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An Analysis of End-of-Life Vehicle Management in Indonesia from the Perspectives of Regulation and Social Opinion

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Abstract. The huge automotive industry in Indonesia has had a major impact on the environment and health caused by ELV. An ELV is a vehicle that has reached the end of life due to age or cannot be reused because of accidents and high repair costs. The absence of procedures and laws in Indonesia related to the driving of this vehicle resulted in the dismantling of ELV, and its management was carried out on an original and unstructured basis. As a result, emissions of gases and toxic substances are released into the environment. To reduce this problem, implementing ELV management must be done. Implementing this ELV policy requires the cooperation of all stakeholders (government, automotive industry, and the community). Therefore, this study aims to understand the laws related to ELV and its implementation in neighboring countries and explore public perceptions of ELV management in Indonesia. The study was divided into two phases. The first phase reviewed literature related to ELV laws, and the second was surveyed with questionnaires. The results obtained from this research show that public awareness and acceptance of the application of ELV are still very low. In addition, the regulations that have been applied to check the feasibility of vehicles are proven unable to cut down the number of old vehicles.

Keywords: Awareness of ELV; ELV laws; End-of-life vehicles; Public acceptance

1. Introduction

Indonesia is one of the developing countries with the second-largest automotive industry sector in Southeast Asia. The automotive sector seems to be a mainstay sector that significantly contributes to the national economy. There are 22 motor vehicle industry

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companies in Indonesia. BPS census results noted that the number of motor vehicles in Indonesia reached over 133 million units in 2019 (BPS, 2020). In 2019, the number of vehicles increased by 7,108,236 units or 5.3% to 133,617,012 units from the previous year. The number of vehicles in 2018 rose 5.9 percent from 2017. As one country with a significantly developed automotive sector, Indonesia must be concerned about vehicles' environmental impact.

The lack of rules regarding the age of vehicles in Indonesia resulted in the number of old vehicles still being used even though they look no longer fit for use. In Indonesia, we often find vehicles over the age of 10 years that are still used daily. This old vehicle is often called the ELV. ELV is a vehicle that has reached the end of use and cannot be reused. ELV itself can be classified into two, a naturally occurring ELV: is a vehicle that has reached its end of use and has been damaged or un-reusable. This natural ELV can occur if the vehicle has reached the age of over ten years. The second is premature ELV: it occurs due to damage from accidents, fires, or destruction. In addition, some vehicles cannot be reused because of economic problems such as being unable to fix, not renewing vehicle taxes, and the dearth of spare parts in the market (Harun *et al.,* 2021).

ELV management should be carried out with special treatment. This is done because ELV includes extremely dangerous garbage (Yano *et al.,* 2019). Oil, CFC, brake oil, tires, glass, and some other materials are extremely dangerous if not managed properly. If this vehicle is abandoned, it will hurt the community (D'Adamo, Gastaldi, and Rosa, 2020; Yano *et al.,* 2019). Such a release of harmful gases from air conditioner liquids can degrade air quality and ultimately affect the ozone layer. However, there are still many irresponsible people leaving them alone on the side of the road, in parking lots, in the police, and in residential areas (Mohamad-Ali *et al.,* 2018).

Besides contributing to poor air quality, considering that old vehicle engines are less efficient in combustion, they will produce higher gas emissions (hydrocarbons and carbon monoxide), and old cars are a major cause of traffic accidents (Kassim *et al.,* 2020; Ahuja and Khanna, 2019; Jawi *et al.,* 2016). According to the Indonesian Ministry of Transportation, there will be 108,000 motor vehicle accidents by 2020, with about 30% of those accidents caused by vehicles that are no longer fit for use (BPS, 2020).

Looking at the negative impact that can be generated by ELV, the right treatments must be done. The first step that must be considered is to clear away all fluids, such as fuel, greasing oil, gear oil, and air conditioning fluids. The second step is to eliminate other harmful components, such as batteries and airbags (Sharma and Pandey, 2020). The last dismantling of the main components of the mainframe is carried out. These components can be reused by recycling. Once the entire process is complete, the remaining waste must be taken to the car's disposal and crushed (Santini *et al.,* 2011).

As a country with huge automotive production, Indonesia has tried to carry out regulations to cut down old vehicles, but it did not work. In 2009, the government issued emissions test rules under UU 210 paragraph (1) of Law number 22 of 2009. However, this rule cannot be implemented because there is no socialization first. The government is again trying to reimpose the euro 4 standard in which the vehicle exhaust emission threshold is further tightened (MENLHK, 2017; DEPHUB, 2009). The government can learn from the successful experience of the biodiesel program in Indonesia in terms of conducting studies to support incentive policies and implementation stages and involve stakeholders (Tjahjono *et al.,* 2021).

To realize ELV policies, the Indonesia government should accommodate the public to take a role in reinforcing the policies regulating these old vehicles. To ensure public understanding and acceptance of the ELV (old vehicle) issue, we will distribute

questionnaires to the public, government, and non-governmental organizations. It will compare the results with developed countries to compare people's understanding of this regulation.

In Indonesia, there has not been special research referred to ELV. The novelty of this research is to present a mapping and analysis of the current condition of the vehicle owner community regarding knowledge of ELV and its level of acceptance. This research also examines regulations in other nations that have successfully addressed the ELV problem. Previous research has also indicated that examining public responses to ELV management can aid the government in determining the optimal framework for ELV management, particularly in developing nations such as Indonesia (Sitinjak *et al.,* 2022).

2. Literature Review

ELV is a hazardous waste and has the potential for environmental pollution if not managed properly (Dabic-Miletic, Simic and Karagoz, 2021; Karagoz, Aydin and Simic, 2020). ELV itself is a very large and dangerous household waste. ELV is very difficult to manage because it has a very complex structure and varied composition. ELV is also a waste that grows very quickly every year, but in some developing countries, ELV is still not well considered. ELV is a vehicle that has reached the end of its service life, which can be the result of an accident or the vehicle having been used. The first is commonly referred to as ELV premature. The second type is known as natural ELV. However, regardless of their origin, ELV is the end of everything and must be managed by the logistics chain, whether legally or illegally (Karagoz, Aydin and Simic, 2022; Go *et al.,* 2016).

ELV management includes all activities and materials related to the interconnected financial and information flows between all ELV network entities, including vehicle users, old vehicle collection centers, official demolition facilities, shredder industry, recycling centers, remanufacturing, second-hand markets, industrial landfills, and so on. This is critical for the preservation of the environment, economic circulation, and sustainable development in the auto industry (Simic *et al.,* 2021).

The ELV waste treatment process begins with the de-pollution stage, aimed at removing harmful liquids from the ELV (for example, oil) (Sitinjak *et al.,* 2022a; Sitinjak, *et al.,* 2022b). The ELV then continues the disassembly process to dismantle the vehicle components. The destroyed vehicle hulk is then transported to the metal crushing plant, where the ELV's metal and non-metallic components are posted.

Furthermore, ASR (automobile shredder residue) is the residue produced by the crushing procedure that is separated between ferrous and non-ferrous metals from the output of the crushing machine. ASR is the main non-metallic material left over from the ELV crushing process (Cossu and Lai, 2013).

3. Methodology and Data Collection

There are two stages to the research. The first phase entails a thorough review of the literature on Indonesia's old car policy. Following that, we carried out a literature review to look for ELV rules in adjacent nations. In the second quantitative phase, researchers devised a set of questions to gauge people's attitudes toward ELV management and their readiness to adopt it. Interviews with government representatives in charge of automotive and environmental management in Indonesia were used to design this questionnaire. A person over the age of 18 who lived in the JABODETABEK area was the target of the questionnaire group. Questioners are distributed by posting Google-form links on the internet or through the WhatsApp group.

The total number of respondents in the study was 98. The questionnaire contained 5 closed questions, including 8 demographic-related questions. Questions asked such as I know the benefits of implementing the ELV policy; I will support all ideas relating to Old/damaged vehicles, as well as the payment of processing fees if any; I know the benefit of implementing ELV policy; I will do periodic emissions tests to see the feasibility of my vehicle, local governments are capable and professional institutions to make policy; I want to implement the ELV policy. Descriptive analysis is used in this study.

4. Results and Discussion

4.1. Current Legislation

The results of a comprehensive investigation related to ELV management in countries such as China, South Korea, Japan, Singapore, Taiwan, and Malaysia are shown in Table 1. Malaysia and Indonesia do not even have ELV regulations. Although these two countries have rapid levels of automotive production, Malaysia has an advantage over Indonesia by enforcing the age of vehicles and already has operators that manage ELVs well.

Because of the rapid growth of the automotive in China resulted in the country becoming the largest vehicle market in the world. In 2019, vehicle sales in China reached 25.8 million units, the highest sales figure in the world, followed by the US at 17.5 million units (Zhang *et al.,* 2022). The pace of growth in the auto industry in China prompted the Chinese parliament to legislate the ELV in 2001, a year after the European Union introduced legislation on the ELV (Ashari *et al.,* 2018; Xiang, and Ming, 2011). The main feature that becomes the weight point of ELV in China is an ELV classification based on the accumulated mileage and duration of service.

Table 1 Comparison of ELV management between countries.

	China	South Korea	Japan	Singapore	Taiwan	Malaysia	Indonesia
Government Involvement / Act:	Statute 307 Law	The Act for Resource Recycling of Electrical/Electronic Products and Automobiles	ELV Recycling Law	Vehicle Quota System	Waste Disposal Act	No Law	No Law
ELV age:	10 years or 500,000km	Not Specified	Min 3 years, inspection once in 2 years	10 + 5 or 10 years	10 years	10 years	Not Specified
Recycling Fees paid by:	Market-Driven (Collector pay last owner)	Market-Driven (Collector pay last owner)	First owner, upon purchase	Market-Driven (Collector pay last owner)	Manufacturer & Importer pay when purchased	Market-Driven (Collector pay last owner)	-
Operator Size:	367 Recycling operators, 1 pilot recycling center	226 Recycling operators, 7 shredding & Sorting plants	5000 Recycling operators, 140 shredding & Sorting plants	-	303 Recycling operators, 5 shredding & Sorting plants	209 Recycling Operators, 0 Shredding & Sorting Plant	-
Effectiveness: (Recovery rate)	90%	85%	85%	-	95%	None	None

ELV is receiving special attention from the Taiwanese government as a result of an increase in the number of vehicles on the road, which has resulted in substantial pollution

and other environmental issues because of poor ELV management techniques (Chen, Huang, and Lian, 2010). ELV is classified as hazardous waste, including lubricants, liquid acids, and refrigerants, which can contaminate the environment if incorrectly disposed of (Cheng *et al.,* 2012). The Taiwanese government founded the Recycling Fund Management Board (RFMB) in 1998, resulting in a major increase in recycling activities throughout the country (Chen, Huang, and Lian, 2010).

Japan is home to one of the world's most thriving automotive industries. In 2019, Japan's total car ownership reached 62.03 million units (JAMA, 2019). Because of the increasing rate of car ownership in Japan, vehicle waste disposal has become a serious concern. The government passed legislation on ELV recycling in 2002 (Simic and Dimitrijevic, 2013). Vehicle makers and importers are required to collect and recover chlorofluorocarbons/hydrofluorocarbons (CFC/HFCs), airbags, and automobile crushing residues (ASR) present in ELV waste under this legislation, which went into effect in 2005. The number of illicit ELVs in Japan has decreased because of this rule. Japan enforces this legislation to guarantee public safety and environmental sustainability (Zhao and Chen, 2011).

Singapore established a vehicle quota plan because a high tax program alone did not limit the number of automobiles on the road (Chu, 2018). Now all people in Singapore must hold a Certificate of Entitlement (COE) to purchase a vehicle. As stated in the table, COE is separated into five vehicle categories based on engine capacity and power output. The Land Transport Authority (LTA) will declare the availability of COE quotas for each category, after which the vehicles must be registered for ten years. Even if the car has been sold within the last ten years, the owner must comply with this requirement. After ten years, the owner may cancel the registration and continue the certificate by paying the premium quota (Huang, Li and Ross, 2018).

Until now, Indonesia still does not have a law related to ELV. Previously the government has tried to impose periodic emissions test policies, but this policy still cannot reduce the level of vehicles on the road. In addition, emissions test policies also get much rejection from the public. Now, ELV vehicles in Indonesia are still managed poorly by some workshops and some scrap iron collector companies. These workshops are privately managed, and the demolition activities do not follow the correct standards.

4.2. Questionnaire analysis

At the beginning of the questionnaire, we analyzed the respondents' backgrounds. Of the 98 respondents, 71 were male, and 27 were female (see Table 2). They represent several employment sectors, such as civil servants, permanent and contracted private employees, and the self-employed. In education, the highest percentage showed that most respondents were respondents from postgraduate education (61.20%). 66.7% of respondents own at least 1 or 2 private vehicles (see Figure 1).

Table 2 Result of the respondent's background.

Respondent Background	Total	Percent
Gender		
Male	71	72.45%
Female	27	27.55%
Working sector		
Civil Servant	48	48.98%
Permanent private employee	29	29.59%
Contract private employee	8	8.16%
Entrepreneur	13	13.27%
Educational Level		
Senior High School	10	8.10%
Bachelor	28	28.60%
Postgraduate	60	61.20%

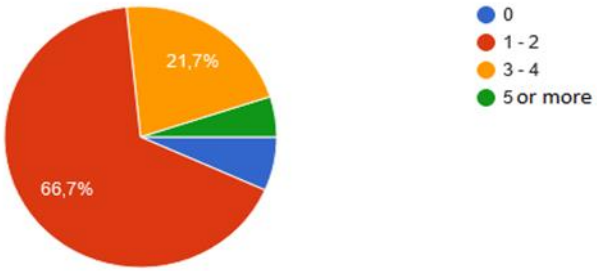

Figure 1 Ownership of vehicles

This finding shows that most respondents have more than one vehicle. People feel more comfortable and flexible working using private vehicles than public transportation. The lack of facilities for public transportation also causes people to avoid public transportation in Indonesia.

The second question is about social support related to ELV management. As illustrated in Table 3, 52 people, or 53.06% of respondents gave, strongly disagreed. This shows a lack of public support for the ELV rules. Wang *et al.* (2021) in their research stated that social support is a major factor in the success of ELV management in one country. This finding shows that the support from the community of vehicle owners in Indonesia is still weak, so the implementation of ELV regulations is not yet possible.

Table 3 Result of the respondent's answers about ELV.

Questions about ELV	The number of respondents		
	Strongly disagree	Not sure	Strongly agree
Support for ELV policy	52	22	24
Knowledge of ELV policy	53	10	35
Mandatory inspection	15	24	59
Institutional trust	49	19	31
Implementation of ELV	51	19	28

Respondents were then asked if they were aware of the benefits of implementing the ELV policy. As seen in Table 3, most answers are on the public's ignorance regarding the benefits of implementing ELV policies. This shows that public knowledge related to the benefits of ELV management is still very low (54.08%). Referring to Lee and Ko's research (2021) statees that public knowledge related to the benefits of regulation will make it easier for people to accept the rule. These findings also corroborate that the importance of socialization related to ELV programs is given before implementing ELV-related laws.

The next question relates to the mandatory inspection of vehicles. Vehicle owners are required to conduct a vehicle feasibility test every time they want to renew their vehicle letter. As seen in Table 3, most respondents agreed (60.20%) with the importance of conducting a vehicle feasibility check. This is because the older the vehicle, the vehicle has the high risk of accidents due to the lack of safety and quality owned by vehicles older than 15 years (Santini *et al.,* 2011).

Then all respondents were surveyed related to trust in the government. Table 3 shows that half of the respondents (50%) do not trust the government in the credibility of making a policy. The results of this answer tell us the importance of governments in increasing public confidence in their performance. The findings of Zannakis *et al.,* Eiser *et al.,* and Jagers *et al.* (Jagers, Matti and Nilsson, 2017; Zannakis, Wallin and Johansson, 2015; Eiser, Miles and Frewer, 2002) show that public trust in the government is the main factor that determines the community to obey the policies made by the government.

The last question is to find out whether the ELV law is implemented in Indonesia. Table 3 shows that most respondents (52.04%) still rejected the implementation of ELV policies, and some respondents (19.38%) were still undecided about ELV policies. This can be caused by several factors. First, the number of vehicles owned by respondents can influence this decision. The respondents think that they will spend more funds to buy a new and more expensive vehicle.

5. Conclusions

A set of questions in this study has been prepared to find out exactly what the public's interest in ELV policies is if implemented in Indonesia. The dimensions of social acceptance can be measured through attitudes, knowledge, trust in the government, and the desire to imply it. From the results obtained in this study, it can be seen that all respondents still gave a negative response regarding the ELV policy.

The low public knowledge regarding ELV policies is a big homework for the Indonesian government to provide comprehensive knowledge related to ELV policies. From the results of the survey, it was also found that the level of public trust in the government is very low. This strengthens that the rejection of ELV policies can be based on the lack of public trust in the government's ability to make a policy. The respondents also reject the regular vehicle inspection. This is due to the lack of public awareness to maintain the performance of their vehicles.

In addition, the government should take an important role and take swift action on the ELV issue. Responsible parties should conduct more research and develop regulations and laws on ELVs similar to countries that have successfully reduced and addressed the ELV problem. The government, the automotive industry, and the public must work together to achieve the ELV goal.

Based the main purpose of this study is to compare ELV policies. It can be seen that other countries always take the same steps against countries that first successfully implement ELV regulations in solving ELV problems in their countries. Compared to Indonesia, so far, Indonesia still plans to conduct annual vehicle emissions checks, and no specific regulations have been made to address the ELV problem in Indonesia. When compared to Malaysia. Indonesia is still very far behind. Malaysia has moved with ELV processing plants spread across several cities, and the government has implemented vehicle age policy rules to combat the effects caused by ELV.

The findings of this study can be used to show that ELV restrictions cannot be applied unilaterally. This is reflected in the research findings, which show that respondents are still hesitant to use ELV management, and poor levels of trust in the government became

extensive homework. As a result, an in-depth study is required, including the costs associated with implementing the ELV and its financing scheme. This is because ELV integration affects all Indonesian communities.

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