ASSESSING END OF LIFE VEHICLES' ENVIRONMENTAL MANAGEMENT SYTEMS IN KENYA: THE CASE OF NAIROBI CITY COUNTY WASTE MANAGEMENT STREAMS

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DECLARATION

I understand that plagiarism is an offense and I, therefore, declare that this thesis is my original work and has not been presented to any other University for any other award.

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DEDICATION

This work is dedicated to the Almighty God, who has guided me through this Masters academic journey. I am grateful for this wonderful gift He has given me; may it be a blessing to many others.

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ABBREVIATIONS AND ACRONYMS

ATF	**:**	Authorized Treatment Facility
ASR	**:**	Automobile Shredder Residues
BRTS	**:**	Bus Rapid Transit System
CIDP	**:**	County Integrated Development Plan
EIA	**:**	Environmental Impact Assessment
ELV	**:**	End of Life Vehicle
EMCA	**:**	Environmental Management and Coordination Act
EPR	**:**	Extended Producer Responsibility
EU	**:**	European Union
GK	**:**	Government of Kenya
IDIS	**:**	International Dismantling Information System
ISWM	**:**	Integrated Solid Waste Management
KEBS	**:**	Kenya Bureau of Standards
KII	**:**	Key Informant Interview
KRA	**:**	Kenya Revenue Authority
LCA	**:**	Life Cycle Assessment
NCCG	**:**	Nairobi City County Government
NELV	**:**	Natural End of Life Vehicle
NEMA	**:**	National Environment Management Authority
NTSA	**:**	National Transport and Safety Authority
OECD	**:**	Organisation for Economic Co-operation and Development
OSHA	**:**	Occupational Health and Safety Act
PELV	**:**	Premature End of Life Vehicle
PPE	**:**	Personal Protective Equipment
PoPs	**:**	Persistent Organic Pollutants
PSV	**:**	Public Service Vehicle
SEKU	**:**	South Eastern Kenya University
SWM	**:**	Solid Waste Management
UK	**:**	United Kingdom
UNEP	**:**	United Nations Environmental Programme

DEFINITION OF TERMS

Environment: "Environment" includes the physical factors of the surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological factors of animals and plants and the social factor of aesthetics and includes both the natural and the built environment (EMCA 1999).

Environmental Audit: "Environmental Audit" means the systematic, documented, periodic and objective evaluation of how well environmental organization, management, and equipment are performing in conserving or preserving the environment (EMCA, 1999).

Environmental Impact Assessment: "Environmental Impact Assessment" means a systematic examination conducted to determine whether or not a program, activity or project will have any adverse impacts on the environment (EMCA, 1999).

Environmental Management System (EMS): An EMS is a structured framework for managing an organization's significant environmental impacts (IIED, 2007).

Environmental Management:	"Environmental Management" includes the protection, conservation and sustainable use of the various elements or components of the environment (EMCA, 1999).
Environmental Monitoring:	"Environmental monitoring" means the continuous or periodic determination of actual and potential effects of any activity or phenomenon on the environment whether short-term or long-term (EMCA, 1999).
Environmental Planning:	"Environmental planning" means both long-term and short-term planning that takes into account environmental exigencies (EMCA, 1999).
Extended Producer Responsibility (EPR):	An environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle including its final disposal (Walls, 2006; Widmer *et al*., 2005).

Integrated Solid Waste Management:	Integrated Solid Waste Management refers to the strategic approach to sustainable management of solid wastes covering all sources and all aspects; it entails generation, segregation, transfer, sorting, treatment, recovery and disposal of solid waste in an integrated manner, with emphasis on maximizing resource use efficiency (UNEP, 2007).
International Dismantling Information System:	Is the advanced and comprehensive information system for pre-treatment and dismantling of ELVs. This information system was developed by the automotive industry to meet the legal obligations of the EU ELV Directive, and it entails compiled information for treatment operators to promote the management of ELVs in a manner that is environmentally friendly, safe and economical.
Recycling:	Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products (The United States Environmental Protection Agency, https://www.epa.gov/. Last accessed

	on August 2019).
Strategic Planning:	The process by which leaders of an organization determine what it intends to be in the future and how it will get there by developing a vision for the organization's future and determine the necessary priorities, procedures, and operations (strategies) to achieve that vision (Pfeiffer *et al*., 1985).
Sustainable Development:	This is the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs (Emas, 2015).
The 3 R Principle:	Material reduction, reuse, and recycling (commonly referred to as the Three Rs of waste management) are different strategies of reducing the amount of waste produced by manufacturing processes, which ultimately goes to landfill (Hoornweg & Bhada-Tata, 2012).

ABSTRACT

There is a growing evidence that some older cars are smuggled to the country, which is likely to cause serious environmental effects since the rise of the older motor vehicle population in the country results in the volume of ELV waste and hence the need to assess the ELV waste streams, especially in Nairobi City County of Kenya. Therefore, this study aimed at assessing the End-of-Life Vehicles' (ELV) Environmental Management Systems in Nairobi City County, Kenya. The study used mixed research method and a sample size of 62 firms comprising of 32 garages, 15 insurance firms, and 15 salvage companies was selected from Nairobi City County, on a stratified basis combined with the convenient sampling technique. A semi-structured questionnaire was used to collect the required information from firm owners and/or managers, and descriptive statistical techniques comprising of frequency tables, percentages, pie charts, and bar graphs were used to summarize, present, and analyze the information in an informative way. The practices employed to manage ELV waste included contracting salvage firms to collect written off vehicles by insurance companies, recycling of salvaged parts, selling the usable parts to dealers of vehicle parts and disposal of non-salvageable parts including hazardous products via firm mechanisms such as collecting the material and putting fluids in tanks and disposing them off in designated dumpsites. Research findings indicated that ELV waste products associated with three waste streams (insurance firms, garages, salvage companies) can be grouped into three categories, comprising of recyclable waste (metals and plastics, car batteries, and rubber tyres), non-recyclable (spoilt seat covers and sponges), and hazardous (various car fluids including waste fuel, engine oil transmission, power steering, and brake fluids, coolant, lubricants, solvents, degreasers, and acid from batteries). It is recommended that stringent waste management policies and guidelines for the salvage companies and garages should be put in place to mitigate against environmental pollution.

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

As automobile technology has grown in popularity around the world, End-of-Life Vehicles (ELVs) have become a global issue. Automobiles are a valuable asset for both long and short-distance passenger and cargo transportation (Sakai *et al*., 2014*)*. According to Zhou and Dai (2012), automobile ownership has increased faster than the global population, with more than 1 billion units sold in 2010.

Africa, despite having an underdeveloped automotive industry, is expected to have a high potential for adopting automotive technology due to the proliferation of a middle class and an increase in income levels (Schiller and Pilay, 2016). According to studies, 1.55 million new vehicles were sold or registered in Africa in 2015. OICA (2016). This figure is expected to rise to 10 million vehicle units by 2021. (OICA, 2016).

The dominance of second-hand vehicles, mostly imported, is a common trend in the African automotive retail sector. According to Schiller and Pilay (2016), 8 out of 10 imported cars in Nigeria, Ethiopia, and Kenya are used vehicles. Between 2003 and 2012, the number of imported vehicles in Kenya increased by 300 percent. This was attributed to the high costs of purchasing new cars as well as low income levels. In Kenya, road transport accounts for 93% of all passenger and cargo movement (Muiruri, 2014). If current growth rates continue, Kenya is expected to have more than 500 million cars on the road by 2030. (Schiller and Pilay, 2016).

There have been reports on illegal distribution of used vehicles to Africa from Europe demonstrating a looming danger to Africa's environment to impacts that are caused by the automobile technology (Jaiye *et al.,* 2015). According to the EU Implementation and Enforcement of Environmental Laws reports, the complexity of trade with old and end-of-life vehicles is primarily caused by socioeconomic circumstances that favor illegal, at least partially illegal, trade (IMPEL, 2006).

Since 2005, the number of end-of-life vehicles (ELVs) originating in 24 European Union (EU) member countries has been increasing globally. For example, according to European Vehicle Market Statistics, 2013, there were 6.2 million, 12.7 million, and 14 million in 2005, 2008, and 2010. Many vehicles that have been de-registered in member countries are exported as used cars. Under the Waste Framework Directive, the question of when a used car ceases to be a product and becomes garbage is highly subjective and is resolved differently across EU member states.

With an increasing number of automobiles on the road both globally and in Kenya, the question is what will happen to the vehicle shells when they reach the end of their useful lives, and what environmental challenges will result (KMI, 2012). ELVs have traditionally been marketed as a valuable secondary resource because they contain more than 70% iron, and their recycling has been done independently using market procedures. Interventions for effective ELV waste management have been hampered by a drop in the global market value of steel scrap and the high cost of processing ELV waste (Sakai *et al.,* 2014). It is in this light that the study seeks to assess the ELV management systems in the country in order to identify sustainable solutions on safeguarding the environment from negative impacts posed by the increasing quantities of ELVs.

1.2 Statement of the Problem

Nairobi City County vehicle ownership especially the imported used cars is on the rise in Kenya. Although Kenya Policy is clear that only vehicles under 8 years should be imported into the country, there is a growing evidence that some older cars are smuggled to the country (Okoth, 2018). This is likely to cause serious environmental effects since the rise of the older motor vehicle population in the country results in the volume of ELV waste and hence the need to assess the ELV waste streams, especially in Nairobi City County of Kenya, which is a destination of the largest number of imported vehicles in the country. This study helps fill the paucity of research in this area of study because despite the existence of an environmental management systems put in place by the government, no study has been conducted to assess ELV waste streams and its management. Considering that most vehicle components are made of non-biodegradable materials and some

consisting of hazardous material, if not properly managed they are a risk to the environment. Therefore, assessment of current ELV management practices and the legislative and regulatory gaps is important to help preserve the environment and ensure the well-being of all persons interacting within the Nairobi City County and the other Counties can use the findings of the study to address this looming problem.

1.3 Objective of the Study

1.3.1 Main Objective

The main objective of this study is to assess End of Life Vehicles (ELVs) Environmental Management Systems in Nairobi, Kenya.

1.3.2 Specific Objectives

The specific objectives are:

i. To identify the ELV waste products generated by waste streams in Nairobi City County, Kenya.
ii. To investigate the current ELV management practices in Nairobi City County, Kenya.
iii. To review the Government of Kenya and Nairobi City County Government Regulations on ELV Management in Nairobi City County, Kenya.

1.4 Research Questions

The study was guided by the following research questions:

i. What are the ELV waste products generated by waste streams in Nairobi, Kenya?
ii. What are the current ELV management practices in Nairobi, Kenya?
iii. What is the level of the National and Nairobi City County Government regulations on ELV management in Kenya?

1.5 Significance of the Study

The study findings will provide information on the status of ELV management practices, as well as their challenges and/or ineffectiveness, which can be useful for NEMA in policy enactment relating to the management and disposal of ELV hazardous waste (oil and other

vehicle fluids) and support for improved and more sustainable environmental management efforts aimed at the ELV sector. This aspect of the research will be illuminated by a review of national and county government regulations on ELV management. ELV researchers can use the study as a springboard for further research and as a reference source. Local leaders and citizens will refer to the study to learn more about the advances made by western communities in protecting their environment from impacts caused by ELVs, and get the inspiration to advocate for the local authorities and institutions to improve the legal systems and infrastructure for sustainable management of ELV waste products.

1.6 Scope of the Study

The study aimed at assessing the End-of-Life Vehicles (ELVs) Environmental Management Systems in Nairobi City County, Kenya. Focal data sources for the first objective on identifying the main streams that generate ELV were mainly the motor vehicle insurance underwriters, salvage companies and the motor vehicle junkyards. Besides the junkyards, the vehicle garages based in Nairobi were assessed to understand how stalled vehicles are being handled. The assessment of the 3R Solid Waste Management principles and practices relative to ELV Management were confined within Nairobi. Legislative and regulatory frameworks by the County Government of Nairobi and the National Government were reviewed to assess policy gaps and barriers towards the achievement of sustainable management of motor vehicle technology. The trends of importation of used vehicles in Nairobi City County and Kenya were also assessed. The study was confined between the years 2012 to 2019.

1.7 Limitations of the Study

During the study, it was not possible to control the attitudes of the respondents who could be drawn to give acceptable answers to please their employers and the researcher. To address this, the study ensured that the respondents understood in detail the aim and objective of the research and its importance to them and the society at large. There was the challenge of non-responsiveness, the informants were assured of confidentiality of their responses making them comfortable to provide information for the successful execution of

the study. Most of the respondents did not allow their real identities and photographs of their premises to be shared.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter aimed to highlight the theoretical background of the research. It also examines current empirical literature to identify knowledge and information gaps based on the study's specific objectives. The literature shall also be reviewed in line with a realistic conceptual framework that seeks to demonstrate gains that have already been made by other researchers concerning this research topic. In the context of this research, the framework should at least review the global trends of ELV waste streams i.e. their sources, the trends of importation of used vehicles, ELV management practices and the regulation of ELVs should be adequately illustrated. All the aforementioned aspects combined are a breakdown of the key components of an ELV Environmental Management System.

2.2 The End of Life Vehicle Process and Environmental Management Systems

Vehicles reach the end of their lives when they grow too old and worn out to be roadworthy ("natural" end of life vehicles or NELVs) or when they are written off after an accident ("premature" end of life vehicles or PELVs) (Sawyer-Beaulieu *et al*., 2015). Vehicles can be sold for export either before they reach the end of their useful lives as used vehicles or after they have been deregistered as garbage. Second-hand car and ELV (waste) transactions are treated differently because only the latter is subject to waste legislation.

Some decades ago, poor African countries used to be the dumping ground for toxic hazardous waste materials from the industrialized world, such as barrels of containerized raw sewage, sludge, incinerated ashes, contaminated soils, chemical substances, acids, and poisonous solvents, before a series of national and regional accords. According to Africa Waste Trade Cases, the promise of earning $20 million, a significant increase in national income for an extremely needy country like Guinea-Bissau, was too tempting to pass up in a toxic waste trade transaction (Noyes, 1989). The trend gradually switched to environmentally hazardous end-of-life autos, refrigerators, air conditioners, and other comparable items. The Port of Antwerp is believed to be the most important Belgian port and a key gateway for trade with West Africa, handling used vehicles in containers bound

for Africa from the United States (Oko, 2010). This unregulated trend of importation of used cars from developed nations to developing nations especially in Africa is wanting.

The primary driving force behind the importation of these waste materials has been the desperate need for these countries to enjoy those products, to be socially equal and enjoy earning import duties in an attempt to alleviate the economic hardships. For example, Nigerians at the Benin Republic smuggle vehicles to their country apart from those legally entering through the seaport. But the challenge now is the trade imbalances and how to manage the dumping of used out-modeled electronics and vehicles on huge tracks of used and unused lands available in the African continent (Sakai *et al.,* 2014*).*

While consumers traditionally dispose of products at the end of their life cycle, Kenné *et al*., (2012) pointed out that recovering used products may be more cost-effective than disposal. When a suitable recovery approach is used, large environmental and economic advantages can be expected. A car is a complex product made up of many different materials (Harraz Galal, 2011). Metals in ELVs account for up to 75% of a vehicle's mass and, particularly ferrous metals, are relatively straightforward and profitable to sort and recycle. Despite European Directive regulations requiring waste reduction, the nonmetallic residue known as "car fluff" or "automobile shredder residue" (ASR) is primarily landfilled in many other European countries. In Europe, fluff treatment and alternative management approaches have so been researched (Santini *et al*., 2011). To offer a full life cycle overview of the environmental impact of a motor vehicle's components, an appropriate End-of-Life treatment must be included. Hawkins *et al*., (2013) suggested allocating impacts connected with material recovery and disposal processes to the vehicle, however the researchers also pointed out that the benefits of recovering materials that can be utilized in future goods are not taken into account.

Increasing pressures and challenges to enhance economic and environmental performance have prompted developing countries in general, and vehicle manufacturers in particular, to think about and implement ELV management. It is becoming a major issue that will not only prevent environmental degradation but also assist manufacturers economically (Lin

et al., 2011). There are various recovery methods available when a product approaches its End-of-Life (EoL), including reusing the product or its components, remanufacturing, material recycling, incineration, and landfilling (Mansour & Zarei, 2008). Figure 2.1 below shows a description of ELVs arising and their management.

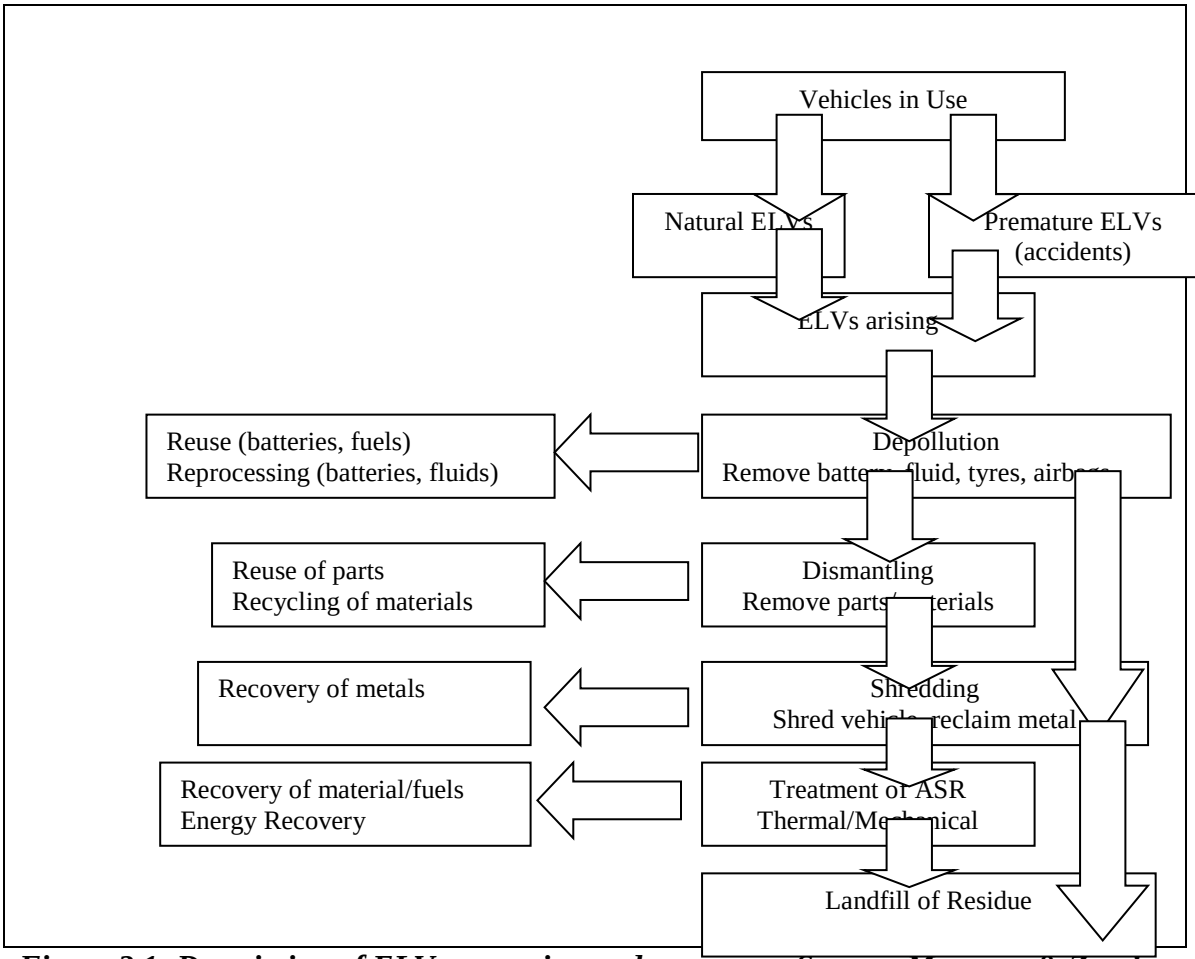

Figure 2.1: Description of ELV generation and treatment; Source: Mansour & Zarei (2008)

Kumar & Sutherland (2008) reviewed studies on vehicle recovery infrastructure and found the following limitations in the available mathematical models: inadequate description of complex material flows and economic transactions within the infrastructure, minimal consideration of market factors, and lack of consideration for government policies. Ilgin & Gupta (2010,) reviewed the literature on environmentally conscious manufacturing and product recovery, concluding that more research is needed to better limit the consequences

of uncertainty. A survey of ELVs, recycling, disassembly technologies, and related disciplines was presented by Go *et al.*, (2011). Mayyas *et al.*, (2012) looked at the car industry's sustainability research by reviewing many studies on the vehicle's life cycle, disposal, and End-of-Life (EoL) analyses, as well as the various sustainability metrics and models used to quantify the environmental impact.

Forton *et al., (*2006) identified key issues and factors in ELV management in the United Kingdom, as well as their real-world implications for vehicle recycling. Edwards *et al*. (2006) detailed the recovery infrastructure and procedures used in the UK's automobile recycling industry, stating that the EU ELV Directive's (2000/53/EC) eco-efficiency objectives are dependent on the availability of post-shredder separation technology. Zameri & Blount (2006) provided an overview of vehicle recycling practices in the European Union, the United States, Japan, and Australia. Dalmijn and De Jong (2007) looked at the growth of ELV recycling in Europe and found that transporting ELVs to China is cheaper than processing them in Europe. The installation of advanced sorting equipment in a vehicle shredding plant could optimize separation efficiency and increase the reached recycling rate, according to Joung *et al*., (2007), who studied the state of ELV recycling in Korea. Chen & Zhang (2009) reported on the progress of process-related operations and provided insight into Chinese thinking regarding the ELV recycling problem. Chen *et al*., (2010) examined the ideas and characteristics of Taiwan's ELV recycling system in depth, stating that tactical and operational planning must be enhanced and optimized to make recycled materials more competitive. According to Altay *et al*., (2011), the current level of vehicle recycling in Turkey could result in the formation of a new job industry if relevant rules are implemented. Cheng *et al*., (2012) investigated the operational elements of the recycling and treatment industry for ELVs in Taiwan and their link to recycling performance using production capacity, power efficiency, and recycling rate as metrics. To raise the recycling rate of ELVs, vehicle shredding plants should improve their operation schedule. Wang & Chen (2012) looked into China's development methods for recycling obsolete electronic control components in automobiles. They considered their benefits, drawbacks, options, and roadblocks. They stated that the ELV recycling industry has successfully responded to all of the causes and campaigned for new growth opportunities.

To investigate the effects of changes in vehicle material composition on the US recycling infrastructure, Kumar & Sutherland (2009) developed a simulation model for material flows and economic exchanges. They discovered that if vehicle design changes, car recycling plants' profits will rise over time as a result of the higher revenue from aluminum in aluminum-intensive vehicle hulks.

Mathieux & Brissaud (2010) suggested a method for constructing an end-of-life product-specific material flow analysis and tested it on aluminum from end-of-life commercial vehicles in the European Union. They did, however, point out that the method's application necessitates a significant amount of field work.

Vermeulen *et al*., (2012) presented a set of seven sustainability metrics that can be used to compare and assess industrial waste treatment procedures. The ASR case study is used to test the suggested overall sustainability assessment technique. The most sustainable processing approach was recycling mixed with energy recovery, which allowed the EU ELV Directive quotas to be met by 2015.

In the EU legal and global business environments, Simi & Dimitrijevi (2012) proposed a tactical production planning dilemma for vehicle recycling plants. They looked at the impact of the EU ELV Directive on the vehicle recycling industry and found that future eco-efficiency targets will not jeopardize their profitability. Furthermore, they advised that the efficiency of the recycling system be monitored at the system level, as this would not undermine the EU ELV Directive's aims.

Composting an automobile component made of a fiber-reinforced bio-composite is a more favorable waste management scenario than landfilling the materials, according to Kim *et al*. (2008), because carbon is sequestered in soil when the bio-composite compost is applied to the land, resulting in lower greenhouse gas emissions. However, this necessitates the removal of all bio-based products from ELVs and their disposal in composting facilities. This would result in new material streams and increased complexity during the vehicle breakdown step.

According to Muiruri (2014), road transport accounts for 93 percent of passenger and freight movement in Kenya, with over 1.3 million registered cars. In Nairobi, almost 780,000 vehicles (roughly 60%) are in use. Automobiles frequently reach the end of their useful lives, and stockpiles of unclaimed vehicles can be found in Kenyan police stations' yards. He goes on to say that, while unclaimed end-of-life vehicles have the potential to contaminate the environment, they can also be recycled. The research's first findings revealed that passenger cars and matatus were the most common forms, accounting for 42 percent and 24 percent, respectively. 86 percent of the automobiles were non-operational, while 14 percent were operating vehicles impounded for violating traffic laws. Contamination of land and water supplies by leaking fluids such as engine oil, possible injuries due to rusting broken vehicle parts, potential health hazard risks to children living within the police stations, breeding places for rodents, mosquitoes, and other pathogens were among the potential environmental impacts. The automobiles also create a hazard (visual pollution). The study's conclusion is that the problem of unclaimed automobiles demands prompt decisions and efforts to address it, or it will deteriorate as motorization and population grow rapidly.

2.3 Legislative and Regulatory Framework of ELVs

ELV recycling legislation is currently only in place in the EU, the European Free Trade Association, Japan, Korea, China, and Taiwan (Santini *et al.*, 2011). A legislative framework for ELV recycling is urgently needed, especially in countries and regions where automobile ownership is rapidly increasing. Automobiles are built of a range of metals, including base metals such as copper and zinc, as well as rare metals such as platinum and palladium, in addition to iron. There is also a demand for secondary resources such as collecting valuable metals.

As manufacturers strive to increase the sustainability of their products, they use tools such as Life Cycle Assessment (LCA) to quantitatively study the impacts and benefits of their actions. As for automobiles, the use phase of automobiles is the greatest contributor to life cycle impacts but it is also necessary to understand the impacts associated with all phases of the life cycle (European Union, 2000). Thus, as government legislation concerning end-

of-life vehicles and waste around the world is enforced or being developed, it is necessary to consider how materials from automobiles are handled at the end of a vehicle's useful life. In this way, the entire life cycle benefits and impacts of vehicles can be assessed (Kahhat *et al*., 2008).

Manufacturers have also responded to the need for more readily reused and recycled automobiles by labeling components and materials and building disassembly information systems (Ferguson *et al*., 2010). The International Dismantling Information System (IDIS), for example, brings together 26 vehicle manufacturers that have built a PC-based information system to enable component material identification and promote more efficient end-of-life vehicle treatment around the world (Zorpas *et al*., 2012).

Extended Producer Responsibility (EPR) makes a product's manufacturer or importer responsible for the product's entire life cycle, i.e. ELV. This responsibility begins with the vehicle's design. The producer's responsibility for a product is thus extended beyond the manufacturing stage of the product's life cycle to the post-consumer stage (OECD, 2001). Because the efficiency of processing facilities affects the prices of take-back and processing, manufacturers have an incentive to improve processing facility efficiency. Manufacturers have established networks of authorized treatment facilities throughout the EU, and there is evidence that they have encouraged the most cost-effective procedures in those facilities in order to save money. Another way in which the ELV Directive (2000) decreases pre-existing market inefficiencies is through this manner.

The EU-Directive on ELVs was enacted in 2000 in the EU. Through the promotion of reuse, recycling, and collecting of ELVs and their components, it aims to control the generation and disposal of waste from automobiles and to raise environmental awareness among parties involved in ELV treatment. The Directive is founded on the subsidiary concept as well as the principle of extended producer responsibility (Smink, 2007).

EU member states must create national legislation on the ELV recycling scheme in accordance with the subsidiary principle. The Directive also establishes recycling goals for

certain phases. Under the extended producer responsibility system, member states are expected to reach the targets, while automobile manufacturers and importers are responsible for recycling costs. The directive covers four primary stakeholders: the producer, the recycling business, the last holder, and the authorities, with these targets in place. Within the bounds of its own potential, each has a responsibility. Legislation on waste is also an essential aspect of EU policy. To improve waste management in EU countries, a framework of several legislation and directives exists (European Union, 2000). The Law for the Recycling of End-of-Life Vehicles was implemented in Japan in 2005. (Li, 2012). The act established appropriate roles among related players to promote sound treatment and recycling of ELVs in light of the need to reduce Automotive Shredder Residue due to a lack of final disposal sites, as well as the prevention of illegal dumping and unsound treatment of ELVs caused by fluctuations in the steel scrap market (Sakai *et al*., 2014). The act typically specifies the components/materials to be recycled, as well as the stakeholders who will bear the cost of recycling and the construction of an information management system.

The Resource Recycling of Electrical and Electronic Equipment and Vehicles Act (Li, 2012) was implemented in Korea in 2008. Prior to this Act, the Korean government's waste management policy was based on EPR (Extended Producer Responsibility). The Eco-assurance System was added to the EPR policy, which grew into the Integrated Product Policy as a result of this Act (Che *et al*., 2011).

End-of-Life Vehicle Recycling Regulations, implemented in 2001 in China, established an ELV collecting system to prevent accidents caused by the usage of restored or over-aged cars. To prevent traffic accidents caused by incorrect use of these components, the reuse of the five primary assemblies (engines, steering, transmissions, axles, and frames) was prohibited (Sakai *et al*, 2014). The Automotive Products Recycling Technology Policy was established in 2006, and it highlighted the duties of manufacturers and importers in promoting ELV recycling, as well as the compounds used in car manufacturing that will be controlled and forbidden for environmental reasons (Wang *et al*., 2012).

South Africa's National Waste Management Strategy Implementation (NWMSI) Project goal, according to Annexure (2005), was to provide a viable and practicable way to promote and extend recycling. The waste streams that could be recycled were identified, as well as the present levels of recycling, collection and processing systems, and the drivers for, and impediments to, recycling these wastes. Each waste stream's potential for further recycling was also determined. The investigation's main objective was to assess the feasibility of recycling all waste stream components (both general and hazardous refuse) and to provide advice on the implementation of sustainable recycling activities in a phased and prioritized way. The findings of this study were utilized as the foundation for related pilot study investigations by South Africa's Department of Environmental Affairs and Tourism (DEAT). The potential for greatly decreasing the burden on landfill sites, a considerable influence on the environment, and potential financial benefits were the main criteria utilized to prioritize waste streams. The report looked at garbage production in South Africa as a whole, including all ‘general' and ‘hazardous' waste streams across the country. The focus was subsequently reduced to waste disposal at municipal dump sites, which are landfills that take "general" trash from residential, commercial, and industrial sources. The paper goes on to say that identifying the various waste streams that make up the total waste stream, as well as quantifying and characterizing them, is the first step in achieving the aim of drastically reducing trash generation. Once this is accomplished, the waste streams can be prioritized, and a staged approach to dealing with these prioritized waste streams can be devised.

Looking at the Kenyan situation, the existing legislation are severely lacking in terms of ELV management strategies and concepts. In terms of the management of the motor vehicle sector and ELVs, Kenya's main environmental act, the EMCA 1999, which was amended to the EMCA 2015, and its subsidiary rules are somewhat ambiguous. The EMCA CAP 387, EMCA – Waste Management Regulations, EMCA – Waste Tyre Regulations, EMCA – Air Quality Regulations, EMCA – Fossil Fuel and Emissions Regulations, and the Environmental Impact Assessment and Audit Regulations 2003 are some of the key Kenyan legislative and regulatory frameworks relevant to this study. These policies will be examined further to determine whether they need to be improved or whether a separate rule

to handle ELVs is required. More attention should be paid to how technology can be handled sustainably in Kenya by restricting the entry of used vehicles and implementing ISWM strategies.

2.4 Conceptual Framework

The overall focus of this research was to investigate and/or assess the status of the ELV waste management products within Nairobi City County, Kenya. This overall objective was achieved through an empirical investigation addressing three research questions formulated as: what are the ELV waste products generated by various waste streams in Nairobi City County?, what are the current ELV waste product management practices that waste streams employ in Nairobi City County and how effective are these practices?, and what are the existing county government and national government ELV waste management regulations, and their effectiveness in waste management in Nairobi City County? Therefore, the independent variables of this study were: (1) type of ELV waste products generated by the waste streams, (2) current ELV waste product management practices in Nairobi City County, and (3) existing Nairobi City County and National Government regulations regarding ELV waste product management. The dependent variable of the assessment of the effectiveness of ELV waste management practices by waste streams in Nairobi City County. The independent variables of the study largely fall under the nominal category (naming and describing the investigated variables of research) and the dependent falls under the ordinal category (ranking the variable of research according to the level of effectiveness). A schematic diagram illustrating the conceptual framework and drawing relationships of the relevant variables of the study is provided in figure 2.2.

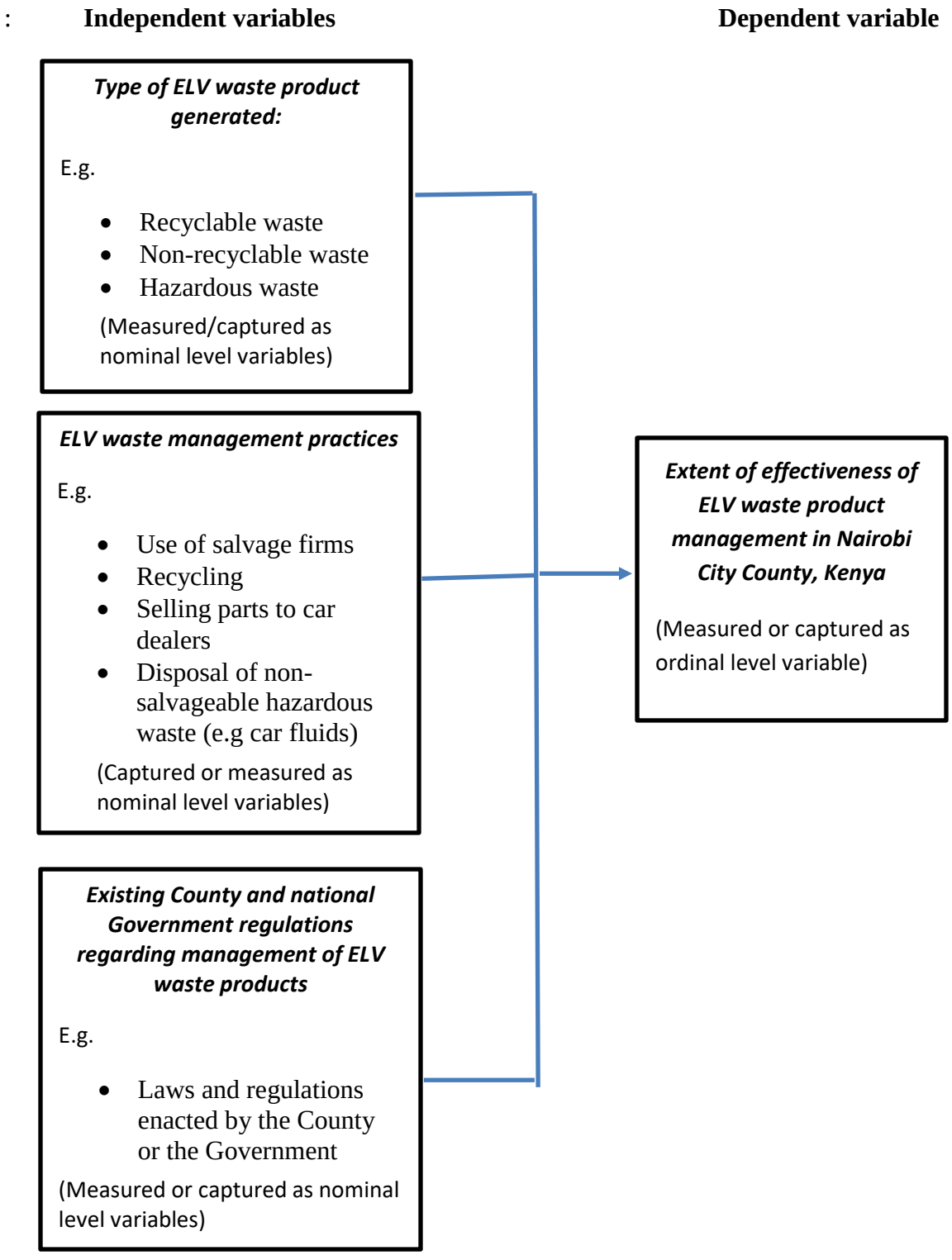

Figure 2.2: Conceptual Framework

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter introduces the study area by providing a brief overview of Nairobi City County, including its physical and topographic characteristics, as well as its ecological conditions and climate. The research design, sampling technique, data sources and requirements, study population, data collection and analysis technologies employed, and ethical considerations are also discussed.

3.2 Study Area

The study area is Nairobi City County (Figure 3.1) which is one of the 47 counties in the Republic of Kenya. It is also the political and commercial center of Kenya, a destination of the largest number of imported vehicles in the country. The county is bordered on the east by Machakos County, on the north by Kiambu County, and on the south and west by Kajiado County. Kiambu County has the longest border with Nairobi City County among the three adjacent counties. The county is located between longitudes 36 ^{o} 45' East and latitudes 1^{o} 18' South and has a total size of 696.1 Km2 (269 square miles). Its elevation is 1,798 meters above sea level (CIDP, 2018).

Lang'ata, Kibra, Dagoretti North, Dagoretti South, Westlands, Embakasi South, Embakasi North, Embakasi Central, Embakasi East, Embakasi West, Ruaraka, Kasarani, Starehe, Mathare, Kamukunji, Makadara and Roysambu are the 17 sub-counties that make up Nairobi City County. Source: (CIDP,2018).

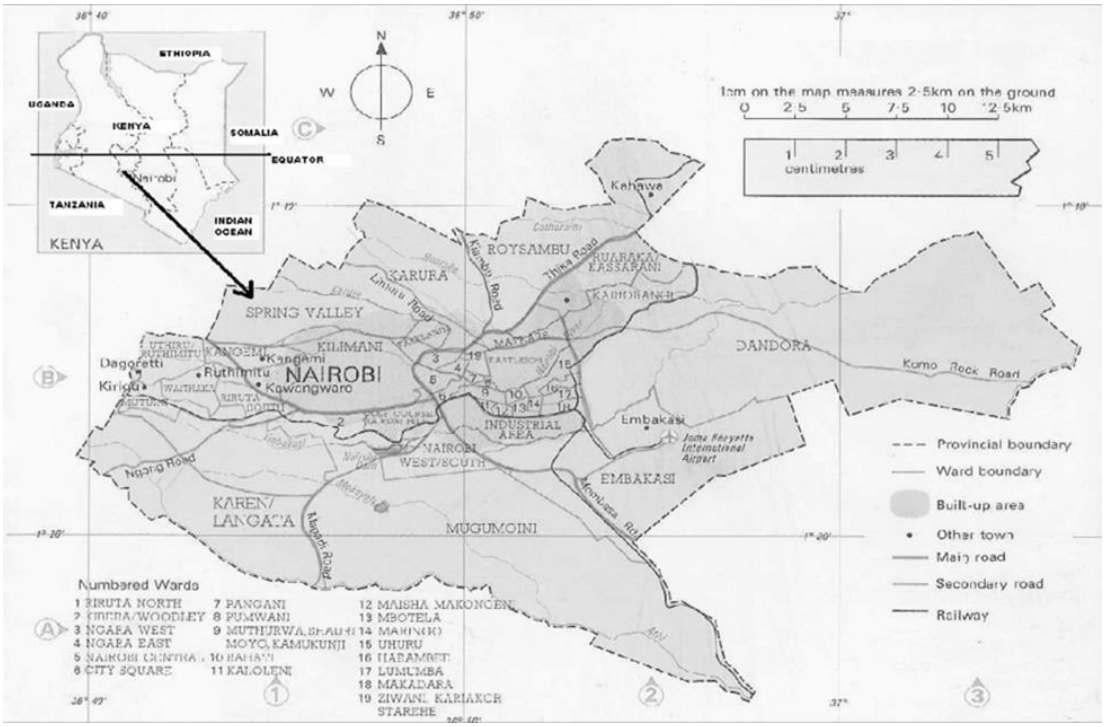

Figure 3.1: A map of Nairobi City County and its sub-counties. Source (Augustine, 2009)

According to the 2019 National Population and Housing Census, Nairobi City which covers 696.1 square kilometers had a population of 4,397,073 people and a population density of 6247 people per square kilometers (CIDP, 2018)

3.2.1 Physical and topographic features

The landscape in the eastern part of the County is moderately sloping, although steep valleys separate it from the city limits. The Karura Forest, located to the north, is known for its steep-sided valleys. Nairobi National Park to the east and Ngong Forest to the south define the Karen-Langata region, which is characterized by plains. A prominent landscape characteristic of the County is several streams with steep-sided valleys covered with vegetation. Nairobi River, Ngong River, and Kabuthi River are the three main rivers in the county. Effluents from open sewers and industrial waste have heavily polluted these rivers. The Nairobi Dam, which is located along the Ngong River, and the Jamhuri Dam are the county's principal water reservoirs. The two main types of soils are black cotton and red soils, which occur in areas throughout the county. Ngong Forest to the south, Karura Forest

to the north, and the Nairobi Arboretum are the three forests in the county. The three forests comprise a total area of 23.19 hectares (CIDP, 2018).

3.2.2 Ecological and climatic conditions

Nairobi City County is mostly a terrestrial environment with a rich web of biodiversity and ecosystems. It is home to over 100 animal species, 527 bird species, and a wide range of plant species (CIDP, 2018). Despite the presence of certain permanent rivers, the aquatic ecosystems are generally suffocated by pollution from various sources. Efforts are currently being made to guarantee that the Nairobi River Basin is both sustainable and clean. Because of its high height, the County enjoys a relatively cool climate, with temperatures ranging from 10°C to 29°C. The rainfall pattern is bimodal. The long rains season lasts from March to May, with an average rainfall of 899 millimeters, and the short rains season lasts from October to December, with an average rainfall of 638 millimeters. The average annual rainfall is 786.5 millimeters (CIDP, 2018).

3.2.3 Environmental degradation in the county

One of the key reasons driving Nairobi's overwhelming environmental degradation is the city's large and rising population. Increased vehicle numbers, unplanned and uncontrolled settlements, poor solid waste management, uncontrolled development, untreated industrial discharge, and inefficient energy use are all contributing factors (CIDP, 2018). Industrial and motor vehicle emissions are the most significant contributors to climate change. Pollution control methods are impeded by a lack of enforcement capacity for existing environmental legislation. The County's environmental degradation has contributed to biodiversity loss, floods, and habitat destruction along river basins. As a result of pollution, health and sanitation standards have deteriorated (CIDP, 2018).

3.2.4 Solid Waste Management

In Nairobi and Kenya in general, solid waste management (SWM) is still a serious public health and environmental concern. Low coverage of solid waste collection, pollution from uncontrolled waste dumping, inefficient public services, an unregulated and uncoordinated private sector, and a lack of key solid waste management infrastructure characterize

Nairobi's solid waste situation, which could be taken to represent Kenya's overall situation. The amount of solid garbage produced each day is 4,016 tonnes (Allison, 2010). The collection rate is as low as 33% (JICA, 1998; JICA, 2010), resulting in an uncollected amount of 2,690 tonnes. Other actors have entered the picture, including private firms and community-based organizations, in addition to the Nairobi City County Government (NCCG), which is responsible for the supply and regulation of SWM services throughout the county. Some of these actors' operating models aren't well known. Effective coordination among these parties is also lacking, and the city council's control of private firms is now just starting up. This research intends to learn more about what has been done on a national level to implement an ELV waste management system. The policy frameworks will also be evaluated in order to identify policy gaps and provide appropriate recommendations based on findings from other nations.

3.3 Research Design

This study uses mixed method design that combines quantitative and qualitative approaches in collecting, analyzing, interpreting, and reporting data. It uses mixed research design because the design incorporates the strengths of both qualitative and quantitative approaches and thus providing a more comprehensive view of the phenomena being studied and does not limit the collected data. Specifically, the study uses survey questionnaire in its collection of quantitative data while it uses in-depth interviews for the collection of qualitative data. The results of the two methods are then integrated at the interpretation stage.

In order to contextualize the problem under investigation, the first phase of the study assessed the trends of importation of used vehicles in Nairobi City County, Kenya through sourcing data on the importation of used vehicles and their quantities. The Kenya Revenue Authority (KRA), which is responsible for the clearing of imported motor vehicles, provided data on used vehicles imported within 5 years in the country. The National Transport and Safety Authority (NTSA) also provided data on the number of vehicles that are registered within Nairobi City County since it began operation in 2016. Five (5) Car

dealing companies located within the County also provided data on used vehicles imported for at least one year.

The second phase of the study assessed ELV waste streams in Nairobi, Kenya. Key informants best placed to provide data on this study aspect included motor vehicle underwriters and the motor vehicle junkyards. Fifteen (15) of the top motor vehicle underwriters in the country as well as fifteen (15) of the top motor vehicle salvage firms recommended by the insurance firms were investigated and 10 major junkyards that are within Nairobi.

The third phase of the study was devoted to investigation of the ELV waste management practices in Nairobi which included the current recycling, re-use, reduce and disposal practices of ELVs. The motor vehicle salvage companies, vehicle repair garages, vehicle junkyards and the infamous Dandora Dumpsite managed by NCCG were identified as the main points of interest to help in assessing the current ELV waste management practices.
The fourth phase of the study reviewed the current National and Nairobi City County Government laws and policies regulating ELVs. Laws and policy analyses were limited to incentives in place with regard to control of used vehicle importation and motor vehicle waste management techniques that have been provided by the National Government and the NCCG. International laws and policies regarding the management of ELVs in developed countries were also assessed.

3.4 Sampling Design and Sampling Frame

3.4.1 Sampling Design

In research, data collection is critical since the data is intended to aid in a better understanding of the theoretical framework (Bernard 2002). The approach of purposeful sampling was employed to select informants based on their characteristics. Their choice was based on the researcher's judgement and professional knowledge of appropriate respondents in the study region. The most notable organizations and institutions working in the fields of automobiles and environmental management were chosen. Some of the data

collected on the legislative frameworks and the importation trends of cars was not limited to Nairobi City County but represented the entire Country.

3.4.2 Sampling Frame

The study's mixed research design, as well as the purposive and qualitative survey approaches, were found to be ideal in determining the study's sampling frame. For example, the number of used vehicles imported into the country was obtained from KRA and NTSA. KRA and other alternative data sources, such as the National Bureau of Statistics, could easily provide data between 2012 and 2017, whereas the NTSA, which was established in 2016, could only provide data between 2017 and 2019. NEMA, NTSA, NCCG, KRA and IRA were identified as relevant organizations to participate in the survey because the study areas were primarily focused on the management of ELVs and ELV wastes. The sampling frame used is summarized below.

Table 3.1: A summary of the sampling frame

Sample Item	Respondents	Sample Size/Duration
Number of vehicles imported in Nairobi City County and the Country.	NTSA and KRA	Over a period of 6 years (2012-2017) NTSA (2017-2019)
Number of vehicles sold within Nairobi City County.	Car Dealers	5
ELV Waste Streams	Insurance Firms	15
	Motor Vehicle Salvage Companies	15
	Car Garages	32
Institutional Review	NCCG NEMA KRA NTSA IRA	5 Organizations
Regulatory Review	EMCA 1999 and its subsidiary regulations - EMCA 2015 - EIA and EA Regulations 2003, - EMCA Waste Management Regulations 2006, - EMCA Waste Tyre Management Regulations 2013 OSHA 2007 Insurance Act (Amendment) 2006, CAP 405 Public Health Act, CAP 242 OSHA 2007 Kenya Bureau of Standards Legal Notice No. 78 Tax regulations found to be relevant for the study were reviewed, they include The; Value Added Tax Act 2013 Excise Duty Act 2015 Miscellaneous Fees and Levies Bill, 2015	13 Policies

3.5 Data Sources and Requirements

Each of the objectives had a unique set of data requirements and sources. Primary and secondary data sources were used in the investigation.

3.5.1 Primary Data Sources

Questionnaires, interview schedules, and field observations were used to gather primary data. Questionnaires were the most common method of gathering primary data, which included both open-ended and closed-ended questions. Copies of the questionnaires that were used are included at the end of this thesis. The survey also entailed keen observation of the current waste management practices with regards to ELVs at the salvage companies, junkyards, garages, and the dumpsite.

3.5.2 Secondary Data

Secondary data was collected from literature such as the existing National and International legislative and regulatory frameworks, County laws and policies, parliament bills, published academic and research papers, newspaper articles, internet articles, and online journals.

The importation trends of used vehicles were assessed in the preliminary to give insight on the looming environmental dangers relating to ELVs and ELV waste. KRA and NTSA provided data on vehicle importation trends in Nairobi City County and the entire Country. Based on data availability at these institutions, the data sourced from KRA was within a 6-year period (2012 – 2017), while that from NTSA was within a three-year period (2017 – 2019). In addition, five (5) major car dealing companies were identified to provide data on the number of vehicles sold within Nairobi City County; the adequacy of the sample size was not dictated by regional boundaries such as constituencies since data from the car dealers regardless of their location directly answers the research question on the trends of vehicle purchase within Nairobi. The sample of 5 may not have represented the situation as it is in the County but gave insight on the looming ELV waste management crisis.

The data on the first objective provided information on the sources of ELV waste as well as other related data such as how written off motor vehicles are handled, treated and disposed of. Using the purposive sampling technique, informants best suited to provide the aforementioned type of information included; the motor vehicle insurance firms, motor vehicle salvage companies, and the vehicle junkyards. Motor vehicle garages provided additional information on how spoiled vehicle parts are handled. In Nairobi City County, fifteen (15) renowned motor vehicle underwriters were interviewed. The fifteen insurance companies referred the researcher to salvage companies they hired to manage written-off vehicles; these companies may not be identified as direct ELV sources, but they are part of the ELV waste stream since they also handle ELVs. The main reason for contacting salvage companies was to find out what happens to the vehicles they receive from insurance companies as write-offs. As their name implies, their main business is to recover some of the vehicle parts for re-use as spare parts. In Nairobi, ten (10) vehicle junkyards and thirty-two (32) car garages were contacted. Four car garages were purposefully sampled within each of Nairobi City County's original eight constituencies, which include Makadara, Kamukunji, Starehe, Langata, Dagoretti, Westlands, Kasarani, and Embakasi, to ensure proper representation of the entire County.

The data required for the second objective on the ELV waste management practices were sourced from the insurance firms, motor vehicle salvage companies, vehicle garages, vehicle junkyards and NCCG.

The data required for the third objective was mainly sourced from the respective regulatory frameworks. Information was acquired through secondary sources and interviews with key informants especially from NCCG, NEMA and IRA. Their responses facilitated the assessment of policy gaps with regards to management of ELV Waste and the motor vehicle technology in general. This phase of the study sought information from EMCA 2015 and NEMA regarding End-of-Life Vehicle Environmental Management Systems in place. The legal and regulatory provisions EMCA 2015 and NEMA have in place concerning importation of motor vehicles, ELV waste handling and disposal, garage operations and general management of motor vehicles and its requisite pollutants were

reviewed. The key subsidiary regulations to be assessed relative to this study include the EMCA; - Waste Management Regulations 2006, Waste Tyre Regulations 2013, Air Quality Regulations 2014, Fossil Fuel Emission Control Regulations 2006, the Environmental Impact Assessment (EIA) and Environmental Audit (EA) Regulations 2003. Other regulations that were identified for review include the; Traffic Act - CAP 404, Insurance Act CAP 405, Public Health Act –CAP 242, OSHA 2007, KEBS Legal Notice No. 78, VAT Act 2012, Excise Duty Act 2015, Import and Export Regulations and the Miscellaneous Fees and Levies Bill 2015. Table 3.1 presents a summary of the sampling frame.

3.6 Data Analysis and Presentation

Using statistical tools like tables, charts, and percentages, data analysis entails breaking down large amounts of information into smaller portions, producing summaries, searching for trends, and more. The majority of the study's data were both qualitative and quantitative, and methodologies were included in the analysis to give the data collected meaning. Thus, data were analyzed using MS Excel and Minitab's analytical tools in both descriptive and inferential ways. After that, it was displayed using graphs, charts, and tables. For the safety and privacy of the majority of the respondents, particularly the insurance companies and the car dealers, it was decided to use pseudo names and nearby landmarks as identification.

3.7 Ethical Considerations

It was necessary to make it clear to respondents that their participation in the study is completely voluntary and that they are free to decline or withdraw at any time during the research process due to ethical considerations. They were not required to reveal their identities in order to prevent linking the responses to specific individuals. They were informed that the research would only be used for academic purposes and that their information would be kept private. In a letter of introduction, the university identified the researcher as a SEKU student and briefly stated the objective of the study.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

The findings from primary and secondary data sources are presented in this chapter. The results were thoroughly examined in accordance with the study objectives. A response rate of 89.56 percent was recorded on average, with variations across the sampled population categories (Table 4.1). This is a reliable response rate for data analysis because any response rate greater than 70% is considered satisfactory (Mugenda, 2008).

Table 4.1: Response rate from questionnaires and interviews

Sample Population	Sampled Population	Returned Questionnaires	Response Rate (%)
Key Informants (NCCG, NEMA, KRA, NTSA, IRA)	5	5	100
Insurance Firms	15	14	93.3
Motor Vehicle Salvage Companies	15	11	73.3
Car Dealers	5	5	100
Car Garages	32	26	81.2
Total	**41**	**32**	**89.56**

4.2 Assessing the trends of importation of used vehicles in Nairobi City County and Kenya

A general survey was carried out to assess the trends of importation of used vehicles in the Country and the County of Nairobi. This was deemed necessary to illustrate and buttress the looming ELV waste crisis based on the number of used vehicles imported over time. Table 4.2 summarizes the importation of used vehicles from 2012 to 2017. In 2017, Kenya imported an average of 24,123 vehicles per month, totalling 289,476 vehicles in 2017, with second hand cars accounting for 70% (202,633) of the total. Between 2012 and 2017, 601,767 used vehicles were imported into Kenya.

Table 4.2: Importation trends of used and new vehicles between 2012 and 2017

Year	Vehicles Imported	Used Vehicles	New Vehicles
2012	120,268	84,188	36,080
2013	136,915	95,841	41,074
2014	157,856	110,499	47,357
2015	143,833	100,683	43,150
2016	271,847	190,293	81,554
2017	289,476	202,633	86,843
Total	**705,156**	**601,767**	**103,389**

The average annual growth rate for the importation of used vehicles over the six-year period was 52.1% and within the 6 years the number of used cars imported annually increased by 80,953 vehicles. A projection of the number of vehicles expected to be imported in Kenya in the future is demonstrated in the linear trend model (equation 1) below;

$$Y(t) = 44113 + 24736.1*t$$

Where: Y(t)= Number of vehicles to be imported in a particular year

44113 Constant, y-intercept

247336.1=Gradient

(t)=Time

Yt= 44113+(24736.1*18)

Yt=489,361

(Equation 1)

According to the linear trend model in the year 2030, approximately 489,361 used vehicles will be imported that year which consequently means more ELVs stock is anticipated, a six-fold increase compared to those of 2012.

Figure 4.1 shows the used car importation trend between 2012 and 2017, where the gradient is 24736, y intercept (a constant) is 44113 and a coefficient of determination (r^2) of 0.80.

According to the trend line there is a well-defined linear increase of vehicles imported, from 84,188 in 2012 to 202,633 in 2017.

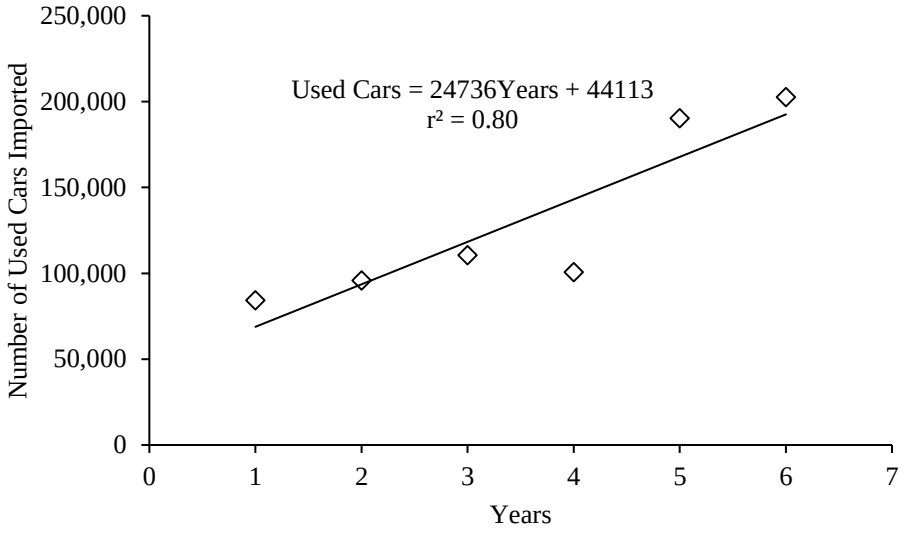

Figure 4.1: A trend line and formula showing the number of imported used vehicles in Kenya between 2012 (Year1) and 2017 (Year 6) (Source: KRA, 2018)

The number of motor vehicles registered in Nairobi City County provided by the National Transport and Safety Authority (NTSA) from its inception in 2016 are presented in Table 4.3.

Table 4.3: Number of registered vehicles in Nairobi between 2017 and 2019

SN	Year	No. of Vehicles Registered
1.	2019	287,611
2.	2018	297,301
3.	2017	287,279
	Total	872,191

Table 4.2 shows the number of vehicles registered in Nairobi City County for the years 2017, 2018 and 2019. A total of 872,191 vehicles were registered over the three years with 287,279 registered in 2017, 297,301 in 20I8 and 287,611. These figures may be indicative

of large numbers of ELVs likely to be generated in Nairobi each year, since a majority of these registered vehicles are likely to end up as ELVs.

4.2.1 Used Motor Vehicle Importation in Nairobi City County between 2016 and 2017

From the 5 car dealing companies that were selected, within one year, they imported a total of 3934 vehicles (Table 4.4).

Table 4.4: Used Motor Vehicle Importation by Five Car Dealers in Nairobi City County between 2016 and 2017

SN	Car Dealer	Units
1.	Car Dealer A (SBT)	1348
2.	Car Dealer B (Parklands)	966
3.	Car Dealer C (Ngong Road, Near Nakumatt Prestige)	390
4.	Car Dealer D (Ngong Road near the Greenhouse)	925
5.	Car Dealer E (Railway Club, Nairobi)	305
7.	Total	3934

From the results it was found that importation trends have been on the rise over the years under study. This demonstrates a consequent high number of vehicles likely to be written off or reach their end of life.

4.3 ELV Waste Streams

The main streams that generated ELV waste in this study were mainly the motor vehicle insurance underwriters, salvage companies and the motor vehicle junkyards. Vehicle garages based in Nairobi were also established as sources of ELVs and ELV waste, the subsections below provide an analysis of the findings;

4.3.1 ELV Waste Stream 1: Insurance Firms

The motor vehicle underwriters commonly known as the insurance firms were found to be the key source of ELVs. Various classes of vehicles are insured by these underwriters who

take responsibility for client vehicles once involved in accidents. All the underwriters interviewed, representing a 100% response rate, agreed that depending on the extent of the accidents, they may opt to repair the vehicles or write them off. The vehicles are declared write-offs if the cost of restoring the vehicle may be higher than the value of the car in its state or if the level of damage may not allow for restoration of the vehicle to its original state.

Figure 4.2 shows the number of insured and written-off vehicles recorded by the 14 insurance firms in Nairobi City County between the years 2014 and 2019. During the 6 years between 2014 and 2019, it was found out that 14 motor vehicle insurance firms were able to underwrite a total of 766,127 vehicles within Nairobi City County. This translated to the insurance of averagely 127,787 vehicles annually within this period. The field survey also found that a total 191,526 units were written-off within these 6 years which translated to an average of 31,921 vehicles written off annually. The least number of written-off vehicles between 2014 and 2019 was 24,846 units and a maximum of 37,946 units. From these findings, the ratio of the number of vehicles written-off and the number of vehicles insured was 1:4 implying that approximately out of every four vehicles that are insured one will be written off within the year. All the 14 insurance firms had outsourced motor vehicle salvage companies and garages to handle the written-off vehicles, findings on this stream of ELVs shall follow in the next subsection.

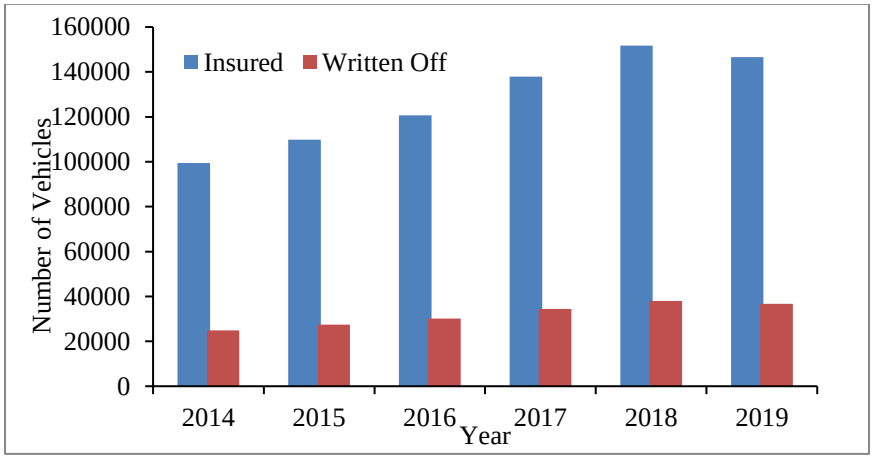

Figure 4.2: Number of insured and written-off vehicles -in Nairobi between 2014 and 2019

4.3.2 ELV Waste Stream 2: The Motor Vehicle Salvage Companies

Out of the 15 motor vehicle salvage companies that were approached, 11 of them responded amounting to a 73.33% response rate. Between 2014 and 2019 the salvage companies received from the insurance companies an average of 25,080 vehicles that they had written off. The field investigation established that 100% of the motor vehicle salvage companies preferred restoration of the written of vehicles as the first resort. The second resort in line is to dismantle the vehicle and sell its parts as used spares to car part shops or dealers. It was also found that 70% of the vehicles received were restored while the remainder was recycled as second-hand vehicle parts or collected for sale as scrap whereas tyres were sold off to dealers who buy and sell second hand tyres. 100% of the respondents disclosed that non-reusable and non-recyclable parts were disposed of for dumping.

4.3.3 ELV Waste Stream 3: The Motor Vehicle Junkyards

The motor vehicle junkyards were also identified as key ELV waste streams. 10 junkyards were selected to investigate how they receive ELVs and ELV waste. 80% of the management of the yards reported that they received ELVs from three main sources, namely; the salvage companies, car garages and from vehicle owners who were unable to restore vehicles that were stuck in their compounds. 100% of the junkyards revealed that they also provided storage space for broken down vehicles, they further revealed that they received these vehicles at a fee and they ended up salvaging reusable parts and sold them to car dealers. 100% of the junkyards disposed of parts that were non-reusable and non-recyclable at the Dandora dumpsite through the regular waste collectors.

4.3.4 ELV Waste Management Practices (Source Reduction, Reusing, Recycling and Disposal) of ELVs in Nairobi, Kenya.

The research results on ELV waste management practices which entail source reduction, recycling, re-use, and disposal of ELVs from the identified ELV waste streams; garages, salvage companies, junkyards and waste management facilities are analyzed and presented in the sub sections below.

4.3.4.1 Waste Types Produced from a Garage

Results revealed that waste types produced at the garages were either in the solid or liquid form. The wastes were further classified as; recyclable, non-recyclable and hazardous. Recyclable waste comprised the largest amount of waste produced at 49%, non-recyclable wastes at 13% and hazardous wastes were at 38%. Recyclables in garages were mainly; metals and plastics, car batteries and rubber (tyres), non-recyclable waste comprised of spoilt seat covers and sponges, electronic parts, whereas hazardous wastes observed included waste oil and used engine oil, oil filters, transmission fluid, power steering fluid, brake fluid, vehicle coolant, acid from car batteries, solvents, degreasers and lubricants.

The survey revealed that out of the 32 garages that were assessed, none were found to separate their wastes. Respondents revealed that only the recyclable waste was deemed valuable and was separated from the rest. The non-recyclable and hazardous wastes were collected for disposal. In addition, it was found that only 4 had put in place a waste management plan representing 12.5% whereas the remaining 87.5% did not have a waste management plan in place (figure 4.3). The 4 garages which had a waste management plan in place separated their wastes while the others did not. None of the garages surveyed had a comprehensive dismantling procedure for ELVs.

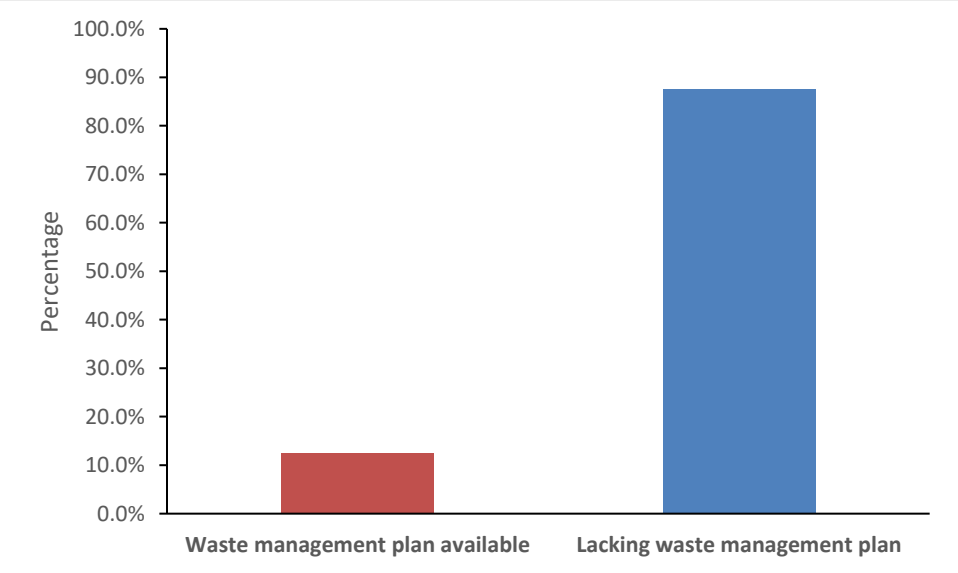

Figure 4.3: Availability of waste management plans in garages

4.3.5.1 Collection and Disposal of Vehicular Waste

Seventeen (17) out of the 32 garages, representing 55% of the total number of vehicles were found to be disposing liquid vehicular waste through licensed hazardous waste collectors, whereas most of the solid wastes were either burnt or collected by regular waste collectors. From the field observations, it was noted that 100% of the garages disposed of inorganic vehicle waste together with bio-degradable commercial and domestic waste. All the 32 garages assessed reported that they dispose of their solid wastes using the regular domestic waste collectors and that there was no specific waste collection firm that dealt with motor vehicle waste.

End-of-Life vehicle parts were either piled on open ground at designated areas within the garages or in containers awaiting collection by a general solid waste collection firm. Out of the 32 garages, 10 garages reported that they use private waste collectors, representing 31.3% of the total sample while the larger 68.8% dumped their solid wastes at central collection points and bins provided by the Nairobi City County Government. Twenty (20) garages representing 62.5% of the total sample reported that they sold ELV parts as used spares.

Liquid wastes were either collected in containers some of which spilled on the ground as most of the garage grounds were found to be oily with extensive soil contamination, a few respondents revealed that there were oil waste collectors who came for the waste oil but did not specify how they disposed of the other liquid wastes. Out of the 32 garages, only 10 had concrete floors representing 31.3% of the total sample while the 22 had earth floors translating to 68.8%. Five (5) out of the 10 garages were situated within petrol stations and were fitted with oil-water interceptors. In some instances, vehicle wastes were left to pile up in the garage such as waste tires, broken panes among other solid malfunctioned vehicle parts and disposed later at the will of the garage's management.

Figure 4.4: The various types of wastes identified at motor vehicle junkyards sampled for this study

4.3.5.2 Electronic Waste Management

The respondents reported that electronic wastes were collected for sale to motorists seeking used spare parts. Due to the high cost of new vehicles spare parts, out of the 32 garages, 25 respondents (78.1%) reported that a greater number of car owners preferred second-hand parts over new ones. They also reported that most car parts dealers did not issue warranties to customers buying electronic car parts causing some car buyers to prefer used parts as they are assured of their functionality and if not, they can easily return them to the sellers and claim for a refund or exchange for one that works well.

4.3.5.3 Waste Tyre Management

The field survey revealed that out of the 32 garages, 28 of them sold fairly used tires. It was also found that out of the 32 garages, 10 of them hired the services of waste tire collectors, and the rest 22 disposed of their waste tires through the Nairobi City County Government waste collectors.

4.3.6 Waste Management at the Motor Vehicle Salvage Companies

Motor vehicle salvage companies received vehicles as a whole. All the 11 salvage companies surveyed did not have a predesigned dismantling and depollution procedure. Vehicle parts that are recyclable are removed, assembled at a collection point where they are segregated and thereafter sold to the respective scrap dealers and recyclers. Parts that could not be recycled were disposed of using the normal waste handlers. All the 11 companies reported that vehicles that could not be restored were cut into pieces to recover parts which were still in good condition and sold to vehicle spare shops. 5 out of the 11 companies had installed oil and water interceptors to their drainage systems. These 5 companies also contracted hazardous waste management firms to collect oil waste among other vehicle effluents such as brake fluid and the automatic transmission fluid. The other 6 companies collected their wastes in containers and disposed them with general wastes.

4.3.7 Waste Management at the Junkyards

Ten (10) major junkyards were assessed within the County of Nairobi. All the 10 yards reported that recyclable and non-reusable parts were taken to the respective recyclers especially the metallic parts, whereas the reusable parts were sold to interested buyers, such as the mechanics or vehicle part dealers. The non-recyclable and hazardous parts were collected within the junkyard for later disposal at the respective dumping sites. None of the respondents were found to engage approved waste collectors for handling hazardous waste. It was also found that 80% of the junkyards dumped their waste at non-designated dumpsites. The improper disposal of hazardous motor vehicle waste, such as lead acid batteries containing heavy metals and acid, endangers the natural environment. Components containing oil and grease pollute soil and water ecosystems. Solid, non-biodegradable, and non-recyclable vehicle parts will accumulate over time.

4.3.8 Waste Management facilities

According to EMCA – Waste Management Regulations 2006 and from the field observations, the only waste management facilities that were found to be designed to standard were the facilities handling hazardous waste. Responses from the ELV waste streams established that the non-hazardous and non-recyclable solid wastes were collected

and disposed of at the Dandora Dumpsite. Evident during field observations and as reported here above some of the waste received at the dumpsites was mixed with hazardous wastes from the salvage companies, garages and junkyards. The field survey also uncovered that NCCG's inability to timely collect solid waste from the source led to accumulation of the wastes resorting to the identified streams illegally disposing of their wastes at uncontained collection points once their bins are full.

It was also uncovered that no waste collection firm was designated to specifically collect ELV waste. Key informants from the NCCG revealed that ELV wastes disposed at the dumpsite are mixed with the general wastes during collection. The Key Informant Interview (KII) also revealed that there was no designated area for ELV wastes at the dumpsite. The NCCG management only weighs the general waste at the entry bridge and the waste truck dumps the waste at appropriate sections as directed by the dumpsite's management, dumpsite cartels and waste foragers. During the KIIs it was also revealed that there were no specific institutions, organizations or companies that were working with NCCG on the management of ELV waste. There were also no Authorised Treatment Facilities (ATFs) which ought to issue a certificate of destruction prior to destruction of any vehicle (European Parliament, 2000).

4.4 Review of the National and County Government Regulations on Management of ELVs

4.4.1 The National Environment Management Authority (NEMA) and the Environment Management and Coordination Act (EMCA) 2015

The status of how various issues in the management of ELV are addressed by NEMA regulations is presented in Table 4.5. The legislative review revealed that NEMA should assess compliance of garages with regards to standards set on establishing effluent treatment units (such as oil-water interceptors), quarterly monitoring of effluent discharge, issuance of effluent discharge licenses, compliance with solid waste management standards and conducting annual self-environmental audits. Out of the 32 garages sampled, only 5 that were situated in a fuel station indirectly underwent EIA representing 15.6% of the total

sample, the rest of the respondents representing 84.4% reported that they were only subject to Nairobi City County's conditions and none by NEMA.

During the survey, key informants from NEMA and NCCG acknowledged that Waste Management is now a devolved function as per EMCA 2015. In this case, NEMA's mandate is only to provide overall supervision and ensuring compliance with the relevant environmental legislation. NCCG is responsible for the management of waste produced within its jurisdiction borders, although all waste management activities should mainly be carried out as stipulated in Waste Management Regulations (EMCA, 2006). Both respondents agreed that there were no specific regulations provided for the management of ELV waste apart from the Waste Tyre Regulations (EMCA, 2013). The presence of the EMCA Waste Management Regulations 2006 on the management of both the solid and hazardous waste components of ELVs was emphasized by NEMA and NCCG. It was also found that no organization was working with NEMA on management of ELV waste, additionally there weren't any plans or programs in place.

Table 4.5: A summary of key issues and responses by NEMA

Policies-Plans-Programs	Status
Presence of waste management regulations specific for ELVs.	Non-existent
Collection of ELV waste by specific waste collectors	Non-existent
Policies for pre-designed procedures on dismantling of motor vehicles.	Non-existent
Provisions for the application of Extended Producer Responsibility.	Non-existent
Provisions for taking back by vehicle manufacturers or brands.	Non-existent
Partnership with local and multinational companies in managing ELVs.	Non-existent
Tax exemptions for the purchase of green technologies such as hybrid engines and electric cars.	Non-existent

According to the survey, there is no existing dismantling policy in both the EMCA Waste Management Regulations and the NCCG for motor vehicles. All of the salvage companies, garages, and junkyards evaluated used internal dismantling procedures that were not predesigned or supported by existing policy frameworks. Furthermore, none of the salvage

companies, garages, or junkyards surveyed had pre-designed de-pollution procedures in place, and their management and staff were not guided by an organized and systematic process for managing hazardous substances. There were no pre-designed management procedures for handling car batteries by any of the garages, but they were only collected and disposed of in the trash bin once it was determined that the cells were not rechargeable. Car batteries contain hazardous waste material and fluid that can be harmful to people who rummage or collect items from trash bins without realizing the danger. Batteries, for example, should be entrusted to designated waste collection firms for safe disposal at locations inaccessible to humans and animals, or they should be completely destroyed at a safe site using safe mechanisms provided by the manufacturers.

Furthermore, the EMCA Waste Management Regulations 2006 provide sufficient guidelines for how hazardous wastes should be managed or handled. Only the 5 garages within the petrol stations used authorized hazardous waste collectors, while the remaining 27 garages dumped the batteries in their central waste bins, which were collected by NCCG general waste collectors. The key informants also acknowledged the presence of the EMCA Waste Tyre Management regulations 2013 which provides guidelines to various entities and individuals on how to manage and treat waste tyres.

Personnel who handle, store, or dispose of batteries must be fully aware of the requirements outlined in OSHA 2007 and the EMCA Waste Management Regulations. Knowledge of how to use appropriate tools and personal protective equipment (PPE) for safe lead acid battery handling. Lead acid batteries, which contain toxic fluids and heavy metals, are extremely harmful to the natural environment if they are not handled or managed properly. According to the survey, only the five garages located at the filling stations were aware of the use of PPE. The use of appropriate PPE in handling hazardous vehicle waste and components is clearly provided in the OSHA 2007 regulations; through this Act, all ELV waste generators and handlers operating the entities under research (the salvage companies, garages, the junkyards and the dumpsites) should acquire the Certificate of Registration of Workplace as provided in the OSHA 2007 regulations, The facilities would therefore be subject to requirements such as the OSH Audits, EHS Risk Assessment and relevant OSH

trainings. Only the 5 garages situated at the filling stations had acquired the Certificate of Registration of Workplace, they had records of OSH Audits and trainings carried out whereas the other entities such as the salvage companies only had business permits issued by NCCG, the remaining waste streams i.e. the garages and junkyards did not have any statutory licenses or permits.

Extended Producer Responsibility (Take-back Incentives)

NEMA revealed that there was no Extended Producer Responsibility policy framework provided in the EMCA - Waste Management Regulations 2006 to regulate ELV Waste and facilitate vehicle take-back by manufacturers. None of the 32 respondents from vehicle garages confirmed the existence of vehicle brands that take back ELVs in whole or in parts.

Vehicle Importation

Regarding vehicle importation, the key informant explained that NEMA's mandate is enshrined in the EMCA Air Quality Regulations 2014, which aims to ensure that all cars imported into the country meet the policy's emission criteria. It was also revealed that since late 2006, these vehicle inspections have been carried out in collaboration with the Kenya Bureau of Standards and an accredited vehicle inspection agency, during the field survey QISJ was found to be the authorized vehicle inspection agency in Kenya. NEMA has the authority under these regulations to order the inspection of any vehicle emitting visible exhaust emissions at any time. According to the informant, the majority of Kenya's economic class can afford used vehicles, which are less expensive than new vehicles. The eight-year rule for car imports is an indirect environmental management measure put in place to reduce the influx of used and old vehicles into the country.

The study also sought to ascertain whether the EMCA 2015 offers any incentives for the purchase of green technologies. Although there was no explicit strategy to encourage the importation of greener technologies, NEMA did occasionally fund awards such as the Company of the Year Awards (COYA) with a clear message to adopt and clean technology.

4.4.2 Nairobi City County Government (NCCG) - ELV Waste Management Regulations

Aside from the EMCA Waste Management Regulations 2006, which were adopted by the NCCG, it was determined that there were no regulations or policies specifically governing ELV wastes provided by the NCCG. The key informants revealed that there were no specific regulations for ELV waste collection. It was also discovered that there were no designated sites for the disposal of ELV waste. The key informants also revealed that there were no extended producer responsibility policies in place to govern the treatment and disposal of parts by the various vehicle brands.

Other regulations that were reviewed in light of the study include the; Traffic Act – CAP 404, Insurance Act (Amendment) – CAP 405, Public Health Act – CAP 242, OSHA 2007 and Kenya Bureau of Standards Legal Notice No. 78, Value Added Tax Act 2013, Excise Duty Act 2015, Miscellaneous Fees and Levies Bill, 2015. Table 4.6 below is a summary of the findings on what they had in place with respect to management of ELVs and ELV waste.

Table 4.6: Existing policies and acts on ELV waste management in Nairobi City County

Regulation	Findings
Nairobi City County Government Laws on Solid Waste Management	No such laws were existing, NEMA's EMCA Waste Management Regulations were in use with adequate guidelines on how various kinds of solid waste should be managed.
Traffic Act – CAP 404	The act primarily regulates car registration, licensing, and driving licenses, as well as traffic regulation, designated parking areas, accidents, and the suspension, revocation, and endorsement of driving licenses. If a vehicle has been left on a road or in a public location that may jeopardize the safety of road users or the surrounding neighbourhood and appears to have been abandoned, and the owner or driver cannot be located, the act's subsection 106 applies. It is legal for any officer or inspector to take the vehicle to the police station or to a location that is deemed safe depending on the conditions of the officers. The act only provides that an abandoned ELV can be towed to the police station by the police.
Insurance Act (Amendment) 2006, CAP 405	Stipulates that all vehicles should be insured against third party risks but there are no clauses providing for the management of vehicles which have been written off. Procedures for handling and disposal of the ELVs and ELV waste were in-existent.
Public Health Act, CAP 242	It was uncovered that this Act did not have anything specific in regard to management of ELV waste but stipulated that the act shall be used in case of any regulatory inadequacies. Any factory or trade premises emitting or producing disagreeable odours or effluvia that is hurtful or dangerous to health is defined as an element of nuisance, according to section 118. A notification must be served on the owners of the property where the nuisance originates. Water sources are also under the protection of public health officers. Schedule 16 of Section 126 forbids the discharge of solid matter, steam, chemical waste, and other materials into sewers. The act's provisions should suffice in terms of ELV management.
OSHA 2007	Section 11 of the Act stipulates that an occupier of a workplace should subject their premises to a thorough safety and health audit at least once annually. The ELV waste streams ought to comply with this provision.
Kenya Bureau of Standards Legal Notice No. 78	The following policies were found to be relevant to the study; An imported vehicle must be less than 8 years old from the year of first registration.
The following tax regulations relevant to the study were reviewed, They include the; Value Added Tax Act 2013 Excise Duty Act 2015 Miscellaneous Fees and Levies Bill, 2015	With reference to these Acts, imported vehicles are subject to; Import Duty Taxation, Excise Duty Taxes, Value Added Tax, Import Declaration Fees and Railway Development Levy respectively.

CHAPTER FIVE

5.0 DISCUSSION

This Chapter offers an interpretation and discussion of the results presented in Chapter Four on the basis of the researchers' understanding of the research problem, past findings, existing literature on the research and current best practices. The chapter discusses the results in the order of the study objectives.

5.1 Vehicle importation trends in Kenya and Nairobi City County

The sole purpose of assessing the trends of importation of vehicles in Nairobi was to demonstrate the looming environmental concern with reference to the quantity of vehicles imported, these vehicles are likely to turn into ELVs and contribute to the volume of ELV waste produced; therefore, the need to assess the adequacy of management systems in place to regulate this technology.

As per the study findings, it's evident that the number of vehicles imported into the country has been on the rise over the last six years, from these statistics, a consequent rise in the number of ELVs was projected. With an annual incremental rate of 52.1% on the importation of used vehicles within the last 6 years, a similar projection is expected for ELVs. The Kenyan market is highly inclined to secondhand vehicles imported especially through Japan due to their affordability. A steady rise in importation and purchase of both new and used vehicles has been recorded due to attractive credits offered by financial institutions to the country's middle class. (Africa D., 2016). Given the high number of vehicle dealing companies in Nairobi City County, this study sampled 5 car dealing companies which imported approximately 4000 units per annum. This is indicative of a looming crisis with regards to ELV waste management and therefore a definite cause for alarm for the Government of Kenya to put in more efforts to manage the technology. NTSA also provides that within 3 years 872,191 vehicles were registered in the Capital of the Country, Nairobi, these numbers are a clear illustration of the high demand for the technology.

The Kenyan Government has set an importation age limit of eight years old (KEBS, 2005); and findings from the study indicate that a majority of the cars imported into the country are almost 8 years old. With a global average age of 11.6 years (Cruz, 2018), most of these vehicles are expected to contribute to the ELVs stock within 3 years. As established in this study there has been an 89% shoot in imported cars between 2016 and 2017, this exacerbates the ELV waste management situation in Nairobi City County. Furthermore, Jeff and Gregory (2001) established that measuring the median life expectancy of vehicles is one basis for determining a typical ELV. Almost similar to the 11.6 years vehicle age provided by Cruz, 2018; Jeff and Gregory (2001) established that between 1970 and 1990 the average vehicle lifetime of automotives ranged from 11.3 to 14 years respectively. With respect to these findings, the numbers of vehicles estimated to add to the ELV stock annually in Nairobi City County are 150,500 units.

Singare (2012), established that with the spread of technology, industrialization and increasing standards of living, India is under threat from the accumulation of non-biodegradable solid waste which he described as an unnoticed side-effect of development. The case is not different in Kenya, with the anticipated increase in ELV waste and considering the nature of vehicle body parts mostly being made of non-biodegradable materials, this means if not timely and sustainably managed they will eventually accumulate and possibly lead to irreversible environmental damage. It's also prudent to note that some wastes produced from the ELV streams were hazardous; this translates to increased exposure to health hazards and high risk of environmental pollution and contamination. To deal with this, the government should strengthen and formulate regulations on the management of ELVs in the country. From the field survey and literature review there was no data on number of ELVs produced in Kenya and also quantities of ELV waste produced. According to Sakai *et al*., (2013), the number of ELVs in EU member states, Japan, and Korea is required to be reported under their legislative ELV recycling systems, whereas the numbers in other countries are usually reported by the recycling industry, which plays a major role in the ELV recycling processes.

More than 96% of automobiles imported into Kenya are used, according to the UNEP's Africa Used Vehicle Report (2018). It was also pointed out that Africa buys four times as many automobiles as it exports. Only Egypt, South Africa, Sudan and Morocco have outright banned the import of secondhand vehicles in Africa. According to the research, 16 nations allow the importation of used automobiles aged 6 to 9 years and impose an extra tax up to 9 years, but 24 countries prohibit the importation of used vehicles aged 10 years and more. These are strategic steps used by countries to regulate motor vehicle importation.

5.2 ELV Waste Streams in Nairobi City County

With an annual average of 31,921 vehicles written off, the study established that insurance firms were the key source of ELV waste. This is a significant number considering a motor vehicle mainly comprises of non-biodegradable waste. This research also revealed that the ratio of written-off vehicles to insured vehicles was 1:4, meaning that approximately 1 out of every 4 insured vehicles gets written off. Steel, aluminum, copper and plastics are among the many materials used to construct automobiles. Steel continues to be the most heavily used component in automobiles, accounting for more than 60% of the weight of the average vehicle. (Forbes, 2015). Steel is viewed by automakers as a cost-effective, highly formable material that maintains its durability, strength and stiffness (Ashley, 1997). As provided in Kenya's Traffic Act, CAP 403, a Class B1 vehicle is a light passenger vehicle that weighs an average of 3500kgs. With reference to components of a vehicle being made of non-biodegradable material, an average of 31,921 vehicles written off annually will translate to approximately 31,921*3500=111723500Kgs or approximately 111,723 tonnes of a non-biodegradable composition.

Kenya being a developing nation, with a greater population preferring to buy used cars that are less expensive, the written off vehicles were either cut into pieces and stripped off their components if the vehicles could not be salvaged or, the vehicles were repaired by the salvage companies who then sold the cars to willing buyers, that's if the insurance firms found the vehicles to be quite expensive to repair into a close to original or roadworthy state. This was evident during the field survey when 70% of the vehicles received by the salvage companies were restored while the remaining 30% were recycled as second-hand

vehicle parts or collected for sale as scrap whereas tyres were sold off to dealers who buy and sell used tyres.

According to Sullivan (2005), the amount of steel stocks in use in the United States in 2002 was 4.13 billion metric tonnes, with vehicles being one of the main contributors. USGS (2006) revealed that already processed steel in automobiles indirectly forms part of the US steel stock. With respect to these findings and comparing with the Kenyan situation, ELVs can raise a reasonable amount of resources when these materials or parts can be resold for reuse, segregated and recycled.

As per the results, all 14 insurance firms had a standing contract with salvage companies to receive the written-off vehicles. These firms and the junkyards were identified as next line in the ELV waste stream. These salvage companies, junkyards and garages did not have predesigned dismantling and de-pollution procedures to facilitate for effective handling of ELV waste. The 3R Integrated Solid Waste Management (ISWM) Principles were not applied by all these ELV waste handlers. Best practices at these point sources can be applied through the regulation of these ELV and ELV waste handlers. These organizations also ought to have sufficiently equipped facilities that can aid in the implementation of the 3R principles.

5.3 The current ELV Management Practices (Reducing, Re-using, Recycling and Disposal) in Nairobi, Kenya.

The study found out that the identified waste streams and the NCCG lacked strategic management plans to facilitate for implementation of the 3R principles. The waste management hierarchy begins at the source, this therefore means a management structure should be the first resort to guide parties dealing in the sector on how best to manage ELVs and ELV waste. This can only be actualised through policy frameworks that will facilitate in implementation of such strategies. The European Union established the ELV Directive (2000) whose main aim was to make dismantling and recycling of ELVs friendlier to the environment.

The survey findings revealed that 100% of the insurance firms did not directly handle ELV waste but engaged the services of salvage companies and garages. The salvage companies did not deal with the written-off vehicles only as waste but rather tried to restore them to their original state; vehicle parts that were affected were removed for recycling or disposal depending on the parts' material i.e. if made from metal, plastic or rubber. Plastics recycling, automobile glass management, waste tire management, mercury-containing switches, aluminium scrap sorting and design for recyclability are six important priority areas in ELV management, according to Jeff and Gregory (2001). They also offered an overall ELV processing system and associated materials streams, which included ASR dismantling, shredding, material separation and processing post-shredder, and eventually landfill disposal. They also stated that when a vehicle was decided to be retired from the road, it was transported to one of two categories of dismantlers: High Value Part Dismantlers and Salvage/Scrap yards. The ELV Directive (2001) further provides that only Authorized Treatment Facilities (ATF) that shall meet standards as provided in the regulation are allowed to receive ELVs for treatment. It's the UK's Environmental Agency's mandate to ensure that these facilities meet the set standards. Advanced recycling and reuse of ELV waste is realised through predesigned dismantling procedures, recovery and material processing at these facilities. In Nairobi City County, there were no such policies and guidelines existing and both the salvage firms and the ELV yards lacked equipment for shredding and processing the ELV waste. With reference to the findings on strategies adopted by the EU (Jeff and Gregory, 2001), the Salvage firms and ELV junkyards can be recommended for designation as the authorized ELV waste handlers.

The field survey also found out that there are no specific waste-collecting firms that were dealing with ELV waste and that wastes from the garages were collected by the general waste collection firms. This implied that motor vehicle and ELV wastes are disposed of together with general waste at the dumpsite. Key informants from NEMA and the NCCG also reported that there is no designated area for disposal of ELVs. Designating Authorised Treatment Facilities (ATFs) and landfilling of non-recyclable wastes is a feasible solution to this problem.

As per the findings, all the salvage firms and ELV junkyards did not have waste management plans in place. It was found that 12.5% of the garages assessed had waste management plans in place, and that they separated their wastes, whereas the remaining 87.5% neither had a waste management plan nor separated their wastes. It was also evident that the 12.5% garages, which had the plans in place were able to significantly manage various waste types and tried to apply the 3R ISWM principles. This demonstrates that the presence of a waste management plan enhances the implementation of the 3R ISWM practices. Separation of ELV waste can also be augmented through the development or adoption of predesigned dismantling procedures, which can best be used by the salvage companies receiving the written-off vehicles from insurance companies. Defra and Bis (2011) provided detailed guidelines for depollution and dismantling ELVs. In addition to the use of the International Dismantling Information System (IDIS), they recommended to the Authorized Treatment Facilities (ATFs) to obtain further information on specific and suitable depollution and dismantling procedures.

The field survey revealed that 49% of the waste produced at the garages was recyclable and if there were ELV take-back incentives in place, separation and recycling of ELV waste could have been enhanced, since even without the incentives 62.5% of the garages which were assessed revealed that they sold ELV parts as used spares.

78.13% of the respondents further revealed that a greater number of car owners preferred second-hand parts over the new ones, which was because most brand-new spare parts were more expensive and also dealers did not give warranties especially for electronic parts. This demonstrates that there is a greater likelihood of a market that prefers used parts, which can therefore be refurbished and reused. Vehicle manufacturers can consider the take-back of recyclable vehicle parts to help in cutting down the non-biodegradable ELV waste influx at the dumping sites. It was also noted that some parts were collected for recycling due to their material composition's market value when taken to the recyclers. According to Jeff and Gregory (2001) some of the authorized ELV recipients dismantled vehicle parts mainly to make profits from recovery and sale of used vehicle and ELV parts. This illustrates that

there is ready market for ELV parts as there are businesses which have been set up to sell these parts.

Iintegrated Solid Waste Management (ISWM) of the motor vehicle technology should entail strategies to reduce the production of waste from the source, i.e. through the manufacture of durable and long-lasting vehicle parts. By the fact that most vehicle parts imported into the Country have already been used, there is a need to regulate the importation of used vehicles and come up with incentives to encourage the purchase of new vehicles.

The local legislative frameworks should be enhanced to ensure vehicle manufacturers selling vehicles in the Country are bound by the Extended Producer Responsibility Principle similar to that provided by OECD (2001). Collection and disposal of waste should be done by specific waste collectors to facilitate for treatment and disposal of ELV waste. All the aforementioned strategies demonstrate that appropriate ELV management practices can be realized through improving legislative and regulatory frameworks, as well as providing funding to necessary authorities to create ELV Management Systems and infrastructure.

The study findings unveiled that 38% of the wastes produced from the garages were hazardous. The wastes observed to be under this class included waste oil, used engine oil filters, transmission fluid, power steering fluid, brake fluid, vehicle coolant, acid from car batteries, among other fluids, solvents, degreasers, and lubricants. The findings further showed that most of the garages collected their liquid wastes in basins, a method which was ineffective as the garage grounds were found to be significantly polluted with oil and grease negatively impacting on the soil. Only 5 garages which represented 15.6% of the total sample had concrete floors which enabled oil-water interception. 68.8% had earth floors and without oil water interceptors, implying that significant quantities of hazardous liquids are discharged into the drainage system consequently contaminating surface and underground water ecosystems. The salvage companies also had a similar setting as the normal garage, 80% were outdoor setups without concrete flooring and proper drainage for

oil-water separation. They also disposed of hazardous car components such as the non-reusable vehicle batteries into bins later collected by the domestic waste handlers.

Stringent waste management policies and guidelines for the salvage companies and garages should be put in place to mitigate the associated environmental pollution. UIC Regulations (1999), Class V Rule provides that a Motor Vehicle Disposal Well which is a facility that takes the form of floor drains, work sinks, or washbasins leading to dry-wells, cesspools or septic systems. These "wells receive fluids from vehicle repair or maintenance activities, such as an auto body repair shop, automotive repair shop, new and used car dealership, specialty repair shop (e.g., transmission and muffler repair shop), or any facility that that does any vehicular repair work." These rules have facilitated sufficient safeguard of underground and surface water ecosystems from hazardous motor vehicle effluents in the US. In Kenya, the EMCA – Water Quality Regulations 2006 prohibits discharge of effluent into the environment in violation of established standards, and also states that no person shall discharge any effluent into the environment from sewage treatment works, industry, or other point sources without a valid Effluent Discharge License (EDL) issued by NEMA. Conditions such as the installation of oil-water interceptors by facilities that carry out operations that cause to oil spills are provided following the issuing of the EDL. All other garages, with the exception of those attached to fuel stations, lacked oil water interceptors. The introduction of a policy similar to UIC Regulations, 1999 would be most ideal to mitigate the impact posed by spillage of hazardous effluents.

It's high time that the auto-recycling industries are also encouraged in Kenya, similar to countries such as the US where auto recycling industries are established, with about 95% of 12 million ELVs are recycled yearly (Cruz, 2018). ELVs are one of the most recycled consumer products in Australia (Department of Environment and Heritage, 2002). This is something Kenya should encourage because it will help the country's economy, create jobs and clean up the environment.

ELVs like other technologies ought to be treated on its own, considering the current rate of importation of both new and used vehicles. The rate at which they are being purchased,

wear out and disposed of is high, hence a validated cause for alarm on their handling, treatment and disposal.

5.4 Review of the National and Nairobi City County Government Regulations in Management of ELVs.

5.4.1 EMCA 2015 and the Subsidiary Regulations

The majority of the study's concerns are about environmental management and would be best addressed through EMCA (2015) and its subsidiary regulations. Waste management is a devolved function in the country, and it has been established that NCCG is mandated to provide relative waste management infrastructure, whereas NEMA's responsibility is to develop Waste Management Policies and ensure that parties comply. The study, however, revealed that NCCG issued licenses only to allow interested parties to conduct business within the County which is a limited approach. Through EMCA 2015, the National Government can consider the formulation of a specific ELV management policy and due to the magnitude of ELV related concerns as provided in the EU among other international states. The existing regulations in Kenya do not stipulate what an ELV is whereas the European Parliament Directive of 2000 provides that there must be 4 clear distinctions and indicators among vehicle types outlined as follows:

• Type 1: Operational used vehicle (non-waste): intended for direct reuse- contracts, proof of roadworthiness test, aspect: tires profile, no corrosion, etc.
• Type 2: Repairable used vehicle (non-waste): evidence of valid roadworthiness test certificate, declaration repairable, minor repairs, no safety risk.
• Type 2a: Vintage cars/vehicles (non-waste).
• Type 3: Waste vehicle – depolluted (non-hazardous waste): proof that all hazardous liquids and components removed.
• Type 4: Waste vehicle wreck not depolluted (hazardous waste)- no registration, last roadworthiness test for more than 2 years, repair costs exceed the value of the vehicle, battery, fluids not removed, etc.

The Environmental Impact Assessment and Audit Regulations 2003 were one of the first subsidiary regulations developed under the Environmental Management Act of 1999. These regulations require any facility that may have a significant impact on the environment to conduct an EIA Study prior to project implementation. The EIA process had not been completed by any of the salvage companies or vehicle junkyards. Because they were located within gas stations, the five garages investigated had gone through the EIA process inadvertently. Subjecting these waste streams to EIAs and Annual Environmental Audits will encourage the use of best ELV management practices while also ensuring compliance with existing local and international environmental statutes.

The EMCA Waste Management Regulations (2006) have so far provided compliance requirements for the management of domestic waste, industrial waste, hazardous wastes, pesticides, and toxic substances, biomedical wastes and radioactive substances. The EMCA (Waste Tyre Management) Regulations, 2013 partly addresses ELV waste management by regulating management and disposal of a motor vehicle part which is non-biodegradable that will cause various public health and environmental impacts if not well managed. It's also through the Waste Management Regulations that a waste collection firm that deals with ELV waste can be specified. The Extended Producer Responsibility principles provides that vehicle manufacturers can put in place take-back centers that receive ELV waste from their vehicles (OECD, 2001).

The National Environment Policy of 2013 did not include any practical procedures for managing motor vehicles and ELVs. Several existing policies have been sustainably formulated and implemented by developed nations worldwide, as indicated in the literature review section on policy review. These policies define appropriate roles for relevant business entities, such as automobile manufacturers and technology inspection institutions. According to the OECD's extended producer responsibility concept (2001), automakers and importers are required to collect and recycle (or destroy in the case of CFCs) airbags and shredder residues generated during the ELV treatment process. By establishing regulations for collection and distribution of ELVs between collecting businesses and shredding companies, a recycling network is built to ensure that shredder residue and other

wastes are supplied to the makers. To cope with the environmental effects of 9 million tonnes of vehicles that reach the end of their useful lives each year in Europe, the Europe Commission (EC) created the End-of-Life Vehicles (ELVs) Directive (Edwards *et al*., 2006). The ELV Directive has been the driving force to improve environmentally (de-pollution and phase-out of hazardous materials) and resource efficiency performance (recycling and recovery sub-quota). These policies were found to be inexistent in the Kenyan context and are ideal for adoption by the Kenyan National Government for sustainable management of ELVs and ELV waste when vehicle manufacturers have a role to play in managing waste generated by their products.

5.4.2. ELV Waste Management Regulated by the Nairobi City County Government

In order to better understand the impact of government regulations and municipal policies, the study solicited feedback from the NCCG on various aspects of ELV management in Nairobi. Because waste management is a devolved function in Kenya, it is the County Government's responsibility to manage waste generated within their jurisdiction. NCCG did not provide a clear guide on the management of ELV waste at the ELV waste streams based on the KII questionnaire administered. Licenses issued to waste collectors, garage operators, salvage companies, and junkyards were also devoid of specific conditions governing the handling and disposal of ELV waste.

As per the study, waste collectors disposed of collected motor vehicle waste from the waste streams at the open Dandora Dumpsite. Instead, ELV and general garage waste should be separated at the source, separating recyclables from non-recyclables, and then disposed of in a controlled landfill. It is important to note that while it is the NCCG's responsibility to design a waste management site, NEMA also plays an important role in providing NCCG with guidelines on how to design such facilities.

Other regulations examined such as the tax laws did not encourage importation of brand-new vehicles, electric and hybrid vehicles. Reducing the age of imported vehicles will result in a significant increase their lifespan and, as a result, a decrease in the amount of ELV waste produced. ELVs in various way may pose adverse impacts to the natural

environment necessitating the need to develop specific mitigation measures guided by environmental policies. In the Kenyan context, and as revealed by the study, several policies exist to regulate the management of solid and hazardous waste type but they aren't designed in a manner that facilitates for ISWM of ELVs, ELV waste and general motor vehicle waste.

According to the UNEP's Africa Used Vehicle Report (2018), Mauritius' tax law waives a % Excise Duty on electric and hybrid vehicles, and the registration fee has also been reduced by 50 %, resulting in a significant increase in the importation of these vehicles. The majority of the used vehicles they import are from Japan, and they have a three-year age limit. In Ghana, used vehicles older than five years are subject to a graduated penalty based on the year of manufacture and capacity. African countries have used a variety of techniques to mitigate the effects of motor vehicle technology on the environment. Similar strategies are advocated for implementation in Kenya in order to mitigate the looming environmental threat.

In Nairobi City County, a lack of adequate policies and regulations governing the management of ELVs will result in further environmental damage. Based on this extensive review and discussion, it is clear that developed countries have been working for years to improve their ELV management systems, it is time for Kenya and Nairobi City County Government to start developing policies and infrastructure to regulate and manage the automotive sector.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

According to the findings of the study, a significant number of ELVs are produced each year in Nairobi City County and, moreover, throughout Kenya. Due to a lack of awareness among ELV waste streams about the environmental impacts of ELV waste, inadequacies in existing regulatory frameworks, and a lack of law enforcement, ELV waste and motor vehicle wastes in general were not disposed of properly. It was also discovered that ELV parts have a ready market, making the Extended Producer Responsibility Principle and take-back incentives feasible.

Based on an examination of the trends in the importation of used vehicles, it is clear that there has been an increase in demand for vehicles in recent years. This high importation trend has resulted in production of large amounts of ELVs and ELV waste. Strategic mitigation of the impacts posed by the influx of motor vehicles within Nairobi City County and Kenya at large can be realized through the long-term implementation of various combined techniques, some of which have been shared in the discussion and recommendations section in the following sub-chapter.

The 3R (Recycle, Reuse, and Reduce) ISWM principles were not effectively implemented at the various waste streams, making it difficult for the County to appropriately handle and treat ELV waste. This study also discovered that no comprehensive legislative frameworks and/or policies were in place specifically for the management and regulation of ELVs.

According to the literature review, Kenya's ELVs waste management systems are underdeveloped in comparison to countries like the United States, the European Union, and a few in Asia like Japan, North, and South Korea. These countries have policies in place to ensure that ELVs are managed effectively. Kenya has yet to develop policies that regulate motor vehicle technology from its inception to its final disposal. The country must formulate these specific policies as soon as possible in order to alleviate and mitigate the environmental impacts caused by this technology.

6.2 Key Recommendations of the Study

The key recommendations of the study are:

1. Vehicle manufacturers can consider the take-back of recyclable vehicle parts to help in cutting down the non-biodegradable ELV waste influx at the dumping sites.
2. There is a need to regulate the importation of used vehicles and come up with incentives to encourage the purchase of new vehicles in order to reduce the rate at which the ELV waste products are generated.
3. Collection and disposal of waste should be done by specific waste collectors to facilitate for treatment and disposal of the ELV waste.
4. Encouraging the establishment of Authorized Treatment Facilities is recommended to recycle and process motor vehicle waste auto-recycling companies in Kenya which can also contribute to the country's economic growth by create jobs, and cleaning up the environment.
5. All ELV waste streams to develop and submit waste management plans to the relevant authorities (NEMA and NCCG) for approval and to acquire predesigned vehicle dismantling and depollution procedures.
6. Subjecting the various waste streams to environmental impact assessment and environmental audits as stipulated in the EMCA 2015 regulations to enhance implementation of best ELV management practices and ensure compliance with the required or set standards.
7. It is recommended that interventions to take-back and recycle ELVs between the local organizations (such as NEMA and NCCG) and vehicle manufacturers be developed and implemented. This shall facilitate the achievement of the two principles of ISWM of re-use and reduce.
8. For the government to formulate an ELV Management Policy. The Policy will specifically provide guidelines on how ELVs and ELV wastes should be handled, treated and disposed of. These regulations should also provide for the application of Extended Producer Responsibility Principle and Take-Back Incentives by the respective vehicle manufacturers.
9. Further research on the possible impacts posed by ELVs is also recommended.

10. Automobile manufacturers and importers (hereinafter referred to as "manufacturers, etc.") should be required by law to collect and recycle (or destroy in the case of CFCs) airbags and shredder residues generated during the treatment process of ELVs under the concept of extended producer responsibility.
11. An action plan to execute policies formulated should be developed, providing timelines for each element recommended systematically, prioritizing implementation based on the nature of elements to be addressed. Programs to implement this action plan should be running simultaneously. Some of these programs may include; bilateral arrangements especially with the East African Community, bringing onboard stakeholders to support the course, carrying out regional and international investor summits showcasing the business opportunities available in the sector; addressing gaps within the EU and other trade partners' environmental policies regarding the motor vehicle technology, and regulations to be revised with intent to protect East African Community countries importing new and used vehicles. Coming back home, programs should focus on actualizing this course, involving the relevant stakeholders at the national, county levels among other significant administrative constituents.
12. A strategic approach is needed to regulate automobile technology, considering our dependence on it and the demand. Reducing the reliance on private means of transportation by improving the public transport system through designing and implementing sustainable and effective transit systems, such as the bus rapid transit systems, mini trams among other recently adopted solutions shall cumulatively reduce the need to own a private vehicle.
13. Some recommendations can be achieved in the short term, while others can be achieved in the long-term plan.

6.3 Suggestions for Further Research

Since research on ELVs is limited in Kenya and Africa in general, there is a need for studies to be conducted on the best methods for management of ELVs and ELV waste in the Country to mitigate the impacts they have on the environment. Further studies could be

conducted on the economic viability of establishing ELV recycling plants locally and also with the support of the East African Community.

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APPENDICES

APPENDIX 1

Interview Schedule for Companies and Governmental Authorities and Institutions

i) Questionnaire Administered to the National Environment Management Authority

1. What legal and regulatory provisions do you have in place concerning garage operations?
2. What terms and conditions are in place for the operation of garages?
3. What policies or programs are in place about general vehicle management and also ELVs?
4. Are there specific policies in place that facilitate in management of ELV waste?
5. Are there any government, non-governmental or private institution that works with NEMA regarding ELVs general vehicle management?
6.

a. Are there specific emission standards for motor vehicles i.e. for both new and old vehicles?
b. What measures are in place to ensure standards prevail considering the nature of the motor vehicle technology?

7.

a. What does NEMA look into matters on vehicle importation?
b. As the environmental management authority, are there incentives provided for the purchase of Environmentally Friendly/Green Technologies?

8. Are there any regulations provided by NEMA concerning servicing of vehicles?

APPENDIX 2

ii) Questionnaire Administered to The Nairobi City County Government.

1. Do you have specific waste collectors for ELVs and vehicle spare parts?

   Yes No

   Please Elaborate

2. Do you have designated sites or facilities for managing ELV waste?

   Yes No

   Please Elaborate

3. Do you measure the volume of ELV Waste you receive?

   Yes No

   If yes, how many tones of ELV waste have you received in the past five (5) years?

2017 – 2016
2016 – 2015
2015 – 2014
2014 – 2013
2013 – 2012

4. Generally, how do you handle ELV waste at the moment?
5.

a. Do you need any support regarding the management of ELV waste?
b. Is there any arrangement in progress about the same by a local or international organization?
6. What impacts have you experienced so far concerning the current management of ELVs?
7. Give general guidelines on how ELV Waste should be managed?

APPENDIX 3

iii) Questionnaire administered to Car Garages.

1. What kinds of wastes are mainly produced from your garage?
2. How do you handle these wastes?
3. Do you have an ELV waste management system or general waste management policy?
4. Where and how do you dispose your wastes?
5. Which company handles waste from your garage?
6. How do you handle ELVs in your possession?
7. Do you have a vehicle dismantling procedure in place?
8. For ELVs dismantling, what is your de-pollution procedure?
9. How do you handle battery waste?
10. How do you handle vehicle fluids and grease?

a) Engine Oil
b) Brake fluid
c) Fuel

11. How do you handle vehicular electronic waste?
12. Are you aware of car manufacturers or dealers providing extended producer responsibilities such as ELV take back?
13. Are there car dealers who take back vehicle spare parts for recycling or selling?
14. Do you know of companies that can repair or fabricate universal spare parts?
15. How do you handle waste tires?
16. How do you gauge the performance of an ELV as compared to new vehicles?
17. What tests do you carry out to check on engine performance and exhaust emissions?
18. How can we mitigate harmful exhaust emissions from motor engine technology?
19. What mechanical challenges have been frequently experienced by new-vehicle owners?
20. What mechanical challenges have been frequently experienced by second-hand vehicle owners?
21. How often should a vehicle undergo complete service or mechanical checkup?

22. Averagely how many vehicles do you repair in a week?

Between 5 and 10
Between 10 and 20
Between 20 and 30
Between 30 and 40
Between 40 and 50
50 and above

23. Out of these vehicles, what's your estimate on new to old vehicles?
    (From records if available)
24. Give a critical view on the importation of used vehicles.

APPENDIX 4

iv) Questionnaire administered to KRA, NTSA and Car Dealers in Nairobi, Kenya

1. What have been the trends of importation of used vehicles in the past decade?

Year	Number of Used Vehicles Imported
2016	
2015	
2014	
2013	
2012	
2011	
2010	
2009	
2008	
2007	

Year 2016	
Month	**No. of Vehicles Imported**
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Year	No. of New Vehicles Imported
2016	
2015	
2014	
2013	
2012	
2011	
2010	
2009	
2008	
2007	

2. Who inspects the used vehicles imported into the country?
3. Do you have adequate equipment for carrying out tests during vehicle inspections?
4. Are these vehicles tested by our own engineers to ascertain that they are suitable for use both mechanically and environmentally?

   If not how do you authenticate test results provided by manufacturer or car dealer?
5. What common laws and regulations have been applied in regard to importation of used vehicles? (with reference to age and country of origin)
6. Are there any tax exemption incentives for automobiles?
7. What are your suggestions and recommendations in regard to importation of used vehicles into the country and their management? (up to their disposal)

Name of Interviewee	
Organization	
Job Title	
Location	
Signature	

APPENDIX 5

v) Questionnaire administered to the Insurance Firms

1. (a) How many vehicles were insured annually since 2014 nationally? Please give details below:

SN	Year	PSVs	Personal	Trucks & Heavy Commercial	Others	Total
1	2019					
2	2018					
3	2017					
4	2016					
5	2015					
6	2014					

(b) How many vehicles were insured annually since 2014 in Nairobi City County? Please give details below:

SN	Year	PSVs	Personal	Trucks & Heavy Commercial	Others	Total
1	2019					
2	2018					
3	2017					
4	2016					
5	2015					
6	2014					

2. (a) Approximately how many of the insured vehicles have been written off annually nationally since 2014? Please give details below:

SN	**Year**	**PSVs**	**Personal**	**Trucks & Heavy Commercial**	**Others**	**Total**
1	2019					
2	2018					
3	2017					
4	2016					
5	2015					
6	2014					

(b) Approximately how many of the insured vehicles have been written off annually in Nairobi City County since 2014? Please give details below:

SN	**Year**	**PSVs**	**Personal**	**Tracks & Heavy Commercial**	**Others**	**Total**
1	2019					
2	2018					
3	2017					
4	2016					
5	2015					
6	2014					

3. How do you dispose-of vehicles which have been written off?
4. Do you sell the vehicle remains yourself or through contracted agents? [ ]Yes
   [ ]No
   Please give details
5. Are there any vehicle take-back incentives offered by vehicle manufacturers or vehicle spare part dealers? [ ]Yes_ [ ]No
   If Yes please give details

APPENDIX 6

vi) Questionnaire administered to the automotive salvage companies and ELV yards in Nairobi City County

1. How many ELVs have you received annually since 2014? Please give details below:

SN	Year	PSVs	Personal	Trucks & Heavy Commercial	GK Vehicles	Others	Total
1	019						
2	2018						
3	2017						
4	2016						
5	2015						
6	2014						

2. Where do you receive most of your End of Live Vehicles from?
3. What percentage of ELV vehicles received are accident vehicles? [……..%]
4. How do you handle (what do you do with) the following types of vehicle parts after dismantling?

a. Reusable vehicle parts?
b. Recyclable but non-reusable vehicle parts?
c. Non-recyclable vehicle parts?
d. Hazardous vehicle parts or wastes?

5. How do you manage non-reusable/non-recyclable non-metallic waste? (tick as appropriate)
   [ ] Collected by waste collectors [ ] Burning [ ] Collected by waste scavengers
   [ ] Other (please give details)
6. Who collects waste from your firm/yard? (please tick as appropriate):
   [ ] County Council [ ] Private collectors [ ] Waste scavengers **[ ]** Other (please specify)
7. What are the main challenges that you face in relation to vehicle waste management?