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The Qualitative Measurement towards Emotional Feeling of Design for Product Development

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Abstract. To compete in today's ever-growing technology market, a product needs to be well presentable to the customers. It is a challenge to design a product that is able to attract customer's attention and to build their loyalty towards the product. A product needs to be designed with focus to give the maximum level of satisfaction to the end user which is the customer. That is the focus of this paper, to achieve customer's satisfaction, by studying feelings and emotional value related to product designs using Kansei Engineering (KE) and to test how important that product element (level of satisfaction) by using Kano Method (KM). KE is a method of translating human emotions and feelings into product development. The method studies the human interaction and responses when a customer sees a product, then translates it into a new improved design. However, KE cannot stand on its own. It did not specify in which extends the feeling or emotions is important in a product. After we had the design appearance parameters from KE and existing design evaluation, it need to be classified which is more important than the other is. That is why Kano Method (KM) will also be used. Since this scope of study towards an emotional feeling of design (existing part/appearance) in Kano categories not in deep function of technical requirement, so KM will help to classify parts of product into categories, which part will give fully satisfaction while using it. It studies the more important attributes considered by the customers for improvement. The objective is to find out the design priority guide that can be used to maximize customer's satisfaction. Therefore, in order to apply the qualitative measurement idea into the real situation, the headphone product is chosen (popular among students) as the product (the appearance of part, feeling when use it) domain for this study. As the results progressed, it was found out that the headband part of headphone is the most important part of the product. It needs to be durable and comfortably designed to give full satisfaction while using (Kano-functional). The research and development (R&D), and designing process of a product can be improved greatly to increase the customer's satisfaction by capturing their emotional feeling in physiological design.

1. Introduction

When designing a product, our main target is to achieve customer satisfaction when the final product is being purchased and used by the consumer. Don Norman (1988) states that a design is a success only when the final product is successful in making customer buys it, uses it, and enjoys it, and spreads the word of the product to others. He claimed that designers need to ensure that the design satisfies people's needs, in terms of functions, usability, and the ability to deliver emotional satisfaction, pride, and delight. Customer satisfaction is based on the post choice evaluative judgment after a purchase decision is made (Oliver, 1980; Churchill and Suprenant, 1982; Bearden and Teel, 1983; Oliver and DeSarbo, 1988). Oliver (1997) also states satisfaction as a function of disconfirmation, which relates to both expectations and performances. Swan and Combs (1976) also provide the same argument that satisfaction can be achieved with product performance that fulfills the expectations. Both of these models agree that when the performance meets or is higher than the



expectation, satisfaction has achieved, while when the expectation exceeds the performance, satisfaction is not achievable.

Based on the above reasons, what actually the initial “spark” for the demand in product design is a customer’s own the process decision. First, the new products come out almost every day. Companies need to think ways to make their product stand out against the other products. One of the key factors is the product design. That is what will give the first impressions to the customers. Each day the industries faces increasingly higher competition in their business related to the customers' demands and product design requirement.

Second, what makes a design different from the others? One thing that is lacking in design community today is the needs to please clients first. The engine is as important as the car’s exterior. Here, due to the emotions can change a person's behavior which is a response to environmental conditions (Hartono and Chuan, 2011), but how to unlock those customer decisions to be something that could be in the right interpretation? (Syaifoelida et al, 2016). Consequently, these ideas should translate feelings and emotional value (qualitative measurement) towards their level of satisfaction in each design element.

2. Decision Making Approach Theory

2.1. Kansei Engineering

Kansei Engineering is defined as “translating technology of consumer’s feeling and image for a product into design elements” (Nagamachi, 1995). Kansei Engineering is a method of translating feelings, emotions, and impressions into product development (Watson 2011). Kansei Engineering’s objective is to be able to capture and understand human’s feelings and consideration, and translate those aspects into product design and development. Its main objective is towards customer’s satisfaction in using the final product. Nagamachi (1995) realized that the industry desired to quantify customer’s impression into their products. So, the developed Kansei Engineering can measure and capture feelings toward product properties.

There are some aspects and features in a product that customers are not aware of, but when they use it, they can feel it. It is difficult to be explained, but it is there. Therefore, the goal of Kansei Engineering is to study those features and use it to create a design and products. That is why the understanding of semantics is important in Kansei Engineering. Throughout the process, we will be collecting Kansei words. Kansei words are words that describe the product (Schütte, 2002). For example, when describing a car, adjectives such as fast, beautiful, and economical are used. Besides adjectives, verbs and nouns can also be used to express the Kansei words. Numbers of Kansei words can range from 50 to 600 words, (Nagamachi 1997). Words with similar meanings are compiled to a bank of words.

2.2. Kano Method

The design parameters from Kansei Engineering need to be classified which is more important than the other is. That is where the Kano Model plays its role. Kano Method is a theory developed by Professor Noriaki Kano and supported by Nilsson and Fundin (2005) which the method focuses on how customers evolve, evaluate and perceive quality attributes. It studies the more important attributes considered by the customers, and then improves them. These quality attributes are dynamic, meaning that it changes over time. It may go from satisfactory to unsatisfactory, and vice versa. Kano method also states that satisfaction and dissatisfaction should be considered separately as they are two different concepts. There are five categories of features, quality as categorized by Noriaki Kano as depicted in Table 1, based on these qualities, we can determine in which group the product feature belongs to by using its bipolar (calculation of the extent of satisfaction and dissatisfaction) as mathematical approach.

Kansei engineering will be our main approach in this study supported by Kano Method. Different people will have different ways of expressing their emotions and feelings, thus requires us to have a high understanding of language semantics

Table 1. Kano Quality Attributes

Quality	Description
I. Must-be (M)	When this quality is fulfilled, it will not increase the level of satisfaction, however, when it is not fulfilled it will cause major dissatisfaction.
II. One-dimensional (O)	When this quality is fulfilled, it will increase satisfaction, and when it does not fulfill it will decrease the satisfaction. This is basically what makes the product different from its other competitors. This quality also builds up customer loyalty.
III. Attractive (A)	When this quality is fulfilled, it will increase the level of satisfaction, when it does not fulfil it will not cause dissatisfaction. These qualities are not expected when the customer buys the product.
IV. Indifferent (I)	Whether this quality is fulfilled or not, it makes no difference to the level of satisfaction and dissatisfaction of customers. It gives a minimal impact to the satisfaction level of customers. To save costs and design considerations, this attribute should be excluded if possible.
V. Reverse (R)	This element gives dissatisfaction to the customer. Most customers hate this quality factor. In designing a product, this quality should be avoided at all costs.

3. Methodology

Kansei Engineering's purpose is to improve quality. Product development can be thought as the process to transform market demands and opportunity into a product for sale. It requires knowledge not only from engineering but also from economics, art, and others. The whole process can be roughly divided into investigation of the market, development of product design specification, concept design, detailed design, manufacture and selling. The main of focus of this study is on the 'investigation of the market' and 'development of product design specifications'. On the scope of studies, a headphone product (Figure 1) is chosen (popular among students) as our product domain in order to apply a qualitative measurement in the real situation. Fourteen, 14 types of headphones have been chosen from the market existing design based on their designs and the current trend. These headphones are broken into a few parts (Table 2), headphone models based on these chosen combinations will be developed using 3D Solidwork software (Nine, 9 models, Table 3) and will be used in the final survey.

**Figure 1.** Headphone parts**Table 2.** Headphone features

Features	Parts / designs
Headband	1) Solid headband 2) Framed headband 3) Cushioned / leather headband
Ear cups	1) Over-ear 2) On-ear
Ear piece shape	1) Square 2) Round 3) Triangle
Folding mechanism	1) Foldable 2) Not foldable

Table 3. Headphone features

DESIGN	PARTS
Design 1	leather headband, over ear pad, round shape of earpiece, foldable
Design 2	leather headband, on ear pad, round shape of earpiece, foldable
Design 3	full solid headband, on ear pad, round shape of earpiece, foldable
Design 4	leather headband, over ear pad, round shape of earpiece, no foldable
Design 5	full solid headband, over ear pad, square shape of earpiece, no foldable
Design 6	full solid headband, over ear pad, round shape of earpiece, no foldable
Design 7	frame headband, over ear pad, round shape of earpiece, foldable
Design 8	frame headband, on ear pad, round shape of earpiece, foldable
Design 9	leather headband, over ear pad, round shape of earpiece, foldable

The focus on surveys and studies to find out the demands of the customers and will be rated by using the Kansei emotional feeling of words collection (Table 4). Table 4 contains of the Kansei words used

with the semantic differential to articulate the design characteristics in terms of emotional or quality affective ((D/F, P/I, C/M, A/U, M/O, U/C, P/I, D/P). Furthermore, in the Kano designing process, the final design from ‘development of product design specifications’ will be merged with emotional words (Kansei). Then, both functional and dysfunctional questions are formed with the combinations of the features and the Kansei words (Table 5). For each pair of questions, it needs to be constructed so that respondents can answer them in five different ways in Likert style (Kano, 1984).

Table 4. Headphone features with its related Kansei words

HEADPHONE FEATURES	KANSEI WORDS	SEMANTIC DIFFERENTIAL SCALE
Headband (leather)	Durable- Fragile	(D/F)
Headband (solid)	Portable - Inconvenient	(P/I)
Headband (framed)	Comfortable- Miserable	(C/M)
Round Earpiece	Attractive - Ugly	(A/U)
Square Earpiece	Modern - Old-fashioned	(M/O)
Triangle Earpiece	Unique - Common	(U/C)
On-ear pads	Portable - Inconvenient	(P/I)
Over-ear pads	Durable - Portable	(D/P)

Table 5. Kano functional and Dysfunctional question

	Functional Questions
1.	A headphone with full solid headbands makes me feel <i>durable</i> and secure when using it.
2.	A headphone with framed headband is more <i>portable</i> when I’m listening music on the go.
3.	A headphone with leather headband feels more <i>comfortable</i> when wearing it.
4.	A headphone with over-ear cups feels <i>durable</i> when wearing the headphone.
5.	A headphone with on-ear cups is more <i>comfortable</i> when wearing the headphone.
6.	A headphone with a round shaped earpiece looks more <i>attractive</i> to me.
7.	A headphone with a square shaped earpiece is more <i>modern</i> and futuristic looking.
8.	A headphone with triangle shaped earpiece is <i>unique</i> and seamless looking.
9.	A headphone that can be folded is <i>portable</i> and easy to bring to anywhere.
10.	A headphone without folding mechanism is more <i>durable</i> and lasts longer.
	Dysfunctional Questions
1.	A headphone with full solid headbands makes me feels <i>fragile</i> and loose when using it.
2.	A headphone with framed headband is more <i>inconvenient</i> when I’m listening music on the go.
3.	A headphone with leather headband feels more <i>miserable</i> when wearing it.
4.	A headphone with over-ear cups feels <i>inconvenient</i> when wearing the headphone.
5.	A headphone with on-ear cups feels <i>miserable</i> when wearing the headphone.
6.	A headphone with a round shaped earpiece looks <i>ugly</i> to me.
7.	A headphone with a square shaped earpiece is more <i>old-fashioned</i> and worn looking.
8.	A headphone with triangle shaped earpiece is <i>common</i> and sluggish looking.
9.	A headphone that can be folded is <i>inconvenient</i> and to bring to anywhere.
10.	A headphone without folding mechanism is more <i>fragile</i> and lasts shorter.

In addition, the functional Kano question is “how the respondent would react with the Kansei words”, while the dysfunctional Kano question is “how the respondent would react with the antonyms of the Kansei words”. The “voice of the customer” is the prime importance in creating Kano questions (Hauser&Clausing, 1998). Consequently, the juxtaposition idea of KE and KM is merged, indirectly it gives the translating of emotional feeling while using the headphone.

Therefore, the Kano evaluation table (Table 6) is used as our decision maker, the mathematical approach in order to determine in which categories the feature of the design is belongs to and its level of satisfaction.

Table 6. Kano evaluation table

Functional Answers	Dysfunctional Answers				
	Like	Must-be	Neutral	Live-with	Dislike
Like	Q	A	A	A	O
Must-be	R	I	I	I	M
Neutral	R	I	I	I	M
Live-with	R	I	I	I	M
Dislike	R	R	R	R	Q

4. Results and Discussion

The total 75 final year student (mechanical engineering) in one of the higher institution is chosen as a sample size of the population, the majority of respondents are male with percentage of 65%. Results show that 69% of respondents use their headphones mostly to listen to music, next to gaming usage with 25%. The rest uses it as phone accessories. Most users only replace their headphones when their current one is broken. It can say that they would prefer their headphones be durable and long lasting. Most people prefer to buy the headphones with affordable prices. They would look into the specifications of the headphones before buying it. Respondents would prefer to use earphones as an alternative if headphones if not available. Lastly, respondents prefer to keep their headphones in their own bags instead of using custom cases. This is due to the ease of access. This means that we need to make sure the headphones are durable, so it will not break when being placed in a bag.

4.1 KM Vs KE Result

Using Kano evaluation table, we need to identify the Kano quality based on the answers from both Kano functional and Kano dysfunctional questions. Kano evaluation table converts both positive (functional) and negative (dysfunctional) answers to get our desired Kano Quality. In order to get the total percentage for each Kano quality acquired, the calculation towards the extent of satisfaction and dissatisfaction using the formulas below.

$$\text{Extent of Satisfaction, CS} = \frac{A + O}{A + O + M + I} \quad (1)$$

$$\text{Extent of Dissatisfaction, DS} = \frac{O + M}{-(A + O + M + I)} \quad (2)$$

The values of CS and DS (sample of calculation, Table 7) towards Kano quality are tabulated in Table 8. The lower the number means the higher the importance of the feature.

Table 7. Kano& Kansei Results

Product features	Percentage of replies							Category
	A	M	I	O	R	Q	Total	
Headbands (leather)	8	41.3 3	21.3 3	29.3 3	0	0	100	Must-be (M)
Example of Must be (M)	CS: 0.37		DS: -0.71					

Four product features are recognize as a **Must-be (M)** requirement are leather headband, solid headband, and both of the folding options. Here we can deduce that headband comes with a leather/solid set of design and the folding/no-foldable options is **MUST** in designing a headphone. The other six features are recognized as **INDIFFERENT (I)** , which means the features play a minimal role in increasing customer's satisfaction towards the product. In the ranking analysis, headband (leather) is the top in the rank, further approves that headband (leather) is an important feature, **Must-be (M)** in Kano analysis, and the feeling of **durability** is an important factors need to be considered in designing process in order to give full satisfaction.

Table 8. Kano& Kansei Results

Headphone features	Kano Quality	CS-DS	Rank	Kansei Words
headband (leather)	Must-Be (M)	-0.34	1	durable
ear pad (on-ear)	Indifferent (I)	-0.31	2	comfort
headband (framed)	Indifferent (I)	-0.24	3	portability
headband (solid)	Must-Be (M)	-0.24	4	comfort
ear pad (over-ear)	Indifferent (I)	-0.21	5	durable
shape (square)	Indifferent (I)	-0.14	6	modern
shape (round)	Indifferent (I)	-0.13	7	attractive
shape (triangle)	Indifferent (I)	0.11	8	unique
No foldable	Must-Be (M)	0.24	9	durable
folding	Must-Be (M)	0.24	10	portability

As a most design preference, the evaluation towards all nine models (Table 3) is done by using the Expert Choice software. The software applies the use of analytical hierarchy, which helps us to make decisions with complex problem involving multiple conflicting and subjective criteria (Zahedi, 1986) as depicted in Fig. 2.

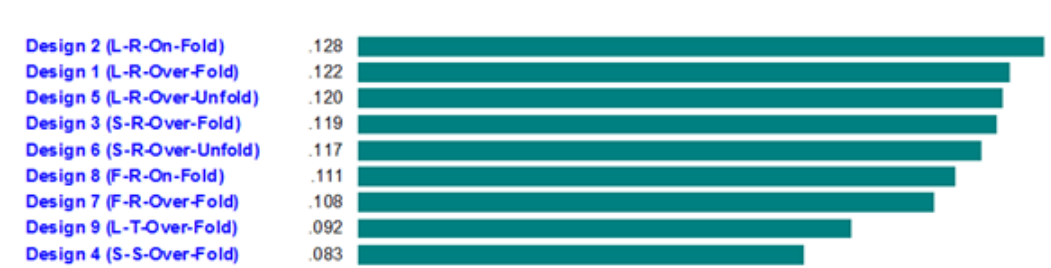


Figure 2. Expert Choice results

The top design chosen by the respondents is **design 2**, which made up of leather headband, round earpiece, on-ear pads, and it is foldable (Fig. 3). In fact, leather headband and on ear pad is in all of the top 2 of design (Table 7). We can strongly agree that **leather headband** and **on ear pad** are the most preferred as the highest attractiveness, which is giving them the feeling of durable and comfortable (Kansei emotional feeling) while they wear it (Kano-functional) and become miserable if this element did not exist in design.



Figure 3. Design 2

5. Conclusion

The qualitative measurement through the collection of the Kansei words is achieved through the words represent of full customer's satisfaction values (KE) and how important the design part of designing process through KM. Based on this study towards the headphone design, we found as follows:

1. Leather headband is the top feature desired by respondents (based on ranking analysis and Kano quality, Must-be (M)). It is chosen for its **durability** (D/F) (emotional feeling) that increases customers' satisfaction towards the headphones. In addition, which is giving them the feeling of durable (Kansei emotional feeling) while they wear it (Kano-functional) and become miserable if this element did not exist in design, Must-Be category (Table 1) in Kano analysis.
2. Other than leather, full solid headband is also favored. Customers also would prefer that their headphone is portable with the folding feature. On the other hand, the shape of the earpiece is not an important part.
3. It is recommended on focusing on the development of headbands especially the **leather** and **the solid headbands**. Developers need to increase its **durability** and **comforts**. These qualities will increase customer's satisfaction while using the new improved product. Customers also prefer to have the option to choose between the foldable and non-foldable

headphones. With the folding feature, it will increase the portability and without the folding feature, it will increase durability.

Since the study carried out is against the engineering students, any further study is required, especially when it is extended to the using of Analytical Hierarchy Process (AHP) based on Semantic Differential towards Kansei Engineering. Therefore, further study can be done towards different product (product development) as a case study. Since this scope of study towards an emotional feeling of design (existing part/appearance) in Kano categories, further requirement can be done in the basic function of product in technical requirement such as sound.

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