International Journal of Technology (2017) 2: 338-351
ISSN 2086-9614

REALIZING THE INDONESIAN NATIONAL CAR: THE DESIGN OF THE 4×2 WHEEL DRIVE PASSENGER CAR EXTERIOR USING THE KANSEI ENGINEERING TYPE 1

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(Received: October 2016 / Revised: December 2016 / Accepted: January 2017)

ABSTRACT

As the imbalance of automotive market competition continues, the domination of foreign industries demands a proper attention from Indonesia's automobile manufacturers. Efforts in creating a national car design that is emotionally attached to Indonesia's automotive market, will be able to meet the challenge appropriately, in part by using the Kansei Engineering Type 1: Category Classification method. Identified through literature studies and interviews, there are 164 Kansei words that represent the exterior designs of a 4×2-wheel drive passenger car. The Kansei words were categorized into 12 groups using an affinity diagram and then arranged into a five-level semantic differential scale for product samples assessment. Results were further processed using factor analysis, leaving nine groups remaining. A collaborative design process with a product designer resulted in an exterior design of a hatchback car with four doors. Scores from the evaluation on Kansei word groups "satisfying", "luxurious", "sporty", "aesthetic", "innovative", "mobile/flexible", "complicated/complex", "credible", and "masculine" indicate that the car exterior design meets users' emotional needs.

Keywords: Automobile design; Emotional design; Ergonomics; Factor analysis; Kansei Engineering

1. INTRODUCTION

According to Statistics Indonesia (Indonesian Central Bureau of Statistics), vehicles are classified into four categories, namely passenger car, bus, truck/pick-up, and motorcycle (Badan Pusat Statistik, 2014). One of the most frequently used vehicles for daily activities is the passenger car, a vehicle with a maximum of 8 seats (driver included), or with a maximum weight of 3,500 kilograms. Based on passenger car production data obtained from GAIKINDO (2015), 4×2-wheel drive passenger car topped the last 3 years (2013-2015) production rate. The 4×2-wheel drive, also called 2WD, refers to a vehicle that has four wheels and torque (power) is delivered to either two wheels at the front (FWD) or the two wheels at the rear (RWD). The car production data implicitly tells that Indonesian people highly depend on this type of car for their daily activities.

To face the domination of foreign automotive industries in Indonesia's automobile market, *mobnas,* which is the short for *mobil nasional* (national car), is one of the real efforts attempted by either the government or private corporations on realization of an Indonesian-made passenger car. The subject of this study is Indonesian-made 4×2-wheel drive national car, where

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Permalink/DOI: https://doi.org/10.14716/ijtech.v8i2.6150

its design process and production phase are performed independently without involvement of foreign parties.

Although many development programs on mobnas still continue today, efforts made tend to not offer Indonesian people any benefit. Viewed from Jordan's (2000) perspective that the needs of humans as product consumers can be classified into three levels of hierarchy: functionality, usability, and pleasure, the Indonesian national car today has not fulfilled the third level of the needs hierarchy (i.e. pleasure). One of the causes is the mobnas' exterior design that is still far from being perceived as desirable in the context of consumers' preferences when choosing a car for their daily activities. The previous projects on developing Indonesian national cars showed a lack of originality in the exterior design. For example, the exterior design of the mobnas Esemka Rajawali is similar to that of a Honda C-RV (Aszhari, 2016; Deny, 2016). Also, mobnas Tucuxi looks like a Lexus 2054 or an Alfa Romeo (Satriawan, 2013; Ulul, 2015), mobnas Gendhis is similar to Toyota Alphard (Ulul, 2015), and mobnas Selo resembles a GTA Spano or a Lamborghini Gallardo (Sutianto, 2016). Furthermore, the main focus of mobnas Tucuxi and mobnas Selo development is on the car's energy source, which is electricity (Sutianto, 2016). Existing studies related to Indonesian national car also do not pay attention on the car's exterior design, but on other aspects, such as industrial strategies, transfer of technology, local development, and economics (e.g. Dale, 2001; Fujita & Hill, 1997).

The above condition urges the existence of a national car whose exterior design is able to build up an emotional attachment with the users. To meet this challenge, the exterior design of mobnas has to be prioritized. Design comfort factors also need special attention, whose criteria can be fulfilled by incorporating cognitive ergonomic aspects when designing. The cognitive ergonomic aspects that are focused on in this research concern the consumers' emotional response to the product. Various methods for identifying or measuring product emotion exist. The Product Emotion Measurement Instrument (PrEmo) (Desmet, 2002), The Four Pleasures (Jordan, 2000), and Kansei Engineering (Nagamachi, 2011) are few of many ways used in designing product based on people's emotions. This study employs Kansei Engineering as the main method and concept towards emotion-based design for the Indonesian national car's exterior design.

Five specific objectives of this research are as follows: (1) to identify Kansei words as an aspect of consumers' consideration when observing the exterior of 4×2-wheel drive passenger cars that are on sale (Indonesian market); (2) to group the Kansei words accordingly, where the groups represent stimuli that bring out consumers' positive emotions when observing the exterior of the 4×2-wheel drive passenger cars that are on sale (Indonesian market); (3) to identify required processes for designing the *mobnas* exterior based on the Kansei Engineering method; (4) to design the exterior of a 4×2-wheel drive *mobnas* based on Kansei words; and (5) to evaluate the designed 4×2-wheel drive *mobnas* exterior.

2. METHODS

2.1. Kansei Engineering

Kansei Engineering (KE) was first introduced by Mitsuo Nagamachi as a new ergonomic technology in product design (Nagamachi, 2011). The KE method translates consumers' feelings into design specifications. Lokman (2010) suggests that the principal implementation of KE involves many steps that enable utilisation of various tools and methods derived from various fields of study, such as marketing, psychology, and statistics.

The process of designing products using KE encompasses: (1) collecting Kansei data from consumers in a specific product domain using psychological (e.g. words, attitude, behaviour) or psychophysical (e.g. EEG, EMG, heart rate, eye movement, face expression) measurements; (2)

analysing Kansei data using statistical, medical, or engineering methods to clarify the Kansei structure; (3) interpreting the analysed data and transferring the data to the new product domain; and (4) designing a new Kansei product (Nagamachi, 2011).

To achieve a Kansei product innovatively, collaboration between a Kansei engineer and product designers is indispensable. The collaboration combines the Kansei engineer's and product designers' ideas so that an excellent product can result from the Kansei data, as depicted in Figure 1.

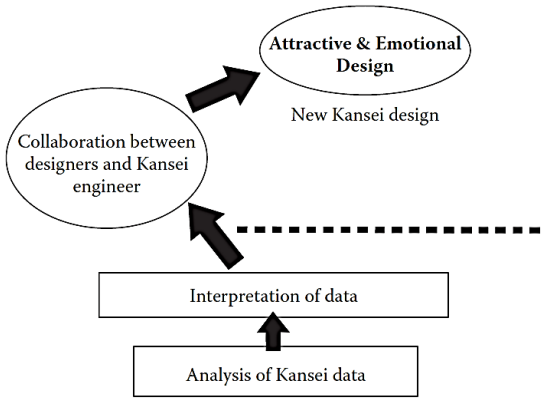

Figure 1 Collaboration between a Kansei engineer and product designers in Kansei product development (Nagamachi, 2011)

There are eight types of KE methods (Nagamachi, 2011; Ishihara et al., 2005 in Lokman, 2010), namely Category Classification, KE System, KE Modelling, Hybrid KE, Virtual KE, Collaborative KE, Concurrent KE, and Rough Sets KE. KE Type 1: Category Classification is a breakdown technique from a targeted concept of a new product to the related subjective Kansei to the objective design parameters, where the procedure involves qualitative research method with the use of affinity diagram (Lokman, 2010). KE Type 1 was employed in this study because it directly involves consumers in most of its steps in the product development process. This KE type is also easier to implement, compared to other types such as KE System, KE Modelling, and Virtual KE that requires an advanced computerised database, networks, algorithms, and systems.

The Category Classification method has an excellent ability in assessing people's emotional perception in a specific form, which is words that express the most of their emotions. Furthermore, this method is already well-known for its ability in designing emotion-based products to meet recent challenges and for its versatility of implementation in various fields. For example, Hilman (2015) applied the KE concept (Category Classification) to design a men's wristwatch, whilst Theniko (2009) implemented the concept in service areas.

2.2. Kansei Words Identification

This study utilised two approaches to obtain Kansei words. The first approach was literature study. Articles that contain reviews of Japanese and European 'Car of the Year' in the period between 2010-2016 were derived from online sources. Several cars from the list were eliminated, because they did not belong to the car category used in this research (i.e. 4×2-wheel drive passenger car). The elimination left six cars remaining: Mazda Demio, Volkswagen Golf, Mazda CX-5, Opel Astra, Peugeot 308, and Volkswagen Polo. Identification process using the literature study resulted in 77 Kansei words.

The second approach was structured interview. Twenty-one respondents (10 males) who met the criterion – active users of 4×2-wheel drive passenger cars – were recruited using

convenience sampling techniques. The participants were shown pictures of 90 product samples (i.e. 4×2-wheel drive passenger cars that were on sale in Indonesia in 2016) and subsequently asked to choose three of the most preferred cars among the samples based on usefulness and aesthetic aspects. They were required to express as to why they chose those cars. Finally, the respondents were asked to select one car they liked most and to explain their reasons. All participants' comments were then transcribed and analysed to identify Kansei words. Kansei words identification from the interviews reached a stagnant condition at the 19th respondent, which means the interview at that moment did not add any new Kansei words. To ensure that no newer words would occur, two more respondents were interviewed. The last two interviews did not change the stagnant condition and thus the Kansei words identification process was stopped. There were 87 Kansei words recorded from 21 interviews. In total, 164 Kansei words were identified from both literature studies and interviews.

2.3. Kansei Words Grouping

The purpose of this process is to sort similarities of meanings among the obtained Kansei words in order to form a number of specific word groups. Identified Kansei words from both literature studies and interviews are the main input for this grouping process.

An affinity diagram was employed as the main tool for grouping, as this method is suitable for pulling ideas from a group of people and for grouping ideas into natural relationships (Hoyle, 2001). Held in the form of a focus group discussion (FGD), using the affinity diagram method, 11 participants (6 males; active users of 4×2-wheel drive passenger cars) plus one facilitator were involved in the Kansei words grouping process. Assisted by the use of sticky notes, participants discussed and sorted out 164 Kansei words into a number of groups, each of which was given a specific label. Under a label were a set of words considered of having similar meaning or strong inter-relationships, so that they were grouped together. The outcome of the FGD session was 12 groups of Kansei words. Examples of Kansei word groups labelled "satisfying" and "luxurious" can be seen in Table 1.

Table 1 Examples of Kansei words grouping

Satisfying									
1	Friendly	5	Happy	9	Natural	13	Optimal	17	Comfortable
2	Capable	6	Quiet	10	Proper	14	Safe	18	Good
3	Easy	7	Suitable	11	Confident	15	Likeable	19	Indulging
4	Different	8	Delightful	12	Genius	16	Nice	20	Aggressive
Luxurious									
1	Representative	4	Sparkling	7	Speechless	10	Luxurious	13	Striking
2	Rare	5	Proud	8	Supremely well	11	Classy	14	Elegant
3	Smart	6	Symbolic	9	Fibonacci	12	Impressive	15	Prestigious

Table 2 Twelve groups of Kansei words

No	Group	No	Group	No	Group	No	Group
1	Satisfying	4	Luxurious	7	Innovative	10	Credible
2	Economical	5	Sporty	8	Mobile/Flexible	11	Feminine
3	Family-look	6	Aesthetic	9	Complicated/Complex	12	Masculine

To minimize potential biases that might occur during the discussion, the grouping process was further refined through consultation with a language expert from the renowned Institute of Technology in Bandung (ITB). Consultation with the language expert did not change the number of word groups from FGD, but minor modifications were made to few group labels. These minor changes were mainly based on considerations related to the sample assessment by means of a semantic differential (SD) questionnaire that would be used in the next stage of this

study. Table 2 shows the end result of the grouping process.

2.4. Product Samples Assessment using a Semantic Differential Questionnaire

This stage was conducted as a preliminary step for factor analysis of the 12 groups of Kansei words. A semantic differential (SD) questionnaire was created using the 12 groups of Kansei words that were arranged in bipolar scales of positive and non-positive (i.e. negation, not antonym) words (Table 3). Converting the 12 groups of Kansei words into five-scale degree of SD will discern the structure of the psychological language from each respondent (Nagamachi, 2011).

The questionnaire included pictures of 16 most preferred cars (i.e. Renault Duster, Ford EcoSport, Nissan Evalia, Mazda CX-5, BMW X1, Mini Cooper, Toyota Vellfire, BMW 218i, Honda Mobilio, Volkswagen Tiguan, Proton Suprima S, Abarth 500, Mini Cabrio, Mercedes-Benz A200, Volkswagen Caravelle, and Lexus RX350) that were selected by 21 participants during the Kansei words identification via interviews. The number of cars was less than the number of participants, since particular cars were chosen by more than one participant. For the assessment process, respondents would be asked to evaluate each product sample using the bipolar SD scales of the 12 groups of Kansei words (Table 3). Three types of questionnaires were created, each of which had a different order of product samples to avoid possible bias.

Table 3 Five-scale degree of semantic differential

No	Positive Words	5	4	3	2	1	Non-Positive Words
1	Satisfying						Not Satisfying
2	Economical						Not Economical
3	Family-look						Not Family-look
4	Luxurious						Not Luxurious
5	Sporty						Not Sporty
6	Aesthetic						Not Aesthetic
7	Innovative						Not Innovative
8	Mobile/Flexible						Not Mobile/Flexible
9	Complicated/Complex						Not Complicated/Complex
10	Credible						Not Credible
11	Feminine						Not Feminine
12	Masculine						Not Masculine

Sixty-three respondents (46 males, Indonesian citizen with 20-40 years of age, and 4×2-wheel drive passenger car daily users) were involved in the product samples assessment. This number was based on Hair et al. (2009) general rule that the minimum sample size required for the data to be sufficient for factor analysis has to be five times of the number of variables being used in the instrument. The three types of questionnaires in the form of Google Form were distributed online to potential respondents.

Product sample assessment scores for each variable were averaged (Table 4). Furthermore, the averaged data would be used for factor analysis using SPSS 23.0.

2.5. Factor Analysis

The purpose of this step is to represent the collected data with the general factors that exist in all variables and to represent the data with unique factors that exist only in particular variables (Nagamachi, 2011). Variables in this study were 12 groups of Kansei words that were already converted into five-scale degree of semantic differential (SD). Two initial statistical tests required before factor analysis were:

Table 4 Averaged product assessment scores from 63 respondents

		Variable											
		1	2	3	4	5	6	7	8	9	10	11	12
Product Sample	1	3.67	2.41	3.33	3.70	3.89	3.32	3.25	2.92	2.90	3.79	1.68	4.00
	2	3.25	3.17	3.10	2.84	3.21	3.17	3.14	3.38	2.68	3.40	2.84	2.90
	3	2.70	3.21	4.49	2.63	1.59	2.16	2.33	2.56	2.40	3.25	2.49	2.19
	4	4.33	2.94	3.40	4.10	4.22	3.97	3.73	3.62	3.05	4.06	2.27	4.10
	5	4.40	2.46	3.41	4.65	4.21	4.05	3.84	3.51	3.41	4.35	2.71	3.92
	6	4.14	2.60	2.03	4.33	3.70	4.03	3.73	3.71	3.10	4.08	3.30	3.22
	7	4.08	2.27	4.56	4.60	2.73	3.44	3.52	2.87	3.48	4.13	2.43	2.87
	8	4.02	2.81	3.27	4.00	3.70	3.71	3.46	3.68	3.03	3.97	2.78	3.52
	9	3.41	3.81	4.14	2.67	2.83	3.21	3.06	3.49	2.57	3.78	2.75	2.79
	10	3.95	2.84	3.57	3.92	3.83	3.62	3.43	3.49	3.13	3.81	2.54	3.56
	11	2.87	3.02	2.30	2.87	3.41	2.92	2.86	3.30	2.86	2.78	2.60	3.03
	12	2.84	3.03	1.63	3.00	2.79	3.02	3.51	3.62	2.78	3.10	3.30	2.29
	13	4.05	2.67	2.14	4.27	3.90	3.90	3.84	3.65	2.95	3.84	3.25	3.37
	14	4.54	2.35	2.46	4.76	4.40	4.27	4.00	3.51	3.32	4.16	2.92	4.00
	15	3.10	2.71	4.52	3.57	2.08	2.83	2.89	2.67	2.94	3.71	2.27	2.63
	16	4.38	2.81	2.87	4.29	4.33	4.10	4.03	3.73	3.59	4.11	2.35	4.08

- Validity Test. This test looks upon three measures (Hair et al., 2009): Kaiser-Meyer-Olkin (KMO, must be > 0.5), Bartlett's Test of Sphericity (significance must be < 0.05), and measure of sampling adequacy (MSA, must be > 0.5 for each variable). The first tests resulted in KMO score of 0.863 and Bartlett's significance of 0.000. However, there were three variables (2: economical, 3: family-look, and 11: feminine) whose MSA scores < 0.5. The three variables were considered invalid and inadequate for further process and thus were removed. The second validity tests with nine remaining variables were then conducted (Table 5). The nine variables were valid and adequate since their MSA scores were higher than 0.5.
- Reliability Test. This test looks upon the score from Cronbach's coefficient alpha test. The obtained score was 0.953, meaning that the instrument used (i.e. questionnaire) had a very high reliability.

Table 5 Results of KMO, Bartlett's, and MSA tests on nine variables

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**.818**
Bartlett's Test of Sphericity	Approx. Chi-Square	211.740
	Df	36
	Sig.	**.000**

Variable	MSA Score	Variable	MSA Score
1	**.904**[a]	8	**.727**[a]
4	**.833**[a]	9	**.916**[a]
5	**.724**[a]	10	**.744**[a]
6	**.836**[a]	12	**.735**[a]
7	**.924**[a]		

The factor analysis with Principal Component Analysis (PCA) method was conducted using SPSS 23.0. Calculation from initial factor extraction using latent root criterion resulted in two factors, as indicated by the Eigen values that were larger than one (Table 6, left table). This result shows that the nine variables can be categorized into two general factors. Following the initial factor extraction, the next process was factor rotation to obtain specific factor loadings for each variable in every factor and to simplify the factors' structure. The result of factor rotation using orthogonal factor rotation with VARIMAX approach is shown in Table 6 (right table). The criterion used in determining the assignment of variables to the formed factors was loading value of 0.3–0.4 (significance minimum requirement) (Hair et al., 2009). Based on the factor rotation, variables that met the significance criterion were assigned to factor(s) that represented them, as shown in Table 7.

2.6. Factor Analysis Interpretation

The interpretation process started by giving each factor a label that most described its Kansei word members. Results of the process are as follows:

- Factor 1. This factor contained eight variables, each of which could be interpreted as consumers' needs when seeking satisfaction in the driving experience. Therefore, the title pinned for this factor was "Driving Experience".
- Factor 2. This factor consisted of six variables, each of which could be interpreted as consumers' wants when observing the shape or exterior appearance of a car for the first time. Therefore, title for this factor was "Look Intimacy".

Table 6 Latent root criterion factor extraction and factor rotation

Component	Initial Eigen Values			Variable	Component	
	Total	% of Variance	Cumulative %		1	2
1	**6.912**	76.795	76.795	4	**.934**	.257
2	**1.100**	12.218	89.013	10	**.903**	.182
3	.477	5.302	94.316	9	**.861**	.260
4	.333	3.702	98.018	1	**.856**	**.481**
5	.095	1.059	99.077	12	**.643**	**.580**
6	.050	.553	99.630	8	.063	**.953**
7	.016	.179	99.809	5	**.487**	**.819**
8	.012	.133	99.941	6	**.698**	**.703**
9	.005	.059	100.000	7	**.657**	**.683**

Table 7 Factors and their variables (members)

	Factor 1	Factor 2
Variable	Luxurious	Satisfying
	Credible	Masculine
	Complicated/Complex	*Mobile*/Flexible
	Satisfying	Sporty
	Masculine	Aesthetic
	Sporty	Innovative
	Aesthetic	
	Innovative	

The next process would look at the scores for each product sample on the two factors (Table 8). These scores were determined by calculating the average value of product assessment scores of all variables assigned to each factor. Product sample with the highest score would be used as the main reference for the next design process. In this study, product sample number 14, which was Mercedes-Benz A200 (Figure 2), obtained the highest score.

Figure 2 Mercedes-Benz A200

2.7. Product Properties Identification

The identification of product properties in this study was based on product knowledge on the anatomy of a passenger car. According to Macey and Wardle (2008), although design concepts have copious variations, there are general components that can be found in every design concept of a passenger car. Of all the list of general components of passenger cars, about 65% of them were eliminated to obtain a set of components that directly contributed to the exterior parts of a car (Table 9). This set of components was now called product properties, for these components would determine the final design specification. Furthermore, in the synthesis process, the product properties would be combined with the variables from previous analysis.

Table 8 Factor scores for each product sample

Product Sample	Driving Experience	Look Intimacy
1	3.57	3.51
2	3.08	3.18
3	2.41	2.25
4	3.94	3.99
5	4.10	3.99
6	3.79	3.76
7	3.61	3.25
8	3.68	3.68
9	3.04	3.13
10	3.65	3.65
11	2.95	3.07
12	2.91	3.01
13	3.77	3.79
14	**4.18**	**4.12**
15	2.97	2.70
16	4.11	4.11

Table 9 Product properties that contribute to passenger car's exterior

No	Exterior Components	No	Exterior Components
1	Backlight	8	Cooling Aperture
2	Trunk	9	Forwards Lighting
3	Rear Lighting	10	Hood
4	Tire Diameters & Profiles	11	Windshield
5	Rear Bumper & Impact System	12	Roof & Roof Systems
6	Ground Clearance & Ramp Over Angle	13	Doors & Door Apertures
7	Front Bumper & Impact System		

3. RESULTS

This section explains the design of a new Kansei product, which is the exterior design of 4×2-wheel drive passenger car that is suitable for Indonesian national car. The design process includes synthesis, design of car exterior, and evaluation of proposed design.

3.1. Synthesis

The purpose of this step is to combine the product properties (Table 9) with the variables involved in consumers' emotional perception (groups of Kansei words). This step was conducted collaboratively between the researcher as a Kansei engineer and a product designer (see Figure 1).

The collaboration process started with the profound explanation of the Kansei Engineering concept by the Kansei engineer to the designer in order to achieve the same level of knowledge, which could leverage the concept ideation properly. After the explanation, product properties of

five product samples with the highest factor scores, particularly properties of the main product reference (i.e. Mercedes-Benz A200), were analysed collaboratively to determine which properties would contribute directly/indirectly to the variables (consumers' emotional perception). This process was done for each property in relation to each variable. The outcome of this step was a synthesis matrix, as can be seen in Table 10.

Table 10 Synthesis matrix

No	Exterior Components as Product Properties	Groups of Kansei Words								
		Satisfying	Luxurious	*Sporty*	Aesthetic	Innovative	*Mobile/Flexible*	Complicated/ Complex	*Credible*	Masculine
1	Backlight	✓		✓	✓	✓				
2	Trunk	✓							✓	
3	Rear Lighting	✓		✓	✓					
4	Tire Diameters & Profiles	✓		✓			✓			
5	Rear Bumper & Impact System	✓		✓	✓		✓		✓	
6	Ground Clearance & Ramp Over Angle	✓					✓		✓	
7	Front Bumper & Impact System			✓	✓			✓		✓
8	Cooling Aperture	✓		✓					✓	
9	Forwards Lighting	✓	✓	✓		✓				
10	Hood	✓	✓						✓	
11	Windshield	✓					✓			
12	Roof & Roof Systems	✓				✓				
13	Doors & Door Apertures	✓		✓	✓	✓		✓		✓

3.2. Design Process

In this step, the role of Kansei engineer was minimised and he only acted as a supervisor, leaving plenty of space for product designer, as the Kansei collaborative partner, to express his knowledge and to develop ideas into a design concept accordingly. The key reference for concept ideation was the synthesis matrix (Table 10) that was created collaboratively in the previous session. In addition, the main product reference (i.e. Mercedes-Benz A200), the entire Kansei words and their groupings, and product samples selected by participants during Kansei words identification were used as extra information by the designer to develop the design concept.

The variable "masculine" is used in this paper to exemplify how to translate the Kansei word into specific design. The masculine impression of a car results from its *front bumper & impact system* and *doors & door apertures* (Table 10). The feature that becomes the focus of attention is the investment of lines contained in the form of these two components. This, for instance, can be seen through the two unique and strong lines on the doors' surface of Mercedes-Benz A-200. Through these lines, attributes such as dashing, solid, and bold are brought out so that the manly characteristics of the car are created.

The first design process started with initial sketches (Figure 3). At this step, the sketching was used to capture the properties of the main product reference. From there, based on emotions represented by groups of Kansei words, new design ideas were developed gradually. The sketching process continued until a final sketch that represented all groups of Kansei words related to their associated product properties was accomplished.

The next process was digitalisation or rendering. This process utilised Adobe Photoshop to deliver the desired design by applying monochrome colours for every detail, contour, outline,

and curvature on the exterior of the car. The end result of the design process (i.e. exterior design of a hatchback car with four doors) is shown in Figure 4.

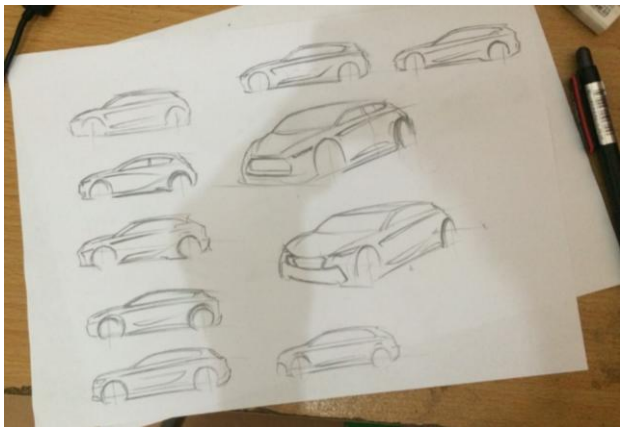

Figure 3 Initial sketches

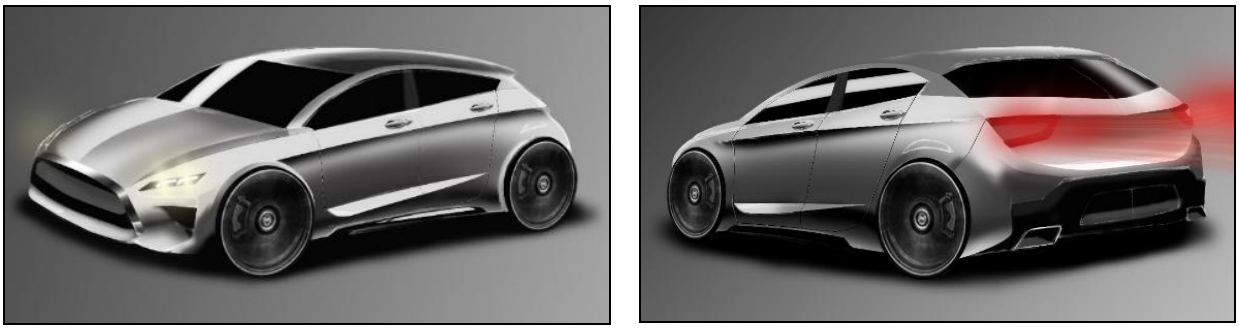

Figure 4 Front and rear views of the final design

3.3. Evaluation of Proposed Design

Evaluation of the proposed design employed the same questionnaire as in the product sample assessment stage. However, only nine variables were included, in accordance with the result of the validity test.

The success criterion for this step was the median value of the five-scale degree semantic differential (SD). The median value for the scale was three; therefore, if the score on a variable was higher than the median value, it was considered that the proposed design had successfully delivered the positive emotion related to that variable.

Table 11 Evaluation result

No	Variables	Average Score	Conclusion
1	Satisfying	4.36	Emotion represented
2	Luxurious	4.58	Emotion represented
3	Sporty	4.33	Emotion represented
4	Aesthetic	4.24	Emotion represented
5	Innovative	4.30	Emotion represented
6	Mobile/Flexible	3.45	Emotion represented
7	Complicated/Complex	3.45	Emotion represented
8	Credible	3.91	Emotion represented
9	Masculine	4.15	Emotion represented

Thirty-three respondents (18 males) with the same criteria as in the product sample assessment process were involved in the evaluation of the proposed exterior design of 4×2-wheel drive

passenger car. They were shown pictures of the design (Figure 4) and asked to assess the design related to the felt emotions represented by the nine variables. Scores from the evaluation questionnaire are recapitulated in Table 11. It is shown that all variables have an average score higher than three, indicating that the proposed design is able to positively represent users' emotional perceptions of a 4×2-wheel drive passenger car.

4. DISCUSSION

This research demonstrates the capability and effectiveness of the Kansei Engineering Type 1 (i.e. Category Classification) for designing the exterior of the Indonesian national car (mobnas). When the proposed design is actually implemented, it is expected that the national car will be able to emotionally attract Indonesian users, which may thus lead to product purchase and, eventually, product success in Indonesia's competitive automotive market. The followings discuss several aspects of this study.

The 4×2-wheel drive passenger car is chosen as a subject of study because of two main reasons. The first is this type of car is the most popular and most frequently used by Indonesian people (GAIKINDO, 2015). However, as per today, there is no national car (mobnas) of this type that has significant success despite many attempts to create one. This phenomenon is caused by many factors and among them is the packaging offered by the national car itself. This would be the second reason, since the exterior design offered by the national cars to date is still not able to make the cars as a preferred option for Indonesian people when purchasing a car for their daily routine.

Besides the study's subject, the selection of research method is important. This study employs Kansei Engineering Type 1: Category Classification, since this method offers an excellent ability in assessing people's emotional perceptions in a specific form, which are words that express most of their emotions. Before the implementation, several basic theories on product emotion and consumer behaviour are observed in the aggregate. For example, according to Hawkins and Mothersbaugh (2010), consumer behaviour is a study of an individual, groups, or an organisation and their respective processes in selecting, securing, using, and disposing a product, service, experience, or an idea to fulfil their needs. Meanwhile, product emotion is emotions that are felt by the consumer when acting, seeing, using, owning, or thinking about a product wholly (Desmet, 2002).

This knowledge of consumer's behaviour and emotion provides a profound comprehension and foundation useful for the implementation of the Kansei Engineering concept. For instance, the labelling of factors during the interpretation of factor analysis can be viewed from product emotion domain. Factor 1's label, "Driving Experience", is derived from consumers' interpretation when observing a specific product as events (Desmet & Hekkert, 2002). With this perspective, aroused emotion is the result of consumers' response when anticipating the usability aspect of a product or when owning the product. Moreover, Factor 2's label, "Look Intimacy", is derived from consumer's way of observing a product as an object (Desmet & Hekkert, 2002). Emotional reaction from this perspective usually is unstructured.

In one stage of study, the Kansei words grouping process is conducted in a focus group discussion (FGD) using an affinity diagram method. According to Bloor et al. (2001), several important aspects in preparing a proper FGD are place selection, facilitator, duration, and debriefing. All of these aspects have been carefully considered in this study. The FGD results in 12 groups of Kansei words, which are then used to create a product assessment questionnaire.

A five-scale degree of semantic differential is used in the questionnaire for its ease in assessing people's emotional perceptions. The use of an extended span (e.g. nine-scale degree) may

confuse the respondents, for their emotional perceptions will require more specific determination to be interpreted into number.

Online media via Google Form is used to distribute the questionnaire during the product samples assessment. This approach is considered appropriate, as it offers several advantages: reduced time and cost required for distributing the questionnaire, and much larger area of distribution can be reached, as proven by this study.

In relation to product properties identification, the process is performed via observation at the level of the anatomy of the passenger car because of its commonness and its ability to provide general character through all components that can be found on the exterior part of a car. With this commonality, every component that gives direct contribution to shaping the car exterior can be identified entirely.

Lastly, during the design process, unless the researcher has a practical design ability, collaboration with a product designer is necessary. The key here is to afford the designer have an equal understanding with the researcher on Kansei Engineering and relevant Kansei words. The design ideation must be based on the collected Kansei words and other related references, and not based solely on the designer's own knowledge, preferences, and creativity. Otherwise, the great effort in collecting and processing Kansei data will be fruitless and the design may not represent the consumer's emotional perceptions.

5. CONCLUSION

There are 164 Kansei words considered by consumers when assessing the exterior of 4×2-wheel drive passenger cars in the Indonesian market. Seventy-seven of the words are obtained from literature studies, while the rest are identified from interviews. Overall, the whole of the Kansei words collected has a variety of forms, from nouns, adjectives, to sentences. Despite their variety, each word represents the feelings or emotions of respondents to the research subject.

Twelve groups of Kansei words are generated from data processing, and are then used as study variables. The grouping process is conducted in a focus group discussion (FGD) using an affinity diagram method. In addition, to minimise biases that may occur during the FGD, consultation with a language expert is also carried out to produce a refinement for the word groups. Despite few minor changes in terms of language, consultation with the language expert did not change the initial number of the word groups. The Kansei word groups are "satisfying", "economical", "family-look", "luxurious", "sporty", "aesthetics", "innovative", "mobile/flexible", "complicated/complex", "credible", "feminine", and "masculine". Through factor analysis, three of the groups (i.e. "economical", "family-look", and "feminine") are eliminated.

The design process for 4×2 wheel drive passenger car is conducted in three stages, namely synthesis, design development, and evaluation of the proposed design. The synthesis and design development stages are performed collaboratively with a product designer. The proposed exterior design of the 4×2 wheel drive national car (*mobnas*) based on Kansei words is in a form of a hatchback car with four doors, presented with monochrome-themed colours. Evaluation of the proposed design shows that the design is able to positively represent consumers' feelings or emotions, indicated by the variable scores that exceed the midpoint of the five-scale degree of semantic differential.

6. ACKNOWLEDGEMENT

We highly appreciate the invaluable help of Dr. Tri Sulistyaningtyas, S.S., M.Hum in refining the grouping and labelling of the Kansei words in one stage of this research.

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