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## Understanding consumers' behaviour for reducing environmental and social impact through sustainable product design – A Study case of vehicles usage in Indonesia

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# Understanding consumers' behaviour for reducing environmental and social impact through sustainable product design – A Study case of vehicles usage in Indonesia

A Hamni<sup>1</sup>, A Y T Panuju<sup>1,3</sup>, and D A S Ambarwati<sup>2</sup>

<sup>1</sup> Faculty of Engineering, University of Lampung, Bandar Lampung, Indonesia

<sup>2</sup> Faculty of Economic and Business, University of Lampung, Bandar Lampung, Indonesia

E-mail: achmad.yahya@eng.unila.ac.id

**Abstract.** One of crucial aspects in achieving a better level of sustainability in a country is the society's responsible product consumption pattern, as described in The United Nations' Sustainable Development Goals (SDGs). Inevitably, the dynamic interaction between consumers and products creates negative effects to the social and environmental dimension, including emissions from all the product's life cycle phases. Among other products, the usage of private combustion engine vehicles in Indonesia is one of the highest emission producers and a highly fuel consuming product. While the exploitation of these vehicles for fulfilling basic needs is essential to increase the society's quality of life, extended behaviour related to the vehicles may come from unimportant desire and endangers the dimensions of sustainability. This paper reveals the consumers' problematic behaviour and their reasons, as a part of a sustainable design framework, by conducting survey and in-depth interview sessions. Subsequently, the data is analysed qualitatively using thematic analysis method. The results may address strategies for the manufacturers in designing future eco-friendly vehicles and also gives recommendations for other stakeholders in creating policies and educational programs for the society.

## 1. Introduction

A responsible production and consumption pattern of daily products is one of the SDGs, which is predicted to have great influence on the environment and the society's quality of life. Many fields of science are related to the discussion of how to achieve the presented goal, and sustainable product design is among of these fields. In design engineering, sustainable design is a relatively new field, where the main target of the concept is addressing sustainability in all phases of a product's life cycle. It can be one of alternatives to answer the environmental problems through product design, and to increase human's quality of life in the same time. However, a comprehensive discussion of the concept is still rarely met. Therefore, there are still many gaps between the concept and the implementation [1]. This study aims to fill one of those gaps, by proposing a model that shows how the identification of consumers' behaviour should be considered as an input in sustainable design. As the study case, environmental problems caused by combustion engine based vehicle (CBV) in Indonesia is brought into the discussion, because of the urgent of the topic [2].

The usage of combustion engine based vehicles in Indonesia is known as the main cause of air pollution, mainly in big cities. While the emerge of electric based vehicle (EBV) and other eco-vehicle products have not been welcome properly in this country [3], an increasing demand for new CBV production, especially passenger cars, is being an inevitable aspect for the sake of commuters' mobility and psychological needs in big cities and rural areas as well [4]. The provision of eco-vehicle



products is proposed to be one of prominent solutions. Nevertheless, it is not easy for relatively high-priced products such as EBV or hybrid cars to penetrate Indonesian market, because the market has many different characteristics in comparison to those in developed countries. This is not merely the problem of marketing aspect, but further it is a problem of how to prepare future eco-vehicle products to be more accepted by Indonesian consumers, and it is started in the design phase. Thus an understanding of Indonesian consumers' behaviour must be obtained properly before developing a more sustainable product.

From the perspective of sustainable design, behaviour related to the environmental problems are crucial factors in developing the product. Environmental problems occur not only because of the basic usage of the CBV which is defined as fulfilling the basic needs of the commuters, but also come from extended behaviour attached to the vehicles usage, which come from the consumers' extended desire [5]. The fulfilling of basic needs properly supports the concept of sustainability, while less-important extended behaviour shall address to waste [6]. Further, by understanding the behaviour and the reasons, product designers may find solutions to develop more acceptable sustainable products.

In this paper, a framework model of how consumers' behaviour may affect sustainability through product design is proposed. To support the framework, a research to obtain an understanding of consumers' behaviour is conducted. A list of environmentally harmful behaviour related to the CBV usage in Indonesia is presented through literature review and direct observation. To validate the result, a survey of more than 500 participants is conducted. Subsequently, an in-depth interview has been taken to 40 participants in order to obtain reasons why the participants do the behaviour, and the results are analysed using thematic analysis method. The result of this research shall be used for industries and other stakeholders in arranging strategies for reducing the negative effects to the environment and improving the sustainability in Indonesia, especially in product design and transportation field.

## Related Works

### *Sustainable Design and Consumers' Behaviour*

Sustainable product design looks for profit from the selling of the product, while trying to reduce negative effect to the environment and increasing human's life in the same time. It is surely a complex project to accomplish, where experts are trying to assemble the puzzle by solving small parts from the whole project one by one. In its relation to the consumers' behaviour, sustainable product design has two big topics to be discussed. Firstly, how the consumers' behaviour should be an input to the design process. It has been commonly overwhelmed that consumers' behaviour is a crucial consideration in making a product to have good acceptance in the market [7,8]. However, how to position this aspect properly in a sustainable-minded design project is still requiring further researches.

The second question in defining the relation between sustainable design and consumers' behaviour is how the result of the design can give impact to the consumers' behaviour. Although having many other affecting factors, the design of sustainable products has the ability to shape the behaviour of the society. Thus it can be a tool for achieving sustainability by developing a more responsible pattern of production and consumption among a community. Previous research has proven that certain design strategy applied to a product may prompt to the behaviour-changing of the consumers, towards sustainability [9]. As the number of sustainable products increasing and forming a system around a society, it would have bigger chance to influence the society's sustainable behaviour [10].

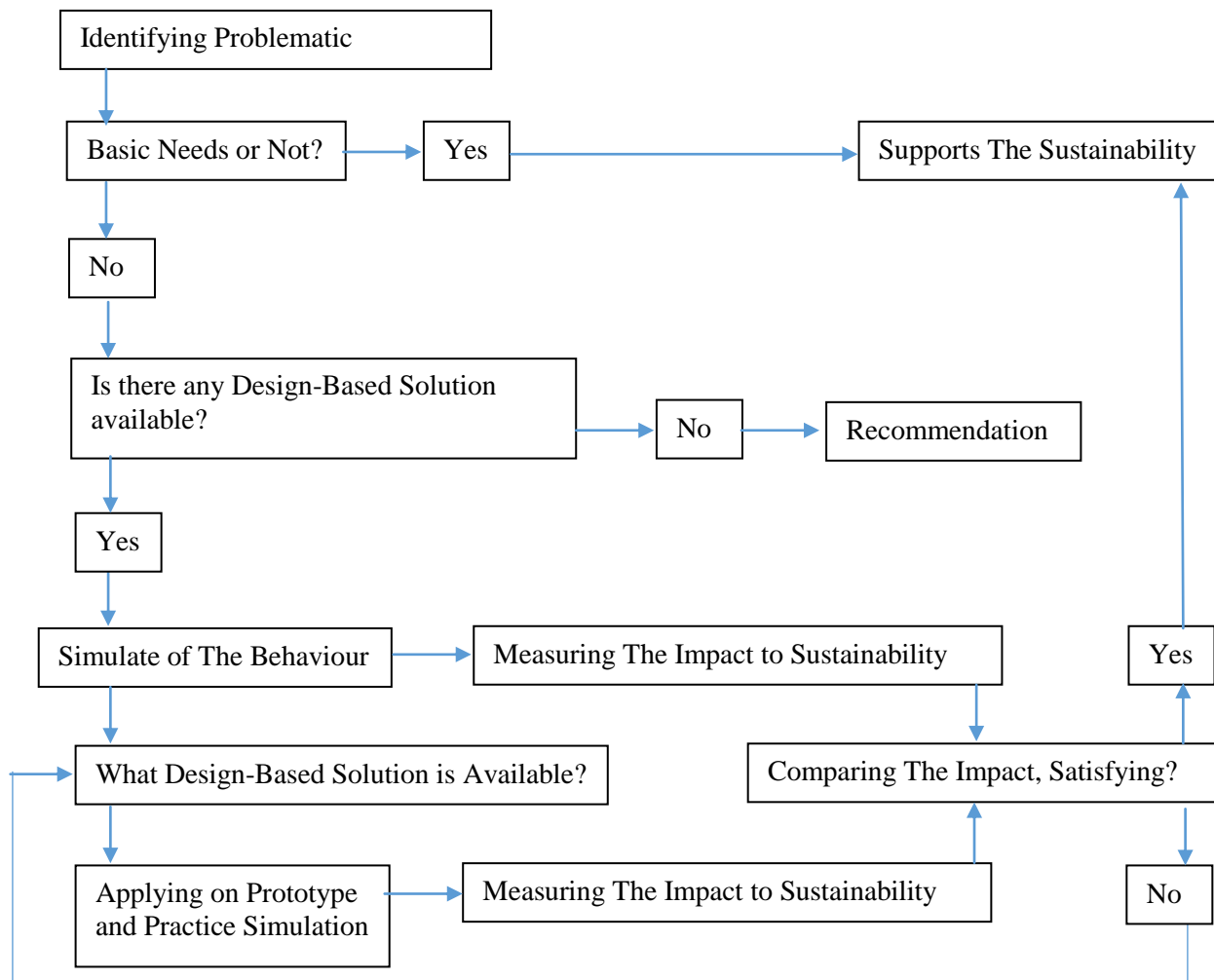
According to the above discussion, it can be concluded that the relation between sustainable design and consumers' behaviour is affecting each other vice versa. Understanding the behaviour of a society is considered as an important platform to determine strategies in achieving sustainability, including to shape the society's behaviour to become more responsible. Moreover, it has to be underlined that each society in different countries may have different needs and characteristics, so that local oriented studies are recommended for a better understanding in this matter. By defining the basic needs and applying solutions to the products, manufacturers help the society to improve their quality of life [6]. Oppositely, adding too many features related to extended desire to a product may lead to

waste and decline the sustainability level. Related to this, a new framework is proposed as described in the next section.

*The Framework of Consumers' Behaviour – Sustainable Design Relation*

Consumers' behaviour and products are affecting each other. The evolution of products has been a sign of the changing of human civilization and also considered as clues to investigate one society's tradition. Researches also show that product design has roles in shaping consumers' behaviour [10,11]. According to this, experts began to use product design to influence consumers' behaviour to become more sustainable.

As discussed before, improving human's quality of life by providing better products is included in the efforts achieving sustainability. On the other hand, one may find that improving quality of life in some cases will increase negative effect to the environment. Therefore, the fulfillment of human's needs in achieving sustainability should be limited to the fulfillment of basic needs [6]. As the result, manufacturers who have committed to support sustainability should reduce the design and production of product features with less-importance to this aim.



**Figure 1.** The Framework of Behaviour – Sustainable Design Correlation

However, consumers' behaviour in interacting with products already exist during their life time. The relation between the existing behaviour in a society and the improvement efforts toward sustainability through product design is presented in Figure 1, as the proposed framework for further discussion. At the beginning of the framework, identifying environmentally harmful behaviour in

specific product usage is assumed to be crucial. In this study, vehicle consumers' behaviour which harming the environment are taken into examples. Further, the behaviour is classified based on its importance in fulfilling the consumers' basic needs. While the behaviour to fulfill basic needs is considered as a supporting factor for sustainability, behaviour with less importance to this shall be reduced, because it would lead to waste. However, it should be admitted that not all of the problematic behaviour can be changed by re-designing products. Thus the framework should accommodate the possibility to let the problems solved in other discipline, by giving recommendations.

This is indeed subjective for different designers, and it depends on the level of creativity and technology mastery of each designer. In a certain level of capability, a design-based solution can be generated to influence consumers to behave more sustainable when using the product. The design-based solutions, in this case, will be made to reduce the negative impact to the environment. In order to do that, the environmental impact of the existing behaviour should be measured based on a simulation. However, measuring the effect of a design to the consumers' behaviour is not easy, due to the complexity of it. A practical testing project is required to conduct a proper investigation to the consumers' reaction [12]. A practice simulation should be applied to check consumers' reaction to the new design. By comparing the measurement result of the simulations, one can determine whether the re-design process has been satisfying or not. This is a recursive process, to ensure the optimum result.

## 2. Methods

This paper provides the discussion on identifying problematic behaviour step in the framework, which is described previously. Consumers behaviour in using combustion engine based vehicles in Indonesia is investigated by exploring prior researches and using direct observation, so that several behaviours are collected through this process. However, the prior researches were conducted in varied cities which may lead to biased comprehension. Thus the collected behaviour should be validated by conducting survey in several cities. This survey is to provide the understanding how the respondents react to the collected behaviour.

Therefore, a survey was conducted in June 2020 using online system through social media. The participating respondents should at least have experience in using their own vehicles, so that they can contribute based their own experience. And even the survey was spread online, to avoid cultural bias, the respondents were limited to those who live in Jakarta, Tangerang and Bandar Lampung. The result of the survey should validate whether the behaviour really belong to the citizen or not. After that, further investigation should be made to obtain an understanding of the behaviour.

While quantitative analysis method in behaviour research sometimes still requires deeper causal explanation [13], this research uses interviewing method to investigate the respondents' reasons and opinions related to the behaviour as the subject of the discussion. Further, interviewees will be selected from the previous survey respondents, and several questions will be asked through phone call. Thus the data collected are in a format of recording which should be noted and further analysed. Then, the data is analysed qualitatively using thematic analysis method, due to its simplicity and reliability [14,15].

## 3. Results and Discussions

### 3.1. Problematic Behaviour Identification

After the process of literature review and direct observation, four related-to-vehicle-usage behaviour are identified among Indonesian locals, which are considered to be harmful to the sustainability dimensions. The list of the behaviour is presented in Table 1. Surely there are other problematic behaviour that have not been listed, but those are assumed as not critical. Vehicle modification activity is listed as the first behaviour (B1) in the table. The emerge of vehicle modification in Indonesia is suspected by the growing number of vehicle modification workshops in big cities. These workshops work on vehicle exhaust system, body customization, additional sound system and others. Most of the works contribute to additional emission constituting energy, CO and NO based gas emission.

The second behaviour (B2) is the preference of Indonesian people to ride on private vehicle instead of using public transportation in their daily activities, such as going to workplace, taking

children to school and going to the market. Meanwhile, the number of private passenger vehicles used in Indonesia has gone beyond the road capacity, causing environmental and social problems. The phenomenon has been discussed previously by Setiawan [16], Khafian [17] and Belgiawan et al [18]. The existence of online taxi is actually adding burden to the condition, due to many people in Indonesia prefer to ride on online taxi than use the mass public transport like bus.

**Table 1.** List of the Behaviour

Behaviour	Code	References
Modifying vehicle	B1	Direct observation
Choosing private vehicle instead of public transportation	B2	[16–18]
Aggressive driving style	B3	[19]
Preference to own or use vehicle with big engine capacity	B4	Direct observation

Aggressive driving behaviour of the drivers is also a problem in Indonesia, and it is listed as the third behaviour (B3). The behaviour causes not only accidents but also reduces the vehicle engine work efficiency, thus it contributes to the increasing of environmental problems. Evidences are presented by Zuraida et al [19].

As the fourth behaviour (B4), Indonesian consumers seem to have preference on vehicles with big engine capacity. In this research, the engine is classified as having big capacity if the combustion volume 2000 cc and above, based on common perspective in Indonesia for passenger cars. The original purposes of this kind of vehicles are for hard-duty works such as in mountain area and lifting heavy burden. However, based on direct observation, many big engine capacity vehicles are bought not for those purposes. To validate the behaviour list as a preliminary data, a survey has been conducted in Indonesia involving more than 500 respondents, which will be discussed in the next section.

### 3.2. Validating the Behaviour

Even though there have been direct observation and related researches to support the preliminary data, it should be validated quantitatively whether the behaviour is owned by Indonesian consumers or not. In order to do this, a survey using online questionnaire has been conducted in June 2020. The survey also reveals the frequency of the behaviour performed by the respondents. Behaviour B1, B2, B3 and B4 are presented to the respondents using online google documents platform and for each behaviour, the respondent should state his or her condition related to the behaviour (Table 2).

**Table 2.** Respondent's Statement in the Questionnaire

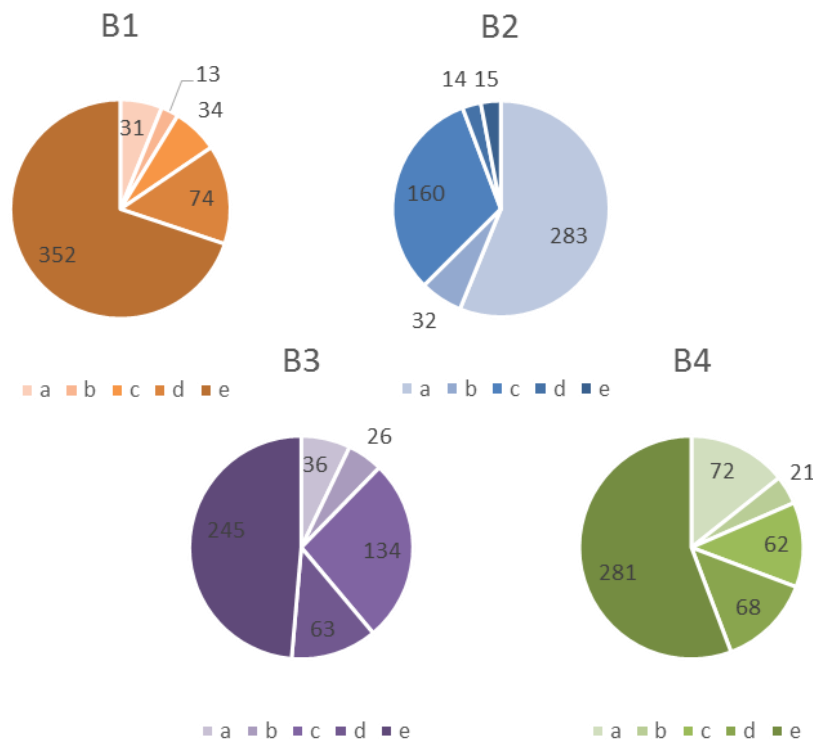
Respondent's Statement related to The Behaviour	Statement Code
I do the behaviour recursively / periodically / every time I have the ability to do it.	a
I did the behaviour recursively / periodically / every time I have the ability to do it, now not anymore.	b
I did it, more than once.	c
I did it once.	d
Never	e

Statement a to e show the highest to the lowest environmentally risk behaviour respectively. By revealing the result, one can arrange a priority in dealing with the behaviour. Statement c and d may happen conditionally due to incidental reasons, while statement a and b may come from the life value

of the respondents. The survey has been conducted using online application, and obtained responses from 504 respondents. The respondents' profile is described in Table 3.

**Table 3.** Respondents Profile

Respondents Profile		Freq	%
Gender	Male	323	64.1
	Female	181	35.9
Age	< 18	3	0.6
	18 – 27	175	34.7
	28 – 40	199	39.5
	41 – 55	113	22.4
	> 55	14	2.8
	Status in The Family	Main Breadwinner in a Family	219
Main Breadwinner, single		41	8.1
Supporting Breadwinner in a Family		111	22
Not a breadwinner		133	26,4
Education Background	Junior High School	3	0.6
	Senior High School	123	24.4
	Diploma & Bachelor	212	42.1
	Master & Doctorate	166	32.9
Family Expenditure Monthly	Under 2 million rupiah	84	16.7
	2 million – 6 million rupiah	249	49.4
	6 million – 17 million	140	27.8
	Above 17 million	31	6.2



**Figure 2.** Survey Results in Charts

### 3.3. Qualitative Investigation: Looking for Why and The Behaviour Importance

Based on these findings, it can be concluded that each behaviour belongs to Indonesian vehicle consumers, though they differ in the frequency. Subsequently, 8 respondents are chosen from each behaviour category, and asked to participate in the interview session. Totally there are 40 interview transcription data listed in the database, which is analyzed by using thematic analysis method. There are three main questions for the participants, which constitute: the reason why the participant did the behaviour, how important the behaviour for the participant, and the participant's reaction to the environmental issues of the behaviour.

Thematic analysis method lets the interview transcription data extracted to be codes which present major idea in each transcription. To simplify the discussion, the codes can be grouped into several themes which usually have wider scope than the codes. The result of the interview data extraction can be seen in Table 4.

**Table 4.** Interview Data Extraction

Behaviour	Reason		Importance	Opinion Related to Environmental Issues
	Codes	Themes		
B1	Something fun	joyful life	not really important; quite important; Important	denial; willing to adjust the activity
	Self-expression			
	Self-development	Earning efforts		
	Related to job			
B2	Comfort	joyful life	important; very important	cannot change now due to current condition, but willing to change in the future
	lack of proper public transportation			
	Mobility related to job	Earning efforts		
	financial reason			
B3	Safety	Safety	not really important; important; very important	cannot change now due to current condition, but willing to change in the future; willing to adjust the activity
	something fun	joyful life		
	Comfort	Safety		
	Emergency	Habitual		
	Habitual related to job	Earning efforts		
B4	Comfort	joyful life	not really important; quite important; very important	denial; admit the problem but do not want to change
	Social status			
	Safety	Safety		
	Mobility related to job	Earning efforts		

There are several main themes found in the reasons stated by the participants, constituting how to achieve a joyful life, safety, earning efforts and habitual reasons. To provide a clear illustration, the extraction process will be described for each behaviour.

4.3.1 *Modifying Vehicles (B1)*. According to the interview result, most of vehicle modification activities are motivated by the desire to obtain happiness, by showing self-expression through the modifications, while other respondents place the activity as just a hobby. Related to this reason, most participants said that the activities having only middle to low importance in their life. Nevertheless, they keep doing it as long as they have the ability to do it. As minority results, two from eight



participants admit that the modification activities are part of their job, so that it holds a more important role in their life. Subsequently, when the interviewer asked the participants' opinion about the activities' risks to the environment, 6 from 8 participants show denials, which means that they do not agree that the activities would be harmful to the environment. Some argue that they have participated in other green campaigns such as the reduction of plastic usage, and assume that changing exhaust and sound system in the vehicles could not be 'that harmful'.

*4.3.2 Choosing to ride on private vehicle instead of using public transportation (B2).* Behaviour B2 shows the highest frequency among other behaviour. All participants confirm the importance of the behaviour for their safety and earning efforts, although they also obtain additional comfort from the activity. Some of them said that they cannot reach their workplace by using public transportation, and some other said that they cannot feel safe while riding on bus or 'angkot' (minibus vehicle used as public transport in Indonesia). The fact is the public transport facilities in many cities in Indonesia have not been properly provided, while safety and the ability to perform earning efforts are considered as basic needs by the society. Thus most of the participants are quite aware that the behaviour is actually endangering the environment, but they are still doing it until proper public transport facilities provided.

*4.3.3 Aggressive Driving Style (B3).* Most of participants (6 from 8) who was interviewed about behaviour B3 told that at the beginning, their aggressive driving behaviour is stimulated by emergency condition and urgent agenda such as meeting or taking relatives to the hospital. However, 5 from 6 participants admit that the aggressive driving behaviour become habitual, and they do it in occasions without the presence of the emergency or urgent condition anymore. The rest of the participants said that they enjoy the aggressive driving style, it gives them fun and excitement. Fortunately, all participants stated that they are aware about the environmental risks and willing to change the behaviour. However, 5 from 8 participants argue that it will need time for them to shift the habit, so that the change cannot be done in a short time.

*4.3.4 Preference to Use or Own Vehicle with Big Engine capacity (B4).* Vehicles with big engine capacity are mostly more expensive and having 'macho' appearance. There are 4 participants from 8 stated that the ownership of this kind of vehicle is associated with pride and social status. Other two argue that they need the engine performance to feel comfort and safe, mainly when driving in the highway. And the rest said that they really need the strong performance of the engine for being mobile in remote area, due to job requirements. Mostly, the participants deny that the using of this kind of vehicle could bring more risk to the environment. Therefore, they are willing to use fuel with higher octane number in reducing the vehicle's emission. However, the higher amount of fuel used in a bigger engine capacity is inevitable as one of the environmental burdens.

### *3.4. Implementing The Result*

Based on the framework explained previously in section 2, it is essential to determine whether the behaviour is a part of the consumers' basic needs or not. In this research, it is represented by revealing the importance of the behaviour by the respondents. Ironically, the behaviour with the highest frequency (B2) is performed based on basic needs of the respondents. Moreover, it is quite difficult to use this as an input for further sustainable vehicle design. Almost all of the respondents utter their hope for a safe and comfort public transport to support their daily activities, so that the provision of this facility in the future will be an accurate solution. Therefore, proper regulations about transportation to reduce environmental and social effect in this matter is acclaimed to be crucial for the next improvement.

Other findings in this research are more possible to become inputs for the future sustainable vehicle design in Indonesia. The problematic behaviour can be sources for new idea in designing new shape, arrangement and technology-based features on the vehicles. Surely, the design should aim for more responsible behaviour of the users. For instance, a device to remind drivers when aggressive driving behaviour occur may be a nice additional technology to be attached to the dashboard. Prior researches

have measured the behavioral effect of the design from existing vehicle products [20,21]. Nevertheless, a research with intentional design for behavioral changes is hardly met in vehicle product development field. Furthermore, this paper's scope also does not cover the discussion of applied solutions in the design area. Another problem to solve in the future is to measure the effect of the behaviour to the environment and social dimension quantitatively. The identified behaviour obviously affect the environment, but the exact amount of the impact is required to be expressed in numbers.

#### 4. Conclusion

In this research, a framework of consumer behaviour and its relation to sustainable design is proposed, as an effort to improve the sustainability. Four problematic behaviour have been identified among Indonesian vehicle consumers, where most of these behaviour come from extended desire, as admitted by the respondents. There are similarities found in most of the respondents' reasons, including to gain joy (hobby, self-expression or comfort), safety reasons and as a part of their occupation. However, to reduce the negative impact of these behaviour, mainly to the environment, some improvements should be made in the future. Based on our opinion, the solution should include making proper public mass transportation and changes in the future vehicle design.

The results may be useful for vehicle industries in designing future sustainable vehicle for Indonesia. Based on the findings, designers may find new eco-innovations to be installed in their products. However, not all of the problematic behaviour can be solved by the changes in product design. Some of them can be simply reduced by applying regulation by the government and proper educational programs to the society.

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