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ELV Policy and Management System in Malaysia: Exploratory Study of Dynamics, Rationale and Opportunity through Digitalised Public Services

(Dasar dan Sistem Pengurusan ELV di Malaysia: Kajian Eksplorasi Dinamik, Rasional dan Peluang melalui Perkhidmatan Digital Awam)

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ABSTRACT

A sustainable end-of-life vehicle (ELV) management system requires a well-thought and well-designed process covering strategies, regulations, technologies, and future adaptive systems. Among others is the urgent need for feasible implementation of the integrated vehicle deregistration process, especially to kickstart the process for registered abandoned vehicles (approximately eight million units nationwide in 2018). In line with this aspiration, this study will explore the dynamics, rationale, and opportunity for public services to have a unified digitisation platform. This initiative will integrate networks of public (e.g., Ministry of Transport, Ministry of Housing and Local Government, Ministry of Environment and Water, Local councils, Road and Transportation Department, courts, Royal Malaysian Police), industry (e.g., authorised automotive treatment facilities (AATF), scrapyards) and other related parties. Those entities are critical to developing local ELV management system capacity to address current complex problems and achieve collective goals for the future automotive industry in Malaysia. Based on the Focus Group Discussion (FGD) outputs, literature survey, and relevant proposed frameworks, this study aims to enlighten policymakers on the necessity of having an integrated system in supporting various business, legal and administrative needs of the sustainable ELV Policy in Malaysia.

Keywords: End-of-life Vehicle (ELV); deregistration; public policy; digital transformation

INTRODUCTION

We are looking at advances in digital technology in recent years, which created a wealth of opportunities, especially in policy-making. This research will outline an overview of recent technological developments, where the main opportunities lie, and highlight the key challenges. The sensitivity of the ELV policy and imperative outcomes from the policy would be the key considerations. This research proposes that setting out how the government might do so through the streamlined process (as proposed for the deregistration of the vehicle) will be a significant kickstart for a sustainable ELV ecosystem in Malaysia. Furthermore, with more and better data available around us and dramatic improvements in connectivity and communication, ELV policy should be better informed, more rigorously tested, more collaborative, and more responsive to external events (public participation).

The public sector needs to leverage digitalisation and internet of things (IoT) technology, and this scenario offers tremendous opportunities for various institutional applications. They are predominantly about information gathering (data collection, data sanity) and policy implementation to establish resilience for modern society. In this context, this study aims to investigate the motivational factors that can positively influence the continuous and expansion usage intention of digital services, especially regarding the ELV policy in Malaysia. Thus, adapting the digitalisation technology and operation is very pertinent, considering Malaysia's proposed ELV management system falls under several jurisdictions by different Ministries (Harun et al. 2021; Jawi et al. 2016). The details regarding the ELV management system important for dissemination among governmental entities, industry stakeholders, and affiliated parties and crucial for several critical purposes within the context of ELV management (D'Adamo et al. 2020; Karagoz et al. 2020; Soo et al. 2021).

These parties in the ecosystem are now in the need for "embracing digital," and actively incorporating digital technologies and processes at a more profound level within their structures (Amorós et al. 2019; Lloyd, 2020). Despite the strides made, there remains a necessity for further efforts to authentically "embody digital". As government organizations advance to this stage, they will need to harness technologies such as artificial intelligence (AI), cybersecurity, and cloud computing to enhance the human experience and instigate a profound overhaul of both service delivery and backend operations. At the core of digital transformation lies the transition from sporadic digital applications to strategically designing and implementing digital technologies that become ingrained across the organization, forming a part of its fundamental makeup.

Prior to the pandemic, government agencies were primarily engaged in "digital activities," which involved leveraging digital technologies to enhance their capabilities while still relying on traditional operational models. However, the outbreak of COVID-19 propelled many government entities into the subsequent phase of digital transformation. A substantial 77% of government agencies acknowledge that the digital transformation initiatives undertaken during the pandemic have already yielded positive impacts on their organizational functioning (Ben-Zvi & Luftman, 2022). Administrative regulations from different government agencies must be streamlined and integrated for efficiency and a sustainable ELV management system (Sitinjak et al. 2022). From our research, government agencies must be digital-first, flexible, and responsive to address current industry requirements' changing needs and expectations. Siloed (different jurisdictions), legacy systems cannot support needed agility but pose a greater risk and increased challenges for data sharing and service delivery (Aagesen & Krogstie, 2011; Arnold et al. 2021; Correia, 2005; Numfor et al. 2021).

From the industry perspective, well-thought and well-designed sustainability ELV ecosystem(s) will assist companies. Companies increase their revenues through various cost-savings, eliminating the issues of going concerned and mitigating possible risks (Krishna Mohan & Amit, 2020; Numfor et al. 2021; Rovinaru & Rovinaru, 2019). Creating a sustainable entity includes various transformation agendas, pertinently on the entire value chain in a structured remanufacturing process (Li et al. 2020; McWilliam et al. 2019; Soo et al. 2021). The ELV value chain involves the process from the supply of materials to product extraction technology, engineering-related operations, creative branding and marketing, and efficient ELV management (Molla et al. 2023). As a solution to the complex value chain, digital technologies offer the potential to transform how the government makes policy and help to tackle the challenges ahead. This article will be divided into chapters as follows: i) Introduction ii) Methodology iii) Discussion, and iv) Conclusion.

METHODOLOGY

SELECTIVE LITERATURE REVIEW

Through selective literature review, we investigate public services' motivational and intentional factors to onboard digitalisation as a platform for the ELV ecosystem. We use a selective literature review based on the current vehicle life cycle and ELV framework. This process produces a convergence of perspectives from digitalisation, public services delivery, functions, and policy-making process to provide the foundation for the dynamics model building. This process is also essential to ensure rigour as the research design's strength and the method's appropriateness to answer the questions in a qualitative study (Cypress, 2017; Gioia et al. 2013; Snyder, 2019).

The model in Figure 1 illustrates the dynamic nature of the environment in which government services are provided by identifying core contributors to changes in service delivery and how these interrelate. From the selected literatures together with the comprehensive review explores the dynamics of government service delivery involves several systematic steps to ensure the inclusion of relevant and impactful studies. This process is crucial for developing a robust understanding of the subject matter and uncovering the various factors that influence government service delivery dynamics. Based on the

dynamics model, our study will explain how digitalisation will support the ELV ecosystem and how this model motivates further research. By leveraging digital tools, Malaysia can embrace a more efficient and sustainable approach to ELV management, aligning with circular economy principles and contributing to broader environmental sustainability objectives.

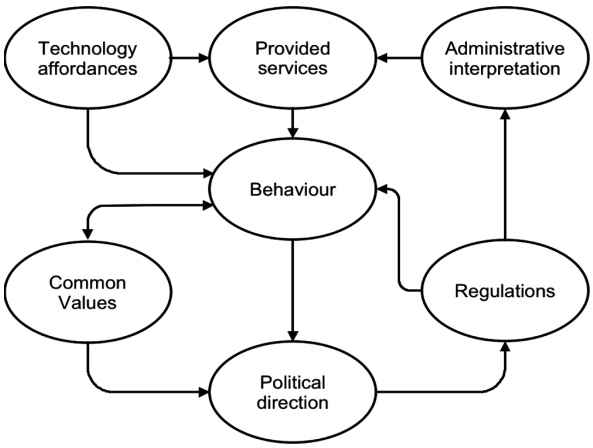

FIGURE 1. Dynamics of Government Service Delivery (Summary from this study)

FOCUS GROUP DISCUSSION (FGD)

This research also uses expert opinions through fact-gathering, and data analysis from a FGD conducted on 9 April 2021. This focus group study sheds light on the promising opportunities that digitalized public services present in augmenting Malaysia's End-of-Life Vehicle Policy and Management System. While acknowledging challenges related to data security and infrastructure, the findings underscore the potential of digital platforms to bolster ELV management through enhanced transparency, stakeholder collaboration, and informed decision-making. The insights garnered from this study provide a foundation for policymakers, industry stakeholders, and technology experts to collectively advance ELV management practices through the digitalization paradigm. The discussion also underscored the importance of educational initiatives in tandem with digitalization. Participants recognized the potential of digital platforms to serve as hubs of information, raising public awareness on responsible ELV disposal practices and the broader benefits of recycling. This aspect aligns with Malaysia's commitment to fostering environmental literacy and aligning policies with sustainable development goals. The benefits of digitalization were prominently featured in the discourse.

Participants recognized the capacity of digital solutions to enhance transparency, accountability, and efficiency in ELV management. Real-time monitoring and reporting mechanisms were highlighted as potent tools to identify non-compliant practices and expedite enforcement measures. Furthermore, the data-driven insights garnered from digital platforms could inform evidence-based policy adjustments and long-term planning strategies. Stakeholder collaboration also emerged as a cornerstone for successful digitalization. Participants emphasized the need for harmonious engagement between government bodies, automotive manufacturers, recycling facilities, and technology providers.

This collaborative approach as highlighted during the FGD, often facilitated through public-private partnerships, was deemed instrumental in overcoming implementation barriers and achieving optimal outcomes. The discussion also underscored the importance of educational initiatives in tandem with digitalization. Participants recognized the potential of digital platforms to serve as hubs of information, raising public awareness on responsible ELV disposal practices and the broader benefits of recycling. This aspect aligns with Malaysia's commitment to fostering environmental literacy and aligning policies with sustainable development goals.

RESULTS AND DISCUSSION

Rapid technological advances and how it has moved on, and in some areas, were quite dramatic, but the policy-making process is still lagging in many ways. From the perspective of policy-making, the make of a reasonable policy remains the same: it is an intervention that achieves the intended outcomes at an acceptable cost and with manageable consequences in a way that proves to be politically sustainable (Brenner & Broekel, 2019; Hanberger, 2001; Lloyd, 2020; Zhang et al. 2020). Using the model for the Dynamics of Government Service Delivery illustrated from the Figure 1, the summary of the opportunities of utilising digital technology based on the dynamics of public services are proposed and presented below in Table 1.

This framework presents a comprehensive analysis of the various dynamics, rationales, and opportunities discussed in the focus group regarding the enhancement of ELV policy effectiveness through the integration of digitalized public services. Each dynamic highlights a specific challenge in policy formulation and implementation, followed by the rationale for addressing it. The corresponding opportunities through digitalization are then outlined to harness the potential of advanced technologies and public engagement to overcome these challenges. The structured table offers a clear overview of the strategies

that can be employed to optimize the ELV policy and management system, guiding policymakers, industry stakeholders, and technology experts toward a more effective and sustainable approach.

TABLE 1. Factors Influencing Effective Policy Implementation and Digitalization Opportunities (Summary by this study)

Dynamic(s)	Rationale	Opportunity (Digitalization)
Political Direction	Many policies fail due to inadequate problem analysis and unclear objectives.	Utilizing data and advanced analysis provides policymakers with a better understanding of policy issues. Enhanced communication of decision outcomes to implementation specialists is facilitated through digitalization.
Regulations	Policy failure often results from practical implementation challenges.	Policy testing through simulations and experimentation is amplified in the digital realm. Increased public involvement and co-design opportunities are enabled by digital platforms.
Administrative Interpretation	Understanding the interaction of policy components aids intervention determinations.	Effective policy system monitoring and modeling are enhanced through digital tools for informed intervention.
Technology Affordances	Hasty rejection of options and incomplete appraisal are common pitfalls. Ignoring secondary costs and benefits during appraisal can occur.	Advanced modeling and simulations enable thorough evaluation of a broader array of impacts within appraisals. Digital platforms help in accounting for second-round impacts, contributing to a more comprehensive appraisal.
Provided Services	Monitoring policy impacts and making necessary adjustments are pivotal.	Understanding the interaction of policy components aids intervention determinations. The digital space allows rapid capture of real-time information from a wide range of sources for effective monitoring.
Behaviour	Inadequate consideration of public attitudes and reactions is a concern.	Engaging a diverse stakeholder spectrum, including the public, is facilitated through digital involvement.
Common Value	Relying solely on internal development hinders leveraging external expertise.	Digital platforms enable the identification of a broader array of expertise and relevant resources. The digital landscape encourages broader solicitation of evidence and ideas for well-informed policy development.

In the above table, we explore the dynamics influencing effective policy implementation and how digitalization offers opportunities to address and enhance these dynamics. These factors shed light on the rationale behind policy outcomes and how digital tools and platforms can optimize various aspects of policy design, execution, and evaluation.

The framework to be develop for enhancing policy effectiveness through digitalized public services in the context of ELV management is underpinned by a logical progression of principles. It recognizes that policies often falter due to inadequate problem analysis and unclear objectives, suggesting that data-driven insights offered by digital tools can provide a more comprehensive understanding of the issue. This approach aligns with the need to communicate decisions effectively to those responsible for implementation. In terms of regulations, recognizing that practical challenges can undermine policy execution, the framework suggests the utilization of digital platforms for extensive testing, alongside co-design with the public, which can enhance the feasibility of policy implementation. Furthermore, it acknowledges the importance of aligning government

agencies' roles correctly, pointing to digital tools' potential to enhance monitoring and modeling, aiding the identification of optimal intervention points. The framework also addresses the tendency to dismiss valuable options early and overlook secondary impacts, proposing that digital technology's modeling and simulation capabilities can provide a broader perspective.

In terms of behavior and public engagement, the framework promotes involving stakeholders in policy development through digital platforms, addressing the oversight of public attitudes and reactions that can hinder policy success (Chong et al. 2023; Hanberger, 2001; Mintrom & Luetjens 2016). Lastly, recognizing the need for external expertise, the framework suggests that digital tools can facilitate the identification and inclusion of diverse knowledge sources through enhanced searches and calls for evidence. Overall, this logical and systematic approach harnesses digitalization's potential to overcome policy challenges and create more effective and adaptable policies for ELV management, thus contributing to environmental sustainability and a circular economy transition. Although digitalisation is perceived to provide solutions, various systemic obstacles to effective policy-making persist. Policy solutions are too often developed without a proper understanding of the problem, resulting in a higher chance of failing and fulfilling their intended objective. In the worst-case scenario, as evidenced during the preliminary introduction of ELV policy, it even backfired. While the impact of interventions is always challenging to predict, the government does not help itself, often failing to test options rigorously. Furthermore, policies are rarely evaluated after implementation to enable iteration or inform future work, these prompt the need of addressing the gaps as explained in the following sections.

ADDRESSING GAPS IN PUBLIC SERVICE DELIVERY

TABLE 2. Ministry and Acts governing proposed ELV management system in Malaysia (Summary by this study)

Ministry	Gazetted Act(s)	Jurisdictions
Ministry of Transport (MOT)	Road Transport Act 1987 (Act 333)	Deregistration process
Ministry of Housing and Local Government (KPKT)	Local Government Act 1976 (Act 133) Street, Drainage and Building Act 1974	Power to remove abandoned vehicles
Ministry of Environment and Water (KASA)	Environmental Quality Act 1974 (Scheduled Waste and Hazardous Waste Management) Solid Waste and Public Cleansing Management Act 2007	Schedule waste License issuance for AATF
Ministry International Trade and Industries (MITI)	NAP 2020	Introducing AATF in the ecosystem

Many governmental entities exhibit a preference for operating autonomously, leading to potential hindrances in digital initiatives as indicated by the dynamics model's outcomes. To address this challenge, a solution is proposed at the highest echelons of government: the identification of a singular agency responsible for formulating strategies and allocating roles, thereby assuming the role of an industry champion. This process of centralization aims to resolve the issue of overlapping legal jurisdictions that previously impeded progress. To enhance public service delivery through digital platforms, dynamic interactions between various ministries and agencies as summarized in Table 2 are crucial and proposed cross functions and collaboration are proposed as follow:

Data Sharing and Integration: Ministries and agencies should share relevant data with each other to provide comprehensive services. For instance, the Ministry of Health can share health data with the Ministry of Education to improve school healthcare programs.

Interoperability: Digital platforms must be designed with interoperability in mind, allowing different systems to communicate seamlessly. This enables information exchange and collaboration between various ministries and agencies.

Cross-Agency Task Forces: Create task forces with members from different agencies to tackle complex issues that require multidisciplinary solutions. For instance, addressing environmental concerns may involve collaboration between the Ministry of Environment and Water and the Ministry of Transportation.

Standardization: Establish common standards and protocols for data sharing, cybersecurity, and digital identity verification. This ensures compatibility and security in digital interactions between ministries and agencies.

Unified User Experience: Develop a unified user interface and experience for citizens accessing government services online. This reduces confusion and enhances user satisfaction.

Service Coordination: Ministries and agencies should coordinate their services to provide a holistic approach to citizens' needs. For example, when a citizen registers a new business, they may also need services related to taxation, licenses, and employment.

Shared Digital Infrastructure: Invest in shared digital in-frastructure, such as a government cloud platform, to centralize data storage and processing. This enables agencies to access and utilize data more efficiently.

Data Governance Framework: Develop a data governance framework that outlines data ownership, access rights, and data sharing protocols. This ensures transparency and accountability in data management.

Interagency APIs: Implement Application Programming Interfaces (APIs) that allow ministries and agencies to securely exchange data and services. APIs should adhere to open standards for seamless integration.

Cross-Training and Skill Development: Promote cross-training programs for employees in different ministries and agencies to build a shared understanding of digital tools and methodologies.

Citizen Feedback Mechanisms: Establish feedback mechanisms to gather citizen input on digital services. This feedback can drive continuous improvement and help identify areas for collaboration.

Regular Collaboration Meetings: Organize regular meetings and workshops where representatives from ministries and agencies can discuss shared challenges, initiatives, and opportunities for collaboration.

Performance Metrics: Define key performance indicators (KPIs) to measure the effectiveness of digital service delivery and interagency collaboration. Regularly assess progress and make necessary adjustments.

By fostering dynamic interactions and collaboration between ministries and agencies, governments can streamline public service delivery, reduce redundancy, and provide citizens with more efficient and user-friendly digital services. This approach ultimately enhances the overall quality of public services. Concurrently, the role of public communication emerges as a pivotal element within the sphere of policy design and implementation. Effective communication serves not only as an informative conduit for the public but also assumes a pivotal role in garnering support for policies and facilitating the delivery of public services. Within the context of the government's channels for disseminating information, encompassing mediums such as broadcasting stations, radio platforms, and social media networks, citizens acquire insights into governmental actions and directives. This communication paradigm transcends mere information dispersal, evolving into a strategic tool endowed with profound implications for the success of policy initiatives, particularly those contingent upon achieving compliance and instigating shifts in societal behavior. In the realm of government operations, a prevailing inclination toward autonomous functioning can inadvertently impede the advancement of digital initiatives, a concern made evident by the outcomes derived from the dynamics model. To effectively address this challenge, a strategic proposition is introduced at the highest echelon of government. This proposition entails the identification of a singular agency entrusted with the responsibility of conceptualizing overarching strategies and allocating distinct roles. By adopting the role of an industry champion, this agency endeavors to streamline the intricate landscape characterized by overlapping legal jurisdictions, which has hitherto acted as an impediment to the progression of digital endeavors.

As of early 2024, there are more than 20 AATFs registered with JAS. More companies scattered throughout the country are preferred because of the increasing volumes of ELVS. In comparison, 5 years ago, there were merely 3 approved AATFs and only one was operating. Universiti Kebangsaan Malaysia works with one the AATFs and publishes selected emission tracking parameters online, as part of the digitalised information sharing platform. Typical emissions tracked at this AATF is CO2, particulate matter (PM) 2.5 and PM10 and published using UKM domain,https://www.ukm.my/zambri/Weather/Newwave.htm (Harun et al., 2022). The device is called the NewWave1. Other sensitive parameters such as noise, refrigerant leaks SO2, NO, NO2, CO, rains, wind speeds and directions are also tracked but not available online, however, requests for data-sharing can be made. The data facility and advanced data upload and storage using a cloud system make subsequent machine learning and emission prediction algorithm development possible. The data-sharing system has been shared with the stakeholders from the government, NGOs and private sectors.

In essence, the proposed dynamics interaction casts a spotlight on the intricate landscape of government operations, wherein an inclination toward independent functioning may inadvertently hinder the trajectory of digital progress. The proposed strategy of centralizing strategic responsibilities endeavors to ameliorate this challenge, fostering a more harmonized approach to digital pursuits. Furthermore, in acknowledgment of the pivotal role played by communication, the discourse underscores the strategic direction by which public consciousness, when tactically channeled through diverse media platforms, assumes the role of an enabler for effective policy implementation. This, in turn, not only molds behaviors but also creates an environment conducive to the accomplishment of policy objectives.

ADDRESSING GAPS IN POLICY COMMUNICATION

Effective and appropriate public communication stands as a critical pillar in supporting the formulation and execution of policies and public services. Furthermore, within the governmental framework, information dissemination channels such as broadcasting stations, radio platforms, and social media platforms serve as primary conduits through which citizens gain insight into governmental actions and adhere to its directives. This communication approach transcends mere awareness-raising; it emerges as a pivotal strategic tool facilitating policy implementation, particularly those dependent on compliance and behavioral shifts.

Organization for Economic Cooperation and Development (OECD) analytical framework for public communication gives a complete walk-through of proper public communication concerning policy making as illustrated in Figure 2. Policy-relevant evidence is crucial in today's social setting, with easy access to the current alternative media demanding proper communication concerning policy making. Policymakers can benefit from academic research in assessing socio-technical-economic challenges and proposing efficient countermeasures. Thus, having a functional communications network between researchers and policymakers is vital.

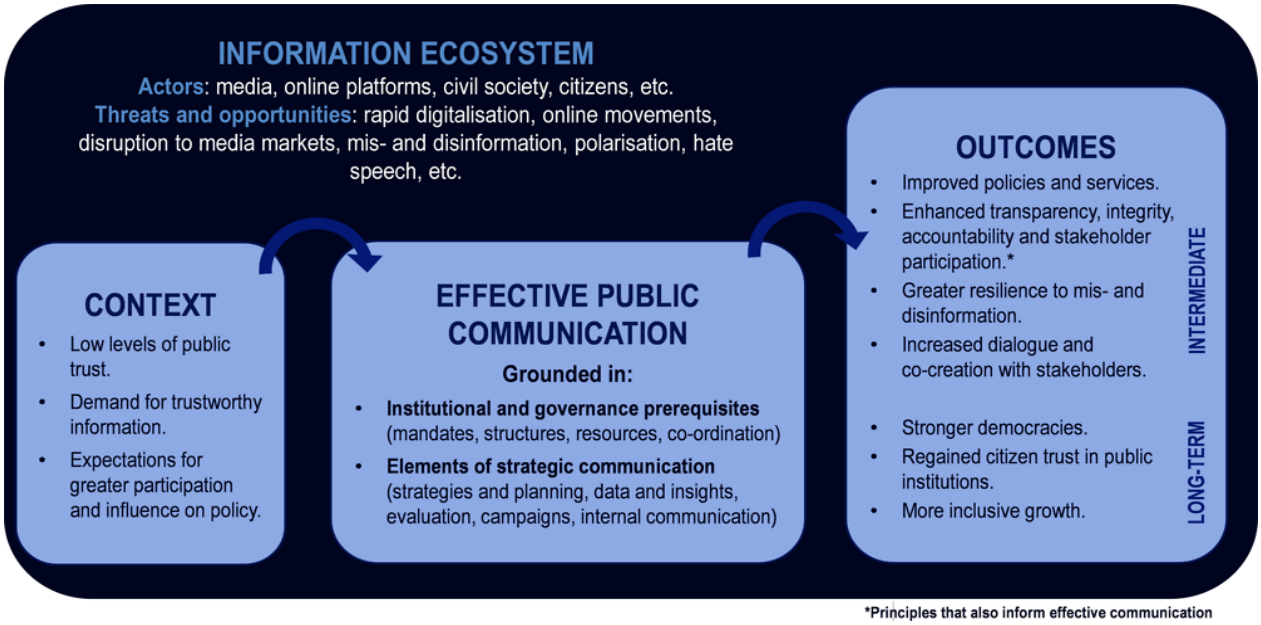

FIGURE 2. OECD analytical framework for public communication OECD (Garca Villarreal, 2010)

The information ecosystem in the realm of public service deliveries constitutes a dynamic and intricate network that plays a pivotal role in facilitating effective governance, enhancing citizen engagement, and optimizing service provision. This ecosystem encompasses the interconnected flow of information, technologies, stakeholders, policies, and processes that collectively shape the landscape within which public services are conceptualized, executed, and evaluated.

At its core, the information ecosystem revolves around the seamless exchange and utilization of data and information. Government agencies, service providers, citizens, and various other stakeholders contribute to and draw from this information reservoir. The ecosystem's architecture encompasses both traditional and digital platforms, ranging from official documents and publications to online portals and mobile applications. This amalgamation of channels ensures the broad accessibility and dissemination of information, enabling citizens to engage with government services, policies, and programs. One of the cornerstones of the information ecosystem is transparency. Modern governance places a significant emphasis on open access to information, fostering public trust and participation. Transparent information sharing empowers citizens to hold governments accountable, thereby nurturing a culture of democratic accountability. Through open data initiatives, governments release datasets for public scrutiny, enabling informed decision-making and innovative collaborations.

Technological advancements have reshaped the information ecosystem, introducing digital transformation as a powerful driving force. E-government initiatives have revolutionized service deliveries, rendering them more efficient, accessible, and user-centric. Online portals and mobile apps provide citizens with convenient platforms to access services, submit applications, and track the progress of their requests. This digitalization not only expedites processes but also enhances the overall citizen experience. Moreover, the information ecosystem extends beyond mere accessibility to encompass the utilization of data for evidence-based decision-making. Government agencies leverage data analytics to extract insights from large datasets, enabling more accurate policy formulation, resource allocation, and performance evaluation. Predictive analytics aids in anticipating trends and needs, facilitating proactive service delivery. Crucial to the success of the information ecosystem is the role of stakeholders, both within and outside the government. Collaboration and partnerships across sectors ensure a holistic approach to public service delivery. Civil society organizations, private sector entities, academia, and international organizations contribute diverse perspectives and expertise, enriching policy debates and fostering innovation.

Yet, challenges persist within the information ecosystem. Privacy concerns, data security, and the digital

divide are critical considerations. Ensuring the protection of sensitive information while promoting its accessibility is a delicate balance to strike. Bridging the digital divide by addressing disparities in internet access and digital literacy is essential to ensure equitable participation in the information age. Digital-first government entities transcend the mere integration of isolated technologies. To "be digital" entails a holistic convergence of technologies, culminating in a transformative synergy with the potential to bring about significant change. The journey toward achieving a digital government characterized by these attributes demands the resolution of intricate challenges. These challenges encompass domains such as privacy preservation, governance protocols, and the establishment of mechanisms for data sharing. It is imperative to underscore that the essence of "being digital" extends beyond the mere deployment of advanced technologies. Ultimately, the objective is to discern avenues for enhanced responsiveness to constituents' requirements. This involves the application of innovation, adept design principles, and digital tools to existing services, while simultaneously forging novel pathways for service delivery. The overarching goal is to not only optimize existing operations but also to create innovative modes of service provision, better aligned with the evolving needs and expectations of the citizenry.

In that vein, the information ecosystem in public service deliveries is a multifaceted network that drives governance in the digital era. By fostering transparency, enabling digital transformation, promoting data-driven decision-making, and encouraging collaboration, this ecosystem optimizes service deliveries, enhances citizen engagement, and strengthens democratic accountability. While challenges remain, the continual evolution of this ecosystem offers opportunities for governments to create more efficient, responsive, and inclusive public service systems. The characteristics of service delivery have a direct impact on the array of services extended by governments to their constituents. Thus,when ELV policy can be communicated effectively to the public, it will ensure a smooth transition and implementation of the policy.

ADDRESSING GAPS IN DATA SHARING

Due to administrative interpretations, given the organisation of government agencies, similar services are provided to support the same goals at different locations. The initial best practice process for providing a particular service should be made available to those providing that service. Of course, other barriers to cross-government join-up and collaboration, such as an absence of departmental incentives, ministerial disinterest, and fear of the unknown, persist, and technology alone cannot get around these issues. Nevertheless, if it does facilitate pockets of improvement, and if this progress is apparent to civil servants and ministers, these cultural and political issues may also prove more easily navigable. the distinct characteristics of service delivery exert a profound influence on the spectrum of services proffered by governments. The emphasis on personalization, streamlined experiences, proactive service initiation, seamless multi-channel engagement, universal digital identification, and anticipatory strategies collectively herald an era of enhanced citizen-centric services that are not only efficient but also responsive to the diverse needs of a modern society.

However, only sanitised data from a single integrated and reliable source can be trusted to convince the public in general. Processes related to the ELV ecosystem mapped directly to the correct stakeholder in the local ELV system will also help clarify. To ensure that the data is collected and compiled correctly at the get-go. Data has become a natural resource essential not only in operating the business for private companies but equally essential for public services in delivering services to the public. As for the ELV ecosystem, facilitating the speedy process will be crucial to ensure all networks can operate efficiently. With the progress of local economy and stable private consumption with average of 7.0% for the period of 2011-2018 (Bank Negara Malaysia, 2019), local automotive industry recorded a significant year to year increment in the sales of both passenger and commercial vehicles in Malaysia for the year of 2010-2020, with average of 598,074 units of the passenger cars (only passenger cars fall under the jurisdiction of ELV management, to date.) sold in each year. Below in Table 3, the summary of yearly sales (Malaysian Automotive Association, 2021), showing the continuous upward trend of newly registered. In 2023, Malaysia's Total Industry Volume (TIV) achieved an unprecedented milestone, reaching a historic high of 799,731 units, surpassing the previous year's sales of 721,177 units in 2022 (Malaysia Automotive Association, 2023). Thus, reliable and integrated databases is very crucial. While the policy and framework currently being cautiously studied, this study in the view that introduction of the digitalized vehicle deregistration, drawing upon the positive result of the dynamics, rationale and opportunity relation, assists in ensuring correct data on numbers of vehicles which are still valid to account for any reference or research.

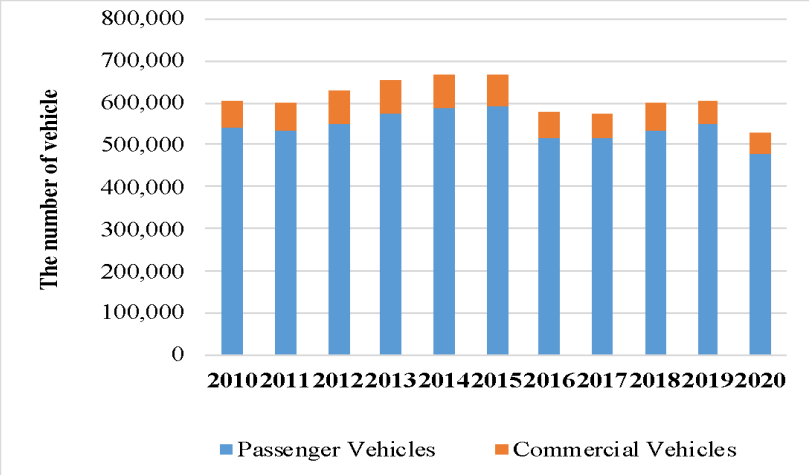

FIGURE 3. Summary of new passenger and commercial vehicles registered in Malaysia for 2010-2020 (Malaysian Automotive Association 2021)

Many of the problems with government's internal systems and processes – from not being able to find documents and people to difficulties with sharing information – derive from the poor management of data. New technology can help address some of these issues, but it should not be seen as a silver bullet. Better search technique and methods for joining up information across government can certainly help departments draw on data more effectively, for example, but standards for saving data still need to be agreed and enforced – which will require strong leadership, especially when it comes to driving culture change in teams and departments where the effective management of information is not seen as a priority.

CONCLUSION

Fundamental principle in management posits that the outcomes a system achieves are an inherent result of its design. Thus, if the government lacks imaginative foresight, it is a manifestation of a deliberate design to suppress such endeavors. Similarly, if the government's engagement with new initiatives is limited, it is reflective of a design tailored to circumvent their pursuit. The innovative and citizen-centric services suggested by this study, coupled with sustained governmental intervention, are poised to act as a catalyst in harmonizing the multifaceted discussions and requisites spanning the End-of-Life Vehicle (ELV) chain. This convergence is pivotal for fostering a sustainable industry, while concurrently introducing a novel approach to educate the general populace on ELV-related concerns. Moreover, our investigation underscores the significance of harmonizing the proposed policies with the stakeholders' acceptance and comprehension levels.

While acknowledging challenges related to data security and infrastructure, the findings underscore the potential of digital platforms to bolster ELV management through enhanced transparency, stakeholder collaboration, and informed decision-making. By leveraging digital tools, Malaysia can embrace a more efficient and sustainable approach to ELV management, aligning with circular economy principles and contributing to broader environmental sustainability objectives. The insights garnered from this study provide a foundation for policymakers, industry stakeholders, and technology experts to collectively advance ELV management practices through the digitalization paradigm.

The innovative and public oriented services as this study proposed and continuous intervention from the government will serve as a catalyst in bringing together the diverse discourse and needs across the ELV chain for a sustainable industry, apart from a fresh approach in educating the general public in regard to the ELV matters. Our study also finds amongst other things, the proposed policies must be working hand in hand with the acceptance and level of understanding (of the proposed policies) among stakeholders.

This study also suggests for future undertakings in research relating to the needs of understanding general public on their concerns of ELV policies which affecting their vehicles ownership, the need in immediate Government interventions due to the climate change concerns and sustainability of the AATF and recycling industry in general. Future research recommendations from this study can be curated in aiming to expand the understanding of ELV management policies and practices, address existing

gaps, and provide insights that could guide policymakers, industry stakeholders, and researchers in developing more effective and sustainable strategies for ELV management.

As part of its implications, this study advocates for future research endeavors aimed at comprehending the public's apprehensions concerning ELV policies and their implications on vehicle ownership. Additionally, the exigency for immediate government interventions due to climate change apprehensions and the sustenance of the Automotive Approved Treatment Facility (AATF) and recycling sector is emphasized as an essential direction for future explorations.

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DECLARATION OF COMPETING INTEREST

None

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