire was formed into hierarchical structure with 5 levels (figure 1). The first level is the purpose of this study, and the second level is the product category. The third level had 5 basic evaluation factors, such as safety, validity, usability, style design, and augmentability. The fourth level is detailed evaluation factors. As the sixth level, we add incentive rate of the certification for consumers.

Participants were selected as consumers that request high quality in design. An investigator visited every participant and explained the purpose of the survey before starting the questionnaire. 133 valid samples were obtained. Weight for every evaluation factor was calculated, and the priority of factors was clarified. Differences of customer satisfaction were discussed based on evaluation factors with high priority.

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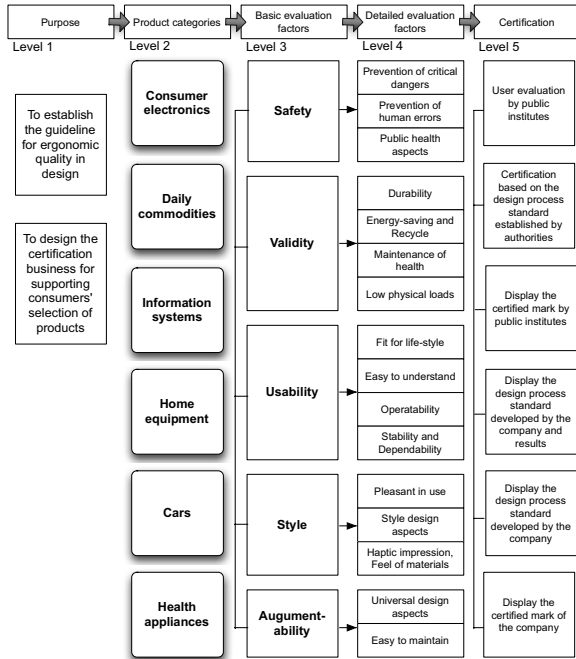


Figure 1 Questionnaire design based on AHP

3. Results

3.1. Analysis for basic factors

Results are shown in figure 2. Factors in the black cell indicate high priority factors of the basic level, and factors in the gray cell indicate high priority factors of the detailed level. The order of factors was different in product categories. Usability was the most important factor for the product categories of consumer electronics, daily commodities and information systems. Whereas, safety was the most important factors for the product categories of home equipment, cars and health appliances. Small differences were founded in the weight of the first to the third priority of consumer electronics, home equipment and health appliances. Thus, the order of the top three factors was not so important for these product categories. The top three factors were safety, validity and usability.

Especially for the product category of home equipment, small differences were founded in the weight of top four priorities. Consumer satisfaction was not so intensive. The weight of safety is significantly smaller for information systems, and significantly higher for cars.

1st level	2nd level	Consumer electronics		Daily commodities		Information systems		Home equipments		Cars		Health appliances	
		Wgt. of basic level	Wgt. of detailed level	Wgt. of basic level	Wgt. of detailed level	Wgt. of basic level	Wgt. of detailed level	Wgt. of basic level	Wgt. of detailed level	Wgt. of basic level	Wgt. of detailed level	Wgt. of basic level	Wgt. of detailed level
Safety	Prevention of critical dangers	0,23	0,36	0,22	0,32	0,12	0,28	0,28	0,38	0,39	0,40	0,25	0,32
	Prevention of human errors												
	Public health aspects			0,32	0,47		0,24		0,33				0,31
Validity	Durability		0,26		0,18		0,30		0,25		0,30		0,16
	Energy-saving and Recycle	0,23	0,30	0,22	0,33	0,20	0,28	0,21	0,31	0,17	0,29	0,25	0,31
	Maintenance of health		0,22		0,30		0,18		0,22		0,16		0,36
Usability	Fit for life-style		0,20		0,34		0,19		0,27		0,20		0,28
	Easy to understand	0,24	0,24	0,23	0,20	0,28	0,24	0,22	0,20	0,18	0,20	0,20	0,22
	Operability		0,29		0,18		0,30		0,23		0,28	0,20	0,23
Style	Stability and Dependability		0,27		0,28		0,27		0,30		0,33		0,28
	Pleasant in use		0,35		0,31		0,40		0,33		0,36		0,40
	Style design aspects	0,16	0,34	0,20	0,31	0,22	0,33	0,16	0,34	0,18	0,35	0,16	0,28
Augment-ability	Haptic impression, Feel of materials		0,31		0,37		0,27		0,33		0,28		0,32
	Universal design aspects		0,13		0,41		0,49		0,41		0,38		0,46
	Easy to maintain		0,59		0,51		0,59		0,62		0,71		0,51

Figure 2 Weight of evaluation factors

3.2. Analysis for detailed factors

Usability was the top priority in basic level factors for the product categories of consumer electronics, daily commodities and information systems. For consumer electronics and information systems, operability is the top priority for the detailed level in the usability factors. For home equipments, whereas, the factor of fit for life-style was the top priority for the detailed level in the usability factors. Focusing on the factor of safety as the basic level, the detailed level factor of prevention of critical dangers was the top priority for consumer electronics, home equipment and health appliances. For information systems and cars, prevention of human errors was the top priority in the detailed level factors. For daily commodities, public health aspects were most important factors in the safety.

3.3. Incentive rates of the certification

Through this survey, we asked the incentive rate of the certification. The highest incentive rate of certification for all product categories was actual user test by public institutes. The second highest rate was the certification based on the design process standard established by authorities.

4. Discussion

4.1. Reorganization of product categories

Those factors can be divided into two groups (figure 3). One is the ordinary quality and the other is the attractive quality. The ordinary quality is necessary induce consumer to buy. The ordinary quality such as safety was required for home equipment and cars. The common ordinary qualities were required for consumer electronics, daily commodities and home equipments. Whereas, the ordinary quality of validity and the attractive quality of pleasant in use were required for health appliance. For information systems, the attractive qualities were highly required.

As results, it was found that evaluation factors for consumer electronics, daily commodities and home equipment were common.

Therefore, 6 product categories can be reconstruct into 4 categories (home appliances, health appliances, cars, and information systems). Those 4 product categories have independent evaluation factors of customer satisfaction, and those are connected to 4 aspects in daily living. Information systems are related to communication, home appliances are related to home living, health appliances are related to healthy life and cars are related to mobility life (figure 4). Those 4 categories are also related to human functioning in daily activities. Human functioning is standardized as ICF (International Classification of Functioning, Disability and Health) by WHO [2].

It was found that customer satisfaction was different in 4 product categories. Therefore, certification of ergonomic quality should concern those differences of customer satisfaction. If certification of ergonomic quality focuses on only the ordinary quality, it can be valid only in the product categories of mobility life (cars) and a part of daily living (home equipment).

Basic level	Detailed level	Ordinal quality	Attractive quality
Safety	Prevention of critical dangers	Difficult to see	Inter-locking
		Difficult to hear	Well controlled considering human errors
		Difficult to grasp Difficult to hold	
	Prevention of human errors	Likely to be injured	
	Public health aspects	Likely to ruin health Dirty	
Validity	Durability		To be used for long-term Difficult to be broken
	Energy-saving and Recycle		Recyclable Made of ecological materials
	Maintenance of health		To prevent disease To enhance health condition
	Low physical loads	Likely to be fatigued	Easy to use
		Difficult to do	Fit to the human body Low physical loads
Usability	Fit for life-style		Fit to the individual preference To enhance users' skill
	Easy to understand	Difficult to use Inadequate display	Easy to distinguish Low psychological loads
		Difficult to touch	Fit to the individual mental model
		Difficult to learn	Consistency
	Operatability	Not fit to the human body	Intuitive operation
		Too small or too large	
		Too quick or too slow	
Too heavy or too light			
Too bright or too dark Too high or too low			
Stability and Dependability		Error prevention Security	
Style	Pleasant in use		To enhance experiences Not to get tired
	Style design aspects		Good combination To raise morale
	Haptic impression, Feel of materials		Soft to touch Good feel of materials
Augment-ability	Universal design aspects		Accessible for every person
	Easy to maintain	Difficult to repair	Easy to repair
		Difficult to keep	Easy to move
		Difficult to handle	Easy to share
Difficult to dispose			

Figure 3 Ordinal quality and attractive quality

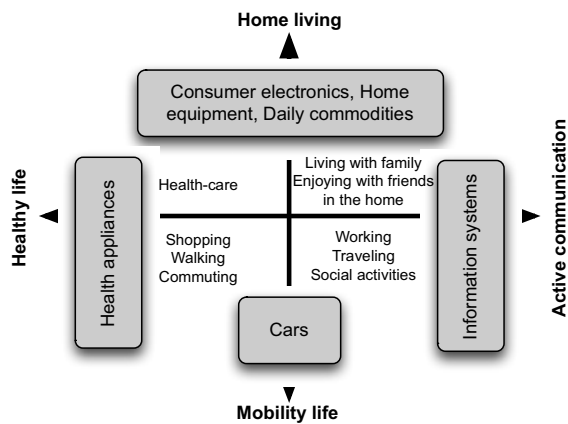


Figure 4 Reorganization of product categories based on the human functioning aspect

4.2. Importance of certification

The certification of ergonomic quality can be an attractor to consumers, whereas it should be established by IEA or ISO, not a private company. Moreover, the certification should cover not only the ordinary quality but also the attractive quality.

5. Conclusions

Customer satisfaction was surveyed for 6 product categories by questionnaires based on the Analytic Hierarchy Process. Analyzing weight of evaluation factors, the 6 product categories were reorganized into 4 categories, those were related to 4 aspects in daily living that formed by two axes: home living - mobility life and healthy life - active communication. It was found that consumers were attracted by the actual user test by public institutes for all product categories. The certification based on the design process standard established by authorities, such as EQUID was the second best attractor for consumers.

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