

Navigating the path to effective End-of-Life Vehicle (ELV) management in Malaysia: A qualitative inquiry

Rosniza Aznie Che Rose ¹, Charli Sitinjak ^{2,3}, Rozmi Ismail ², Zurinah Tahir ¹, Zambri Harun ⁴, Muhamad Razuhanafi Mat Yazid ⁵

¹ Centre for Research in Development, Social & Environment (Seeds),
Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia.

² Centre for Research in Psychology and Human Well-Being (PSiTra),
Faculty of Social Sciences and Humanities, Universiti Kebangsaan Malaysia.

³ Psychology Department, Faculty of Humanities, Bina Nusantara University

⁴ Department of Mechanical and Manufacturing Engineering,
Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia.

⁵ Department of Civil Engineering, Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia

Correspondence: Charli Sitinjak (email: p112562@siswa.ukm.edu.my)

Received: 1 August 2023; Accepted: 26 August 2024; Published: 29 August 2024

Abstract

The adoption of ELV (End-of-Life Vehicle) management policies holds excellent promise in Malaysia as a strategic response to the issue of abandoned vehicles. This qualitative study delves into the challenges and opportunities encountered in implementing sustainable ELV management in the country. Through semi-structured interviews and focused group discussions involving key stakeholders, such as experts, policymakers, industry representatives, and community members, this research identifies critical barriers obstructing the establishment of an efficient ELV management system. The findings underscore significant challenges stemming from the lack of a comprehensive legislative framework dedicated to ELV management and limited infrastructure for proper ELV collection and recycling, which hinder responsible waste management practices. Financial constraints and technological limitations further impede progress toward sustainable ELV management. Concurrently, improper ELV disposal practices and the escalating waste generation from the automotive industry present profound threats to Malaysia's environmental sustainability. Nonetheless, the study also highlights opportunities for improvement, including leveraging collaboration and knowledge exchange with developed nations and capitalizing on the rising market demand for recycled materials to drive resource recovery and circular economy practices. To overcome the identified challenges and capitalize on the opportunities, stakeholders must collaborate to establish an effective ELV management system, enhance public awareness, and enforce regulations. The study concludes by emphasizing the significance of strategic planning and investment in overcoming barriers and promoting sustainable ELV management practices in Malaysia, thereby contributing to a more environmentally conscious and sustainable automotive industry.

Keywords: Challenges, ELV management, end-of-life vehicles, environmental sustainability, opportunities, recycling

Introduction

The automotive industry's rapid expansion has undoubtedly revolutionized transportation and mobility on a global scale, providing unparalleled convenience to people's lives. However, with this growth comes an increasingly urgent environmental concern - the proper management of End-of-Life Vehicles (ELVs) (Mamat et al., 2014; Petronijević et al., 2020). As vehicles approach their end-of-life stage, their responsible disposal and recycling become paramount to minimize ecological impact and efficiently utilize valuable resources. In Malaysia, a nation marked by burgeoning industrialization and a thriving automotive sector, establishing an effective ELV management system faces significant challenges (Shameem Ahmed & Shamsuddin Ahmed, 2014).

With the rapid growth of Malaysia's automotive industry, the country witnesses an escalating number of ELVs reaching their end-of-life stage (Wang & Chen, 2011). ELVs encompass a diverse array of materials, including metals, plastics, glass, and hazardous substances, necessitating a holistic and environmentally conscious approach to their disposal. Mismanagement of ELVs can lead to far-reaching consequences, such as soil and water contamination, resource depletion, and adverse health effects on both humans and the ecosystem. Therefore, a well-structured and efficient ELV management system must address these challenges and promote sustainable waste management practices (Arora et al., 2019; Chaabane et al., 2021; Go et al., 2010).

Despite recognizing the significance of ELV management, Malaysia faces several barriers hindering its successful implementation (Wahab & Fadzil, 2014). A primary challenge is the lack of a comprehensive legislative framework dedicated explicitly to ELVs, resulting in unclear guidelines and roles among stakeholders. This lack of clarity impedes the establishment of an integrated ELV management system and hampers progress in meeting environmental goals.

Furthermore, limited awareness and public engagement present significant hurdles in sustainable waste management. Active public participation is instrumental in driving responsible ELV disposal practices, and a lack of awareness can lead to a suboptimal response from the community. Moreover, the scarcity of adequate infrastructure and facilities poses a significant obstacle to handling and recycling ELVs efficiently. Establishing proper ELV collection centers, dismantling facilities, and recycling plants is pivotal to ensuring the environmentally responsible management of end-of-life vehicles (Harun et al., 2021).

In addition, seamless collaboration among various stakeholders, including government bodies, automotive manufacturers, recycling industries, and the public, is critical in aligning efforts toward effective ELV management. The absence of robust coordination often results in fragmented approaches, hindering progress in achieving sustainable ELV disposal (Jawi et al., 2016; Mamat et al., 2015). Furthermore, informal and unregulated ELV disposal practices present a substantial challenge in managing ELVs sustainably. These practices contribute to environmental degradation and resource wastage, thwarting efforts to establish an efficient and eco-friendly ELV management system. Lastly, the lack of a centralized database for ELVs and related activities complicates monitoring and tracking ELV flows, which is essential for data-driven decision-making and effective policy formulation.

This paper provides a comprehensive analysis of the current state of ELV management in Malaysia, shedding light on the barriers that impede its successful implementation. By identifying these challenges, this study aims to raise awareness and foster collaborative efforts among stakeholders to overcome obstacles and establish a comprehensive and sustainable ELV management system in Malaysia. Addressing the barriers through collective action and responsible

waste management practices will pave the way for a greener and more environmentally conscious automotive industry, contributing to Malaysia's journey towards a sustainable future.

Literature review

End-of-Life Vehicle (ELV) management in Malaysia

The automotive industry's rapid growth in Malaysia has led to a significant increase in the number of End-of-Life Vehicles (ELVs) reaching their end-of-life stage. Effective ELV management is crucial to mitigate these discarded vehicles' environmental and health impacts and recover valuable resources. Various studies have explored the current state of ELV management in Malaysia, analyzing existing practices, identifying challenges, and highlighting potential solutions to improve the sustainability of ELV disposal and recycling in the country (Ali et al., 2023; Ismail et al., 2023).

One critical aspect addressed in the literature is the need for a comprehensive legislative framework and policy initiatives dedicated to ELVs. Scholars have examined the existing regulations and policy initiatives related to ELVs, emphasizing the importance of stakeholder engagement to ensure the successful adoption of sustainable practices. However, challenges in implementing these policies have also been highlighted, calling for more effective coordination among relevant stakeholders (Sitinja et al., 2022).

Another focus area in the literature is the environmental impact and health concerns associated with improper ELV disposal practices in Malaysia. Studies have analyzed soil and water contamination, air pollution, and the potential health risks to communities near informal dumping grounds. Understanding these impacts is critical in advocating for better ELV management strategies and creating awareness among stakeholders about the importance of responsible disposal (Sitinja et al., 2022).

The lack of adequate infrastructure for ELV collection and recycling has been a recurring issue in Malaysia. Scholars have examined the challenges various stakeholders face, including government agencies, automotive manufacturers, and recycling industries, in establishing efficient and environmentally sound ELV management systems. Studies have also assessed the potential for setting up organized collection centers and dismantling facilities to streamline the ELV recycling process and enhance resource recovery.

Extended Producer Responsibility (EPR) has been widely discussed as a potential solution for sustainable ELV management. Researchers have explored the implementation of EPR schemes in other countries and assessed their applicability in the Malaysian context. Additionally, studies have investigated the integration of ELV recycling into a circular economy framework, emphasizing the importance of resource recovery and waste reduction.

Public awareness and active participation are crucial for successful ELV management. Scholars have examined public perceptions of ELV disposal practices, knowledge about recycling options, and willingness to engage in sustainable behaviors. Studies have proposed strategies to enhance public awareness campaigns and encourage responsible ELV disposal practices among vehicle owners (Chong et al., 2023; Wong et al., 2018).

Technological advancements in ELV recycling have also been a focus of the literature. Researchers have explored innovative techniques, such as auto shredding, material separation, and chemical recycling, to maximize the value of ELV components and minimize waste. Evaluating

the feasibility and efficiency of these technologies is essential for shaping the future of ELV recycling in Malaysia.

End-of-Life Vehicle (ELV) management in Malaysia underscores the significance of sustainable practices in addressing the growing environmental challenges that discarded vehicles pose. By understanding the existing legislative framework, ecological impacts, difficulties in collection and recycling, and potential solutions, stakeholders can develop a comprehensive strategy to improve ELV management practices in Malaysia. This review emphasizes the importance of stakeholder collaboration, public awareness, and technological advancements to transition towards a more sustainable and eco-friendlier ELV management system.

Challenges in Implementing Sustainable ELV management in developing countries

Implementing End-of-Life Vehicle (ELV) management in developing countries faces several barriers that hinder establishing effective and sustainable practices. These barriers can vary depending on the country's specific context and level of development. One of the primary barriers is the lack of a comprehensive legislative framework dedicated to ELV management. Developing countries may have inadequate or outdated regulations, making it challenging to address the complexities of ELV disposal and recycling. The absence of clear guidelines and policies can result in fragmented efforts and hinder the establishment of an integrated ELV management system (Chong et al., 2022).

Additionally, developing countries often lack the necessary infrastructure and facilities for proper ELV collection, dismantling, and recycling. The absence of organized collection centers and recycling facilities makes handling and recycling ELVs efficiently difficult. This lack of infrastructure contributes to informal and hazardous disposal practices, leading to environmental pollution and resource wastage.

Moreover, implementing advanced technologies for ELV recycling may be limited in developing countries due to financial constraints and technological barriers. Lack of access to cutting-edge technologies can hinder the efficient recovery of valuable materials from ELVs and progress toward sustainable waste management (Arnold et al., 2021; Li et al., 2014). ELV management requires significant financial investment, which can challenge developing countries with limited resources. Establishing and maintaining an efficient ELV management system requires funding for infrastructure development, public awareness campaigns, and technological upgrades, which may strain the financial capacities of these countries (Ohno et al., 2017).

In addition, public awareness about the importance of responsible ELV disposal and recycling may be low in developing countries. The lack of education and outreach efforts can result in low public participation in sustainable waste management practices, leading to increased informal dumping and improper disposal of ELVs. In some developing countries, the informal sector may play a significant role in ELV recycling. While this sector can contribute to resource recovery, it often operates without proper regulations and environmental standards, leading to health hazards and pollution.

Effective ELV management requires collaboration and coordination among various stakeholders, including government agencies, automotive manufacturers, recycling industries, and the public. In developing countries, fragmented efforts and a lack of coordination among these entities can hinder progress toward a holistic and integrated ELV management system. Even if regulations exist, enforcement can be challenging in developing countries due to limited resources

and capacity (Sitinjak et al., 2006). Weak enforcement of existing rules can lead to non-compliance and improper ELV disposal practices.

Addressing these barriers requires a multi-faceted approach involving stakeholder collaboration, capacity-building, public awareness campaigns, and access to technology and financial resources. Developing countries can learn from successful ELV management practices in other regions and adapt strategies to suit their specific contexts and challenges. By overcoming these barriers, developing countries can pave the way for sustainable and environmentally responsible ELV management practices that contribute to a greener and healthier future.

Method and study area

Research design

The qualitative approach was employed to understand the challenges and barriers faced in implementing sustainable End-of-Life Vehicle (ELV) management in developing countries. This research design allowed for a comprehensive exploration of the complexities and nuances associated with ELV management, providing valuable insights into the perspectives and experiences of key stakeholders involved in the process.

Data collection

Data collection for this study involved semi-structured interviews and focus group discussions. Semi-structured interviews were conducted with relevant experts, policymakers, representatives from automotive industries, recycling companies, and governmental agencies engaged in ELV management. Focus group discussions were organized with community members and individuals directly impacted by ELV disposal and recycling practices. The data collected through interviews and focus group discussions facilitated a comprehensive understanding of the challenges from various perspectives.

Sampling

Purposive sampling was used to select participants with substantial knowledge and experience in ELV management in developing countries. The participants were selected based on their roles and expertise, ensuring diverse perspectives were represented in the study. Additionally, efforts were made to include participants from various regions to capture regional variations and unique challenges faced in different settings (see Table 1).

Table 1. Table of respondents

Respondent ID	Stakeholder category	Role
R001	Expert	Environmentalism
R002	Policymaker	Government official
R003	Industry representative	Automotive manufacturer
R004	Community member	Local resident
R005	Expert	Waste management specialist
R006	Policymaker	Environmental agency official
R007	Industry representative	Scrap yard owner

R008	Community member	Environmental NGO member
R009	Expert	Recycling technologist
R010	Policymaker	Local council member

Data analysis

Thematic analysis was utilized to analyze the qualitative data collected through interviews and focus group discussions. The data analysis process involved several stages, including familiarization with the data, generating initial codes, identifying themes, and refining the themes. The pieces were systematically organized and interpreted to extract meaningful insights regarding the barriers to sustainable ELV management in developing countries.

Validity and reliability

Various measures were implemented to ensure the study's validity and reliability. Firstly, triangulation was employed by utilizing multiple data sources, such as interviews and focus group discussions, to enhance the robustness of the findings. Secondly, member checking was conducted by presenting the preliminary results to some participants to verify the accuracy and credibility of the data. Furthermore, detailed descriptions and precise documentation of the research process were maintained to facilitate the transferability of the study findings to other contexts.

Ethical considerations

Ethical guidelines were strictly adhered to throughout the research process. Informed consent was obtained from all participants, ensuring their voluntary participation and confidentiality. Participants were assured of their right to withdraw from the study at any stage without any repercussions. Additionally, all data collected were securely stored and anonymized to protect the identity and privacy of the participants.

Results and discussion

The qualitative approach of semi-structured interviews and focus group discussions provided in-depth insights into the challenges and barriers faced in implementing sustainable End-of-Life Vehicle (ELV) management in developing countries. Thematic analysis of the data collected from key stakeholders involved in ELV management revealed prominent themes that shed light on the complexities of the process and the obstacles encountered in managing ELVs responsibly.

One primary challenge the participants highlighted was the inadequate legislative framework dedicated to ELV management. They emphasized the need for precise and up-to-date regulations to guide the proper disposal and recycling of ELVs. A respondent commented, "The lack of a comprehensive policy framework makes it difficult to address the increasing number of ELVs in our country. We need stronger regulations to ensure responsible management."

Another significant barrier was the limited infrastructure and facilities for ELV collection, dismantling, and recycling. Participants pointed out the lack of organized collection centers and recycling facilities as a significant obstacle. One respondent stated, "We lack the necessary infrastructure to handle the growing volume of ELVs. This results in haphazard disposal practices and poses environmental risks."

Financial constraints emerged as a considerable hindrance to sustainable ELV management. Participants stressed the need for financial resources to implement advanced technologies and optimize resource recovery. A participant mentioned, "Investing in modern recycling technologies requires significant funding, often beyond our budget. Without adequate financial support, improving our recycling capabilities is challenging."

Technological limitations were also a barrier, impacting the effective recovery of valuable materials from ELVs. Participants expressed the need for access to advanced recycling technologies to minimize waste generation. One respondent shared, "We lack the advanced equipment needed to efficiently extract valuable materials from ELVs. Embracing cutting-edge technologies would significantly enhance our recycling efforts."

Public awareness and engagement were identified as crucial aspects of sustainable ELV management. Participants expressed concerns about the lack of public awareness regarding the environmental impact of improper ELV disposal. A respondent emphasized, "Many people are unaware of the adverse consequences of improper ELV disposal. We need targeted awareness campaigns to educate the public and promote responsible disposal practices."

Additionally, the study revealed the need for improved coordination and collaboration among stakeholders involved in ELV management. Participants stressed the importance of seamless cooperation between government agencies, automotive manufacturers, recycling industries, and the informal sector. One respondent highlighted, "Efficient ELV management requires all stakeholders to work together. Collaborating with various entities will facilitate establishing a more integrated and effective system".

Swot analysis for End-Of-Life Vehicle (ELV) management in Malaysia

The SWOT analysis reveals critical points that significantly influence End-of-Life Vehicle (ELV) management prospects in developing countries. Firstly, the increasing awareness of environmental issues within the automotive industry is a strength, providing a foundation for sustainable ELV management efforts. This heightened consciousness opens doors to explore innovative solutions and garner support for responsible waste management practices.

However, the lack of a comprehensive legislative framework and limited infrastructure are pressing weaknesses. Without clear regulations and guidelines, developing countries struggle to establish efficient ELV collection and recycling systems, hindering progress toward sustainable management practices. Financial constraints and technological limitations also pose significant barriers, impeding investments in advanced recycling technologies and optimizing resource recovery.

Amidst these challenges, opportunities for improvement arise from collaboration and knowledge sharing with developed nations. Utilizing international support, developing countries can enhance their ELV management practices by adopting successful strategies and approaches from more advanced systems. Furthermore, the growing demand for recycled materials presents a valuable opportunity to promote resource recovery and embrace circular economy practices, which can lead to economic and environmental benefits.

However, threats loom in the form of improper ELV disposal practices and escalating waste generation from the automotive industry. These practices contribute to environmental pollution, escalating the urgency to implement effective ELV management measures. Moreover, the lack of coordination among stakeholders poses a critical threat to successful implementation. Without seamless collaboration between government agencies, manufacturers, recycling

industries, and the informal sector, establishing an integrated and sustainable ELV management system remains challenging. Furthermore, limited enforcement of existing regulations undermines efforts to curb hazardous disposal practices and ensure compliance.

SWOT analysis underscores the importance of addressing critical points in developing countries ELV management strategies (see Table 2). Leveraging the increasing environmental awareness and exploring technological advancements offers promising avenues for sustainable solutions. However, overcoming weaknesses related to legislative gaps and inadequate infrastructure while tackling financial and technical limitations requires strategic planning and investment. Collaborating with developed countries can offer valuable insights and opportunities for progress, and focusing on the growing demand for recycled materials presents a path to economic and environmental gains. To mitigate threats posed by improper disposal practices and lack of coordination, concerted efforts are necessary to enforce regulations and foster stakeholder cooperation. By acknowledging and acting upon these critical points, developing countries can pave the way for more efficient, environmentally responsible, and sustainable ELV management practices.

Table 2. SWOT analysis

Strengths	Weaknesses
Growing awareness of environmental issues and sustainability in the automotive industry	Lack of comprehensive legislative framework dedicated to ELV management
Potential for technological advancements in ELV recycling	Limited infrastructure and facilities for proper ELV collection and recycling
Emerging opportunities for resource recovery and circular economy practices	Financial constraints in investing in advanced recycling technologies
Increased public interest in responsible waste management practices	Technological limitations inefficient resource recovery from ELVs
Access to international support and knowledge sharing on sustainable waste management	Insufficient public awareness and engagement in ELV disposal
Opportunities	Threats
Potential for collaboration and knowledge exchange with developed countries	Improper ELV disposal practices leading to environmental pollution
Growing market demand for recycled materials	Increased waste generation from the automotive industry
Advancements in recycling technologies and material recovery processes	Lack of coordination among stakeholders in ELV management
Integration of ELV recycling into a circular economy framework	Limited enforcement of existing regulations
Policy incentives and funding support for sustainable waste management	Limited financial and technological resources for ELV management

Conclusion

The study has provided valuable insights into End-of-Life Vehicle (ELV) management challenges and opportunities in developing countries. The SWOT analysis highlighted critical points that significantly impact the progress of sustainable ELV management practices. Developing countries have the advantage of a growing awareness of environmental issues in the automotive industry, which opens opportunities for implementing responsible waste management strategies. The

potential for technological advancements and resource recovery offers promising prospects for efficient ELV recycling.

However, several barriers were identified, including lacking a comprehensive legislative framework and limited ELV collection and recycling infrastructure. Financial constraints and technological limitations further impede progress in achieving sustainable ELV management. The threats posed by improper ELV disposal practices and increasing waste generation underscore the urgency to address these challenges. Additionally, the lack of coordination among stakeholders and limited enforcement of regulations poses a significant obstacle to establishing an integrated and effective ELV management system.

Despite these challenges, the study has identified several opportunities for improvement. Developing countries can leverage collaboration and knowledge sharing with developed nations to enhance their ELV management practices. Embracing the growing market demand for recycled materials can lead to economic and environmental benefits, encouraging resource recovery and circular economy practices.

Limitations

This study's findings are subject to limitations that should be considered when interpreting the results. Firstly, the research was conducted in a specific region, and the challenges and opportunities may vary in developing countries. Additionally, the qualitative approach focused on gaining insights from key stakeholders, but the perspectives of other relevant parties, such as consumers and informal sector workers, could further enrich the understanding of ELV management challenges.

Future studies

To build upon the current research, future studies could explore in-depth case studies of specific developing countries to understand their unique challenges better. Comparative studies between developing and developed countries may also provide valuable insights into successful ELV management strategies that could be adapted to suit specific contexts.

Furthermore, quantitative studies could complement the qualitative findings by providing statistical data on ELV generation rates, recycling rates, and environmental impacts. Understanding the economic and ecological costs associated with improper ELV disposal and the potential benefits of sustainable ELV management could inform policymakers and industry stakeholders.

Moreover, future studies could delve into the social and behavioural aspects of ELV management, exploring consumer attitudes and behaviours toward responsible disposal practices. Understanding public awareness and engagement in developing countries can help design targeted awareness campaigns to promote accountable ELV disposal.

Addressing the critical points highlighted in this study is essential to foster sustainable and environmentally responsible ELV management practices in developing countries. By leveraging strengths and opportunities while mitigating weaknesses and threats, stakeholders can collaboratively work towards building an integrated and efficient ELV management system that contributes to a greener and more sustainable future. Embracing future research directions can further enhance the understanding of ELV management challenges and inform evidence-based solutions for a more sustainable automotive industry.

Ethical approval

This research study has obtained ethical consent from the Jawatankuasa Etika Penyelidikan (JEP) Universiti Kebangsaan Malaysia with code UKM-PPI/111/8/JEP-2023-113.

Acknowledgement

This research was sponsored by the Ministry of higher education, Malaysia, and the University Kebangsaan Malaysia, via the Transdisciplinary Research Grant Scheme project (TRGS/1/2020/UKM/02/1/2).

References

- Ali, H. M., Simic, V., Sitinjak, C., Hassim, J. Z., Said, M. H. M., Khalid, R. M., Kaka, G. E., & Ismail, R. (2023). Exploring Public Perceptions and Disposal Procedures in the Development of a Comprehensive End-of-Life Vehicle Regulation in Malaysia: A Pilot Study. *Sustainability*, *15*(6), 4786.
- Arnold, M., Pohjalainen, E., Steger, S., Kaerger, W., & Welink, J. H. (2021). Economic viability of extracting high value metals from end-of-life vehicles. *Sustainability*, *13*(4), 1902.
- Arora, N., Bakshi, S. K., & Bhattacharjya, S. (2019). Framework for sustainable management of end-of-life vehicles management in India. *Journal of Material Cycles and Waste Management*, *21*(1), 79–97.
- Chaabane, A., Montecinos, J., Ouhimmou, M., & Khabou, A. (2021). Vehicle routing problem for reverse logistics of End-of-Life Vehicles (ELVs). *Waste Management*, *120*, 209-220.
- Chong, J. Y., Mat Saman, M. Z., & Ngadiman, N. H. A. (2022). Critical enablers and inhibitors for economic sustainability in the supply and demand of end-of-life vehicles in Malaysia: A swot analysis. *Journal of Material Cycles and Waste Management*, *25*, 3048-3064.
- Chong, J. Y., Mat Saman, M. Z., & Ngadiman, N. H. A. (2023). End-of-life vehicles research development in Malaysia: a comprehensive review with the integrated conceptual model of innovative sustainable manufacturing elements. *Journal of Material Cycles and Waste Management*, *25*, 698-716.
- Go, T. F., Wahab, D. A., Rahman, M. N. A., & Ramli, R. (2010). A design framework for end-of-life vehicles recovery: Optimization of disassembly sequence using genetic algorithms. *American Journal of Environmental Sciences*, *6*(4), 350-356.
- Harun, Z., Nizam Che Kasim, A., Mat Hashim, N., & Azuan Hashim, N. (2021). Techno-Economic Readiness and Acceptance Analysis Study of End-of-Life Vehicles (ELV) Implementation in Malaysia. Virtual Conference on Computational and Experimental Mechanics (VCCEM 2021).
- Ismail, R., Sitinjak, C., Tahir, Z., Che Rose, R. A., Mat Yazid, M. R., Harun, Z., & Suparjo Noordin, N. A. (2023). A model analysis on the knowledge, attitude, and readiness of ELVs policy among Malaysians: A cross-sectional study. *Frontiers in Built Environment*, *8*.

- Jawi, Z. M., Isa, M. H. M., Solah, M. S., Ariffin, A. H., Shabadin, A., & Osman, M. R. (2016). The future of end-of-life vehicles (elv) in Malaysia - A feasibility study among car users in Klang valley. *MATEC Web of Conferences*, 90.
- Li, J., Yu, K., & Gao, P. (2014). Recycling and pollution control of the End of Life Vehicles in China. In *Journal of Material Cycles and Waste Management*, 16, 31-38.
- Mamat, T. N. A. R., Saman, M. Z. M., & Sharif, S. (2014). The need of end-of-life vehicles management system in Malaysia. *Advanced Materials Research*, 845, 505-509.
- Mamat, T. N. A. R., Saman, M. Z. M., & Sharif, S. (2015). A Survey Instrument Design to Determine the Success Factors in Implementing the End-of-Life Vehicles (ELVs) Management System in Malaysia. *Advanced Materials Research*, 1125, 620-624.
- Ohno, H., Matsubae, K., Nakajima, K., Kondo, Y., Nakamura, S., Fukushima, Y., & Nagasaka, T. (2017). Optimal Recycling of Steel Scrap and Alloying Elements: Input-Output based Linear Programming Method with Its Application to End-of-Life Vehicles in Japan. *Environmental Science and Technology*, 51(22), 13086-13094.
- Petronijević, V., Đorđević, A., Stefanović, M., Arsovski, S., Krivokapić, Z., & Mišić, M. (2020). Energy recovery through end-of-life vehicles recycling in developing countries. *Sustainability*, 12(21), 8764.
- Shameem Ahmed, Shamsuddin Ahmed, Md. R. H. S. and M. A. Q. (2014). End-of-Life Vehicles (ELVs) Management and Future Transformation in Malaysia. *Journal of Applied Science and Agriculture*, 9(18), 227–237.
- Sitinjak, C., Ismail, R., Bantu, E., Fajar, R., & Samuel, K. (2022). The understanding of the social determinants factors of public acceptance towards the end of life vehicles. *Cogent Engineering*, 9(1).
- Sitinjak, C., Ismail, R., Bantu, E., Fajar, R., & Simanullang, W. F. (2022). Study of Public Perception Toward End-of-Life Vehicles (ELV) Management in Indonesia. *International Journal of Sustainable Development and Planning*, 17(4), 1341-1347.
- Wahab, D. A., & Fadzil, Z. F. (2014). Public Community Knowledge on Reuse of End-of-Life Vehicles: A Case Study in an Automotive Industrial City in Malaysia. *Journal of Applied Sciences*, 14(3), 212-220.
- Wang, J., & Chen, M. (2011). Recycling of electronic control units from end-of-life vehicles in China. *JOM*, 63, 42-47.
- Wong, Y. C., Al-Obaidi, K. M., & Mahyuddin, N. (2018). Recycling of end-of-life vehicles (ELVs) for building products: Concept of processing framework from automotive to construction industries in Malaysia. *Journal of Cleaner Production*, 190, 285-302.
- Zameri, M. M. S., & Blount, G. N. (2006). End of life vehicles recovery : Process description, its impact and direction of research. *Jurnal Mekanikal*, 21, 40-52.