

# Affective Design with Kansei Mining: An Empirical Study from Automotive Industry in Indonesia

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**Abstract.** Automotive industry delivers a great contribution to Indonesia by accounting high percentage in gross domestic product. As automotive industry is developing, especially for car industry, the competition between car companies is highly increasing. This condition resulted in a situation where products from different car companies having the same standard for quality. Therefore, customers are triggered to consider another factor beside functional specification and quality, which is affective perception. This research focused on how customers of city car in Indonesia evaluate the product from its exterior shape by considering their affective side. Method of this research is *Kansei* Engineering, specifically its *Kansei* Words. Data from customers are processed with the method of association rule mining and conjoint analysis. From the output of this research, there are five groups of *Kansei* Words that represent customers' affective perception (i.e., classic and sleek, robust and powerful, sporty and formal, cute, and modern). The final output from this research are five recommended designs for city car exterior shape that describe all the *Kansei* Words above.

**Keywords:** *Kansei* Engineering · *Kansei* Words · City car · Car exterior shape · Association rule mining · Conjoint analysis

## 1 Introduction

Automotive industry is one of the fastest-growing industrial sectors in Indonesia. According to The Association of Indonesia Automotive Industry, in the second quarter of 2013, the manufacturing industry accounted for 23.64 % of the gross domestic product of Indonesia with the largest contribution coming from automotive manufacturing, amounted to 50.37 %. This leads the automotive industry to be one of the industries that support the three pillars of industrialization in the country (i.e., increasing added value, maximizing the impact in the country, and positioning Indonesia in the global supply chain). The third pillar in this term refers to the opportunity for Indonesia to become a part of global network by evolving Indonesia as a global automotive industry producer.

From the various types of car that are available in the Indonesian automotive market, city car is the type of car with the most rapid development. City car is the notion of four-wheeled vehicles powered from 1000 cc to 1300 cc that brings the concept of light and compact vehicle. According to The Indonesian Automotive Industry Association, the trend of city car sales in the last five years increased five-fold in 2012.

As automotive industry is developing, especially for city car, the competition between car companies is highly increasing. This condition resulted in a situation where products from different car companies having the same standard for quality. Consumers will be more selective in choosing a car when all brand products offer the same quality, price, design, comfort, performance, security, and after sales service. Therefore, customers are triggered to consider other factors beside functional specification and quality, which is affective perception; given the fact that car's exterior is the first thing that is recognized when looking at car products.

Therefore, when designing a product, the consumer affection needs to be considered [1]. Based on previous study, six different roles of product appearance for consumers are identified (i.e., communication of aesthetic, symbolic, functional and ergonomic information, attention drawing and categorization) [2]. From those six appearance roles, it can be concluded that a product's appearance can have aesthetic and symbolic value for consumers, can communicate functional characteristics and give a quality impression (functional value), and can communicate ease of use (ergonomic value). However, they are much more difficult to measure and understand compared to product assessment through the specification and technology owned.

This research focused on how customers of city car in Indonesia evaluate the product from its exterior shape by considering the affective factors. In order to guide the designers in designing products that consider the customer affection, this study used the concept of *Kansei* mining. This method utilizes available design of products in the market to run the product design process. Therefore, the product development process does not have to start from scratch. This research aims to propose the exterior design of city car based on the affective perception of consumers. The proposed designs will be useful for designers in the automotive industry in running their product development process.

The rest of the paper is organized as follows. Section 2 describe the data and methodology used in this study. Section 4 presents the analysis based on the result of data processing and also shows the proposed designs. The paper ends with conclusions and suggestions of the overall study, mainly from the results and analysis. In addition, the suggestions will include input for further research.

## 2 Methodology

This section explains about the data and methodology used in the study. This study used two types of data, namely primary data, which was gained through questionnaires, and secondary data, such as data gained from reports, journal, etc. The method used in this research are *Kansei* Engineering, Data Mining and Conjoint Analysis. *Kansei* Engineering was chosen because it is one of the most implemented method in

emotional design and engineering methodology that translates impressions, feelings, and demand of customers on existing products or on the concept of design solutions and concrete design parameters.

Primary data needed are the consumer's perception mapping data in the form of *Kansei* Words against city car exterior shape, and the consumer's perception data against a combination of city car exterior components. Therefore, this research collected customer's perception in the form of two questionnaires. The consumer's perception mapping data in the form of *Kansei* Words against city car exterior shape was obtained through first questionnaire.

Table 1 below shows *Kansei* Words that represents the exterior shape of city car, while Fig. 1 shows several type of city car's exterior shape. Respondents were asked to choose their favorite type of car based on *Kansei* Words given and match it with the cars in the picture. The first questionnaires were processed using association rule mining in order to find the pattern of the data. From the data processing using Magnum Opus software, five groups of *Kansei* Words that represents city car's exterior shape were obtained (i.e., classic and sleek, robust and powerful, sporty and formal, cute, and modern) (Table 2).

**Table 1.** *Kansei* Words of city car's exterior shape

No.	<i>Kansei</i> Words
1	Cute
2	Sporty
3	Classic
4	Formal
5	Powerful
6	Modern
7	Robust
8	Spacious
9	Sleek
10	Luxurious

The next step of this study is collecting the consumer's perception data against a combination of city car exterior components through the second questionnaire. Of the eight types of city car exterior components from previous study, five were chosen as the most influential exterior components for the consumer as shown in Fig. 2. Then, those five city car exterior components, namely headlights, front bumper, rear light, fog lamp, and door handle, were combined with five groups of *Kansei* Words that represents city car's exterior shape obtained from the first questionnaire.

Data was collected by distributing the second questionnaires in the form of rating by respondents towards the stimuli presented. Rating was given using a *Likert* scale of 1 to 5 where higher values indicate higher preference (Table 3).

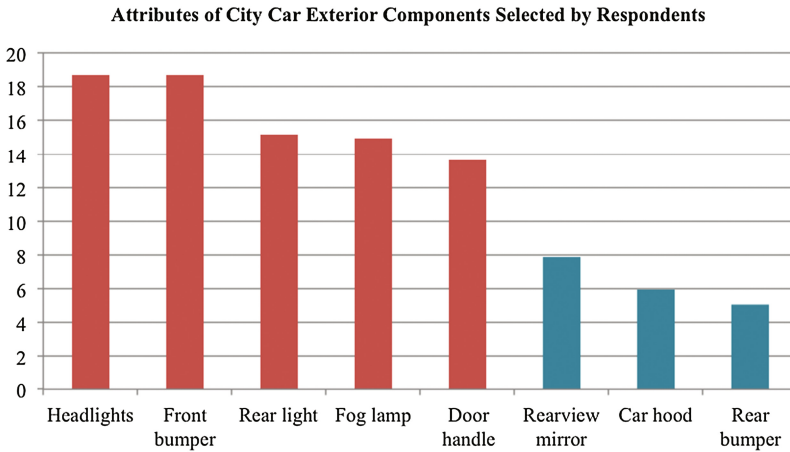
Afterwards, the questionnaires were processed using conjoint analysis. Conjoint analysis was used because it is a technique specifically used to understand the desire or



**Fig. 1.** Exterior shape of city car from various brands

**Table 2.** Descriptive statistics of the first questionnaires

		Sample
<i>N</i>		1000
Age	20–24	39 %
	25–30	33 %
	31–35	22 %
	36–40	6 %
Gender	Male	65 %
	Female	35 %
Occupation	Student	31 %
	Employee	56 %
	Entrepreneur	7 %
	Teacher	1 %
	Lecturer	2 %
	Others	3 %
	Car ownership	Yes, I have owned a car
Yes, I have and still own a car		70 %
I have never owned a car		25 %



**Fig. 2.** Percentage of city car’s exterior components selected by respondents (Color figure online)

**Table 3.** Descriptive statistics of the second questionnaires

		Sample
<i>N</i>		100
Age	20–24	70.3 %
	25–30	17.82 %
	31–35	7.92 %
	36–40	3.96 %
Gender	Male	55.45 %
	Female	44.55 %
Occupation	Student	62.38 %
	Employee	24.75 %
	Entrepreneur	1.98 %
	Others	10.89 %

preference of consumers towards a certain product or service by measuring the level of usability and the relative importance of various attributes of the product [3].

### 3 Results and Discussions

This section explains about interpreting the results and analyzing the results obtained in this study. From the data processing before, the consumer’s perception mapping data in the form of *Kansei* Words was obtained in the form of rules based on the association rule-mining concept. *Rules* is a pattern that shows the relationship of consumer perception—in this case is *Kansei* Words—with the exterior shape of the associated city car. The *rules* can also shows the probability of *Kansei* Words to emerge which followed

by the appearance of the exterior form of a particular city car that represent consumer preferences. The probability in this term can be seen from the value of strength. The *rules* gained have a strength value between 0.030 and 0.727. Those *rules* data obtained with Magnum Opus software are to be filtered based on the strength value in order to group *Kansei* Words that has several similarities in term of exterior shape of city car. The higher the strength value indicates the higher probability of *Kansei* Words to appear in consumer's preference data. Therefore, *rules* that have the strength value between 0.0 and 0.1 are to be considered insignificant. Table 4 below shows several groups of *Kansei* Words that have similarities in terms of the exterior shape of related city car.

**Table 4.** Kansei Words that have similarities in terms of the city car's exterior shape

<i>Kansei</i> Words	Exterior shape elements
Sleek, Classic	Car 7, Car 9
Robust, Powerful	Car 7, Car 8
Sporty, Formal	Car 4, Car 9
Cute	Car 4, Car 6
Modern	Car 10, Car 12

In order to determine the most preferred combination of attributes, the authors measured the level of each utility value of each component of the exterior for every combination obtained from the second questionnaires.

The combination that most represents the consumer's perspective on classic and sleek cars is the combination of components that have rear lights, door handles, and front bumper from the car 9 and headlights and fog lights from the car 7. As for the robust and powerful cars, the best combination is the combination of components that have rear lights and door handles from the car 8 and headlights, front bumper, and fog lights from the car 7. The combination that most represents the consumer's perspective on sporty and formal cars is the combination of components that have rear lights, headlights, and fog lamp from the car 9 and door handles and front bumper from the car 4. On the other hand, the combination that most represents the consumer's perspective on cute cars is the combination of components that have rear lights, front bumper, and fog lamp from the car 6 and door handles and headlights from the car 4. Lastly, the combination that most represents the consumer's perspective on modern cars is the combination of components that have rear lights, headlights, and fog lamp from the car 12 and door handles and front bumper from the car 4.

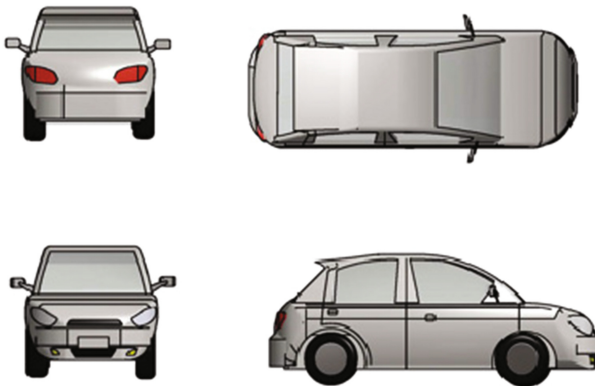
Table 5 below shows the relationship of *Kansei* Words that represent consumer perception with the exterior shape of the associated city car. It can be seen that there are some exterior components that do not only represent one *Kansei* Words alone.

As it is previously stated, this study aims to propose the exterior design of city car based on the affective perception of consumers. Therefore, those combinations above will be used as inputs to design the new city car's exterior shape. Each group of *Kansei* Words is represented by one exterior design of city car.

**Table 5.** Combination of city car’s exterior components against *Kansei* Words

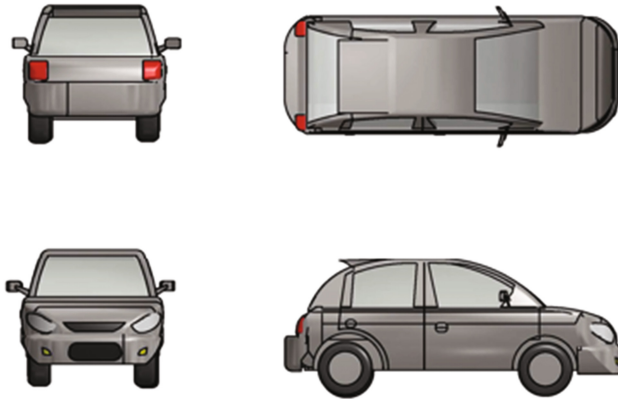
<i>Kansei</i> Words	Rear light	Door Handle	Headlights	Front Bumper	Fog Lamp
Classic, Sleek					
Robust, Powerful					
Sporty, Formal					
Cute					
Modern					

For the classic and sleek city car, consumers are more likely to choose long rear light, lift-back type for door handles, and headlights with oval shape on the right side and pointy on the other. As for the front bumper, consumers tend to choose the one with a slightly curved shape at the bottom and straight line at the top. Lastly, the diamond shaped fog lamp is more preferred by the classic and sleek seeker (Fig. 3).



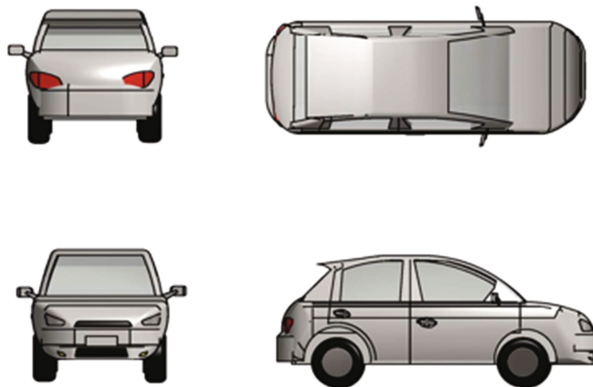
**Fig. 3.** 2D design of classic and sleek city car

The headlights and fog lamp chosen for the robust and powerful city car are the same with the classic and sleek city car. The robust and powerful seeker tends to prefer the rear light that is longer vertically and pull-type door handles. As for the front bumper, consumers are more likely to choose the one with trapezoid shape (Fig. 4).



**Fig. 4.** 2D design of robust and powerful city car

For the sporty and formal city car, consumers' preference is the same with the classic and sleek city car for the rear light component. Consumers of this type of car prefer to have pull-type door handles, headlights with oval shape on the left side and pointy on the other, and a rectangular front bumper with slightly curves at the top and bottom. The fog lamp for the sporty and formal city car is a little bit similar with the previous two types of city car (Fig. 5).



**Fig. 5.** 2D design of sporty and formal city car

For the cute city car, consumers are more likely to choose tiny rear light with triangle shape, pull-type door handles, and long headlights. As for the front bumper,



consumers tend to choose the oval shaped type. Lastly, the round shaped fog lamp is more preferred by the cute city car seeker (Fig. 6).

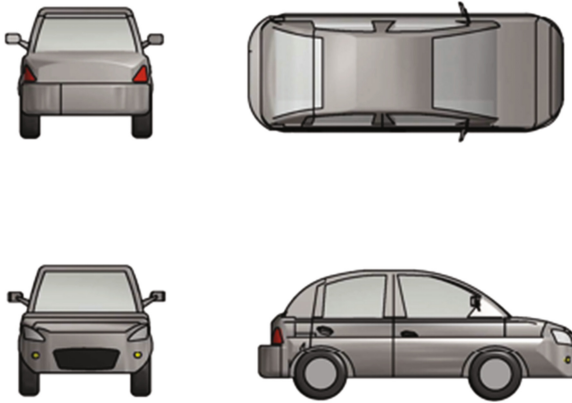


Fig. 6. 2D design of cute city car

The last type of city car, which is modern city car, has the same type of door handles with the previous three. As for the rear light, consumers are more likely to choose the one that is longer vertically, but a little more complicated compared to the robust and powerful city car's. For the modern city car seeker, they prefer to have a car with diamond shaped headlights, long front bumper, and diamond shaped fog lamp with sharper corner (Fig. 7).

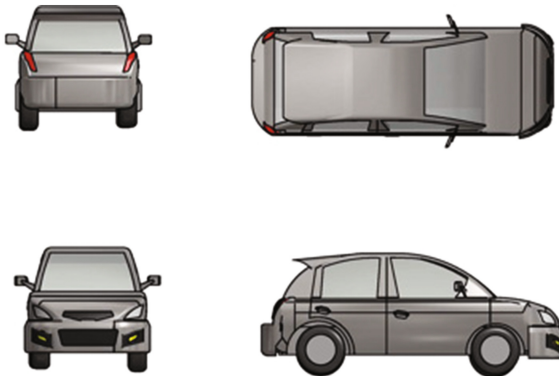


Fig. 7. 2D design of modern city car

## 4 Conclusion

Along with the increasing the competitiveness of the car manufacturers, particularly for the type of city car, functional specification is no longer the only factor of consideration for consumers to purchase a car. Car's exterior is the first thing that is recognized when looking at car products, thus becomes a significant impact on the consumer's decision to buy a car. This study aims to provide a draft proposal of the car's exterior shape that represents affective perception of the consumer in the form of *Kansei* Words.

The early stage of this study was determining what kind of existing exterior shape of city car that represents the affective perception of consumers. By mapping *Kansei* Words of the car's exterior shape with a certain type of car, several *Kansei* Words associated with car's exterior were obtained.

Afterwards, the study continued to know specifically what kind of exterior components according to consumer that represent their affective perception. The determination of the most representative exterior components based on consumer perceptions was conducted by calculating the utility value of every combination of exterior components. Combination with the highest total value of utility will be proposed as a draft form of city car's exterior shape. It can be concluded that the proposed designs for the shape of city car's exterior will fulfill affective needs of consumers.

This study resulted in five designs of city car's exterior shape. These proposed designs are the result of combination between the five most significant components (i.e. rear lights, door handles, headlights, front bumper and fog lamps) and five groups of *Kansei* Words (i.e. classic and sleek, robust and powerful, sporty and formal, cute, and modern). For the future research, a similar research can be conducted with other types of car, such as family car, SUV, or sport car.

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