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Assessing the Readiness of Integrating Electric Motor Vehicles in The Supply Chain in Zambia

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Abstract

This study assessed Zambia's readiness to integrate Electric Motor Vehicles (EMVs) into its supply chain and logistics sector by examining infrastructure adequacy, stakeholder perceptions, operational capacity, and the policy environment. The global transition toward electric mobility has accelerated due to climate change concerns, energy security needs, and the demand for sustainable transport systems. However, evidence on EMV preparedness in Sub-Saharan Africa remains limited. In Zambia, where transport and logistics are vital to economic growth and regional trade, limited empirical research has examined readiness for EMV adoption. A mixed-methods research design was employed. Quantitative data were collected through structured questionnaires administered to 194 respondents comprising car dealers, transport operators, and logistics firms. The sample size was determined using the Yamane (1967) formula at a 95% confidence level and a 5% margin of error. Qualitative data were obtained through interviews with 20 key informants from ZESCO Limited, Road Transport and Safety Agency, the Ministry of Energy, and the Ministry of Transport and Logistics. Quantitative data were analyzed using descriptive statistics, while qualitative responses were analyzed thematically. Findings indicated partial readiness for EMV integration. While 82.5% of respondents acknowledged lower long-term energy costs and 64.9% recognized reduced maintenance costs, over 70% perceived EMVs as significantly more expensive upfront. Limited financing options, unreliable electricity supply, inadequate charging infrastructure, and insufficient grid capacity were identified as major constraints. More than 85% of respondents reported shortages of trained EV technicians. Regulatory uncertainty and the absence of a comprehensive national electric mobility framework further limited preparedness. The study concluded that although Zambia demonstrates growing recognition of electric mobility's strategic importance, large-scale integration remains constrained by financial, infrastructural, technical, and policy challenges. It recommends targeted fiscal incentives, investment in charging infrastructure and grid modernization, technical skills development, and stronger public–private partnerships to accelerate EMV adoption. This study contributes context-specific evidence to support sustainable transport policy and supply chain modernization in Zambia.

1. Introduction

1.1 Introduction

The global transition toward sustainable development has positioned electric mobility as a key strategy for reducing carbon emissions and promoting energy efficiency. As countries intensify efforts to address climate change and strengthen energy security, the adoption of Electric Motor Vehicles (EMVs) has accelerated across both developed and emerging economies. The transport sector remains one of the largest contributors to greenhouse gas emissions worldwide, accounting for nearly one-fifth of global carbon dioxide emissions, making transport electrification a critical component of decarbonisation strategies. Beyond environmental benefits, EMVs offer economic advantages such as reduced operating costs, lower maintenance requirements, and decreased dependence on imported fossil fuels.

The role of EMVs has expanded beyond private transportation to include commercial logistics and supply chain operations. Globally, supply chain electrification is increasingly recognised as essential for enhancing efficiency, lowering operational costs, and supporting sustainable logistics systems. Advances in battery technology, falling battery costs, and increased investment in charging infrastructure have accelerated this transition. However, while many developed economies have made substantial progress, adoption in developing countries remains constrained by infrastructural, financial, technical, and regulatory challenges.

For developing economies such as Zambia, integrating EMVs presents both opportunities and challenges. Zambia's transport and logistics sector plays a vital role in supporting trade, mining, agriculture, and regional connectivity. As a landlocked country heavily dependent on efficient transport systems, transitioning toward electric mobility could improve supply chain efficiency, reduce fuel import dependence, and support national sustainability goals. However, readiness for such integration depends on several factors, including electricity infrastructure, charging networks, policy frameworks, technical expertise, and stakeholder acceptance.

Despite growing global interest in electric mobility, limited empirical evidence exists on Zambia's preparedness to integrate EMVs into supply chain operations. This study therefore assesses the country's readiness by examining infrastructural capacity, stakeholder perceptions, operational preparedness, and institutional support. This chapter presents the background of the study, problem statement, research objectives, research questions, significance, scope, limitations, theoretical and conceptual frameworks, and the organisation of the dissertation, thereby establishing the foundation for assessing electric mobility integration within Zambia's supply chain sector.

1.2 Problem Statement

Zambia's economic lifeblood is its supply chain, a road-dependent network that is almost entirely powered by imported fossil fuels. This dependency is not an abstract vulnerability; it is a quantifiable and escalating economic crisis. The Road Transport and Safety Agency (RTSA) reports over 900,000 registered vehicles on Zambian roads, the vast majority of which are internal combustion engine vehicles (RTSA, 2022). This fleet consumes approximately 1.5 billion litres of diesel and 500 million litres of petrol annually (Energy Regulation Board: ERB, 2023). At a prevailing average pump price of ZMW 25.5 per litre for diesel, this translates to a staggering ZMW 38.25 billion (approximately $1.74 billion USD) spent on diesel for transport each year, a massive drain on the nation's foreign exchange reserves and a primary driver of the high cost of goods. For Zambia's key economic sectors, this is a direct hit to the bottom line; the Zambia Chamber of Mines has consistently identified high fuel and transport costs as a leading constraint on the competitiveness of the copper industry, which accounts for over 70% of export earnings (Zambia Chamber of Mines, 2021).

While the potential of Electric Motor Vehicles (EMVs) to break this dependency is recognized in policy documents like the Eighth National Development Plan (8NDP), a profound and dangerous disconnect exists between this ambition and on-the-ground reality. The central problem is that Zambia is considering a major infrastructural transition without a data-driven understanding of its own capacity to support it. It is known that the national grid is predominantly hydro, but it is also known that this grid is profoundly unreliable, with ZESCO implementing load shedding for up to 12 hours a day due to climate-induced droughts (Mfula, 2022). What remains unknown is whether this fragile grid can support the power demands of a commercial EV fleet. The total cost of ownership for an electric truck versus a diesel truck on Zambian roads, the business case for private investment in charging stations along the North-South Corridor, and the nation's technical capacity to maintain these advanced vehicles are all critical, unquantified variables. Therefore, the problem is not a perceived need for sustainability, but an immediate and tangible risk of strategic failure. Without a rigorous, evidence-based assessment of readiness, Zambia risks making catastrophic investments in a transition its infrastructure cannot sustain, leading to stranded assets and economic disruption. Conversely, inaction perpetuates a crippling and unsustainable fossil fuel dependency. This study is therefore justified by an urgent national imperative to move beyond policy rhetoric and answer the pivotal question: Is Zambia's supply chain ecosystem truly ready for electric mobility, and what are the non-negotiable prerequisites for a successful transition? The absence of a clear answer to this question is the single greatest impediment to progress and the core problem this research must solve.

1.3 Research Objectives

- To evaluate Zambia's electricity infrastructure capacity, stability, and reliability for commercial EV charging on key supply corridors.
- To analyze economic and policy readiness for EMV integration by comparing electric versus diesel Total Cost of Ownership (TCO) and examining the financial impact of regulations and incentives.
- To determine stakeholder and operational readiness by identifying key barriers, enablers, and capacity-building needs for logistics, energy, and government stakeholders.

2 Literature Review

This chapter reviews literature on the integration of Electric Motor Vehicles (EMVs) into supply chain systems. It examines global developments, African experiences, and Zambia's local readiness for electric mobility adoption. The chapter further reviews infrastructure readiness, economic viability, policy frameworks, and stakeholder preparedness. The review identifies gaps in existing literature and establishes the basis for assessing Zambia's readiness for integrating EMVs into supply chain operations.

2.1 Landscape of Electric Motor Vehicles

Global Perspective

Globally, electric mobility has become central to sustainable transport strategies due to climate change mitigation and energy security concerns. The transport sector contributes approximately 20% of global carbon dioxide emissions, making electrification essential for decarbonisation (IEA, 2023). Battery costs have fallen significantly, improving affordability and accelerating adoption (BloombergNEF, 2023).

China leads global EV adoption due to aggressive subsidies and industrial policies (Li et al., 2020). The European Union has accelerated adoption through regulatory certainty and internal combustion engine phase-out targets (Schmalensee, 2021). In the United States, infrastructure development and consumer incentives have supported market growth, though range anxiety remains a concern (Hardman et al., 2018).

In commercial logistics, electric freight vehicles are increasingly viewed as essential for reducing supply chain emissions. Taefi et al. (2016) found that total cost of ownership determines adoption decisions, while Roland Berger (2022) noted that profitability depends on vehicle utilisation, charging access, and electricity costs. These experiences demonstrate that successful integration depends on coordinated policy, infrastructure investment, and technological readiness.

African Perspective

In Africa, EMV adoption remains at an early stage but presents significant opportunities for sustainable development. Rapid urbanisation and rising transport demand increase the urgency for cleaner mobility solutions (World Bank, 2022).

Kenya has demonstrated progress through electric motorcycles, supported by innovative battery-swapping models (Lcuru et al., 2021). South Africa's EV market shows positive consumer interest but is constrained by high purchase costs and weak charging infrastructure (Brent & Kotzé, 2021). Nigeria's experience highlights how policy uncertainty and unstable electricity supply hinder adoption (Ike, 2021).

Morocco has positioned itself as an EV manufacturing hub through strong industrial policy (Kassimi & Hafner, 2021), while Ghana's stakeholder consultations reveal the importance of inclusive policy development (Kumi-Boateng et al., 2023). These studies suggest that African EMV success depends on context-specific policies, financing innovation, and infrastructure development.

Zambian Perspective

For Zambia, electric mobility offers both economic and environmental opportunities. Zambia's dependence on imported petroleum contributes to exchange rate pressure and economic vulnerability (Bofota & Moyo, 2021). Electrification could reduce fuel import dependence while leveraging the country's hydroelectric power base.

Zambia's partnership with the Democratic Republic of Congo to develop battery value chains presents industrial opportunities (UNECA, 2022). Additionally, Zambia's large copper reserves position it strategically within the global EV supply chain (Mutasa & Kinyondo, 2023).

However, studies identify significant barriers. Grid reliability challenges remain a concern (Sikaonga, 2021), while climate policy implementation gaps persist (Kanshabe, 2021). Existing transport systems are dominated by ageing diesel fleets, especially in logistics and public transport (Hichaambwa, 2017). These factors raise questions about Zambia's practical readiness for large-scale EMV integration.

2.2 Grid Readiness and Infrastructure Capacity

Grid readiness is critical for EMV adoption. Richardson (2013) found that uncontrolled charging increases peak electricity demand and can overload power systems. Blanchard et al. (2020) observed that many Sub-Saharan African grids face low capacity and frequent outages.

In Zambia, underinvestment in electricity infrastructure has limited grid expansion (Sikaonga, 2021). Heavy-duty commercial charging would require substantial upgrades to support logistics electrification (Bielaczyc et al., 2021).

2.3 Economic Viability and Policy Landscape

The Total Cost of Ownership framework shows that lower operating costs can offset higher EMV purchase prices (Breetz & Salon, 2018). However, affordability remains dependent on incentives and financing.

Sierzchula et al. (2014) found that fiscal incentives strongly influence adoption. The IEA (2023) emphasises integrated policy frameworks covering incentives, infrastructure, and standards.

In Zambia, the absence of a comprehensive electric mobility policy creates uncertainty for investors and fleet operators.

2.4 Stakeholder and Operational Preparedness

Successful EMV integration requires stakeholder coordination and technical readiness. Kapucu and Garayev (2011) highlight the importance of institutional collaboration, while Bhattacharjee et al. (2022) emphasise training and skills development.

In Zambia, shortages of EV technicians, charging specialists, and maintenance expertise present operational challenges. Stakeholder confidence will depend on infrastructure reliability, technical support, and policy clarity.

2.5 Knowledge Gap

The reviewed literature reveals important insights into electric motor vehicle (EMV) adoption; however, a critical analytical gap remains regarding the integration of EMVs into supply chain systems within developing economies such as Zambia. Existing global studies largely analyse EMV adoption within developed economies where enabling conditions such as advanced charging infrastructure, stable electricity grids, mature financing systems, and strong regulatory frameworks already exist (IEA, 2023; BloombergNEF, 2023). While these studies provide useful theoretical and policy benchmarks, their assumptions are not directly transferable to Zambia's context, where infrastructural deficits, energy supply instability, and limited institutional coordination fundamentally alter adoption feasibility. This creates a contextual mismatch between existing global evidence and the realities of Zambia's transport and logistics sector.

At the African level, the literature provides fragmented perspectives that focus on isolated aspects of electric mobility. Studies from Kenya emphasise innovative financing and battery-swapping models (Lcuru et al., 2021), South Africa focuses on consumer willingness to pay (Brent & Kotzé, 2021), while Morocco and Nigeria highlight industrial policy and regulatory readiness (Kassimi & Hafner, 2021; Ike, 2021). Although these studies offer valuable lessons, they remain sector-specific and geographically distinct, limiting their analytical relevance for Zambia. They do not sufficiently examine how infrastructure readiness, supply chain operational requirements, stakeholder preparedness, and economic constraints interact simultaneously within a logistics-focused transition.

Within Zambia, available studies identify important structural challenges including fuel import dependency, electricity reliability concerns, and industrial policy limitations (Bofota & Moyo, 2021; Sikaonga, 2021). However, these studies are largely diagnostic and disconnected, addressing energy, transport, or industrial development independently rather than as interconnected determinants of EMV integration.

The central analytical gap therefore lies in the absence of an integrated empirical assessment that examines Zambia's readiness through a multidimensional lens combining technical infrastructure, economic feasibility, policy coherence, and stakeholder operational preparedness. Without such analysis, policymakers and logistics stakeholders lack context-specific evidence to determine whether current conditions can support EMV integration or what interventions are required. This study addresses this gap by providing a holistic readiness assessment of EMV integration within Zambia's supply chain sector.

2.6 Theoretical Framework

This study utilizes a dual-theoretical framework combining the Domino Theory and Dynamic Capability Theory to assess Zambia's supply chain readiness for EMV integration. The Domino Theory acts as a diagnostic tool to understand systemic risks, while the Dynamic Capability Theory provides a prescriptive framework for identifying adaptive strategies. This integrated approach allows for a dynamic evaluation of resilience and adaptability, moving beyond a static assessment of readiness.

The Domino Theory posits that an initial disruption in an interconnected system can trigger a cascade of subsequent failures (Heinrich, 1931). In modern supply chains, this vulnerability is acute, as a single point of failure can cause widespread operational paralysis (Ivanov, 2020). Applied to Zambia, this theory helps diagnose profound vulnerabilities in that an initial disruption like grid failure from EV charging demand can trigger a domino effect, leading to incapacitated logistics, crippled production in key sectors, and severe economic downturn. It allows the research to identify the critical first domino and map its catastrophic consequences, highlighting the cost of inaction.

Complementing this, the Dynamic Capability Theory focuses on the proactive competencies organizations must develop to thrive in volatile environments (Teece et al., 1997). It posits that competitive advantage comes from the ability to integrate and reconfigure resources in response to technological change. For sustainability transitions like EMV adoption, this capability is paramount (Bansal and Roth, 2021). For Zambia, this theory provides a framework for how stakeholders can cultivate the necessary competencies such as technical skills in EV maintenance, innovative financing models, and strategic adaptability to overcome infrastructural and regulatory barriers. Thus, the analytical power of this framework lies in the synthesis of these two theories. The Domino Theory illuminates the high-stakes risks of systemic failure, while the Dynamic Capability Theory provides the actionable pathway to mitigate those risks and build resilience. This dual-lens approach ensures a balanced analysis that neither overstates EMV potential nor succumbs to fatalism. Consequently, this integrated framework will guide the empirical investigation, ensuring the assessment of readiness is always contextualized within the broader dynamics of systemic risk and adaptive capacity.

2.7 Conceptual Framework

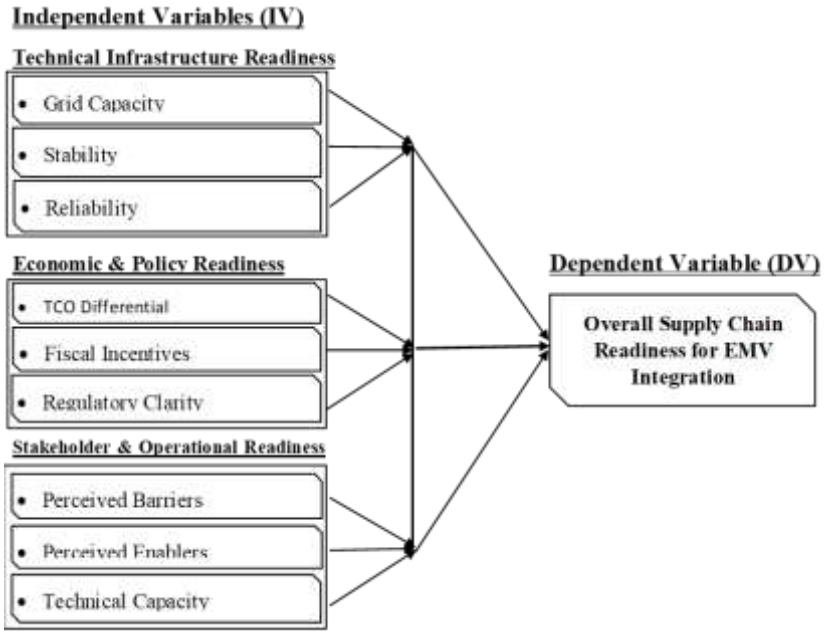

Figure 1: Researcher's Proposed Conceptual Framework (2025)

3 Research Methodology

This study adopted a convergent parallel mixed-methods design guided by a pragmatic research philosophy to assess Zambia's readiness for integrating electric motor vehicles (EMVs) into the supply chain. The study was conducted in Lusaka, Zambia's major commercial and logistics hub, targeting 378 entities comprising car dealerships, logistics firms, and transport operators, from which a sample of 194 respondents was determined using the Yamane (1967) formula. Quantitative data were collected through structured questionnaires using stratified random sampling, while qualitative data were obtained through semi-structured interviews with 20 purposively selected key informants from key institutions including ZESCO Limited, Road Transport and Safety Agency, the Ministry of Energy, and the Ministry of Transport and Logistics. Quantitative data were analysed using descriptive statistics, while qualitative data were analysed through thematic analysis. Ethical considerations such as informed consent, confidentiality, voluntary participation, and anonymity were observed throughout the study to ensure reliability and validity of findings.

Researcher Reflexivity

The researcher acknowledges their role as an active instrument in the research process, particularly in data interpretation and thematic development. Given the interpretive nature of the study, efforts were made to remain aware of potential biases and assumptions, especially regarding enforcement systems and informal trade practices. Reflexive journaling and continuous engagement with the data were employed to ensure that findings accurately reflect participants' perspectives rather than preconceived views.

4 Data Presentation, Analysis and Discussion

This chapter examines the data gathered from surveys and interviews to assess the readiness for integrating electric motor vehicles (EMVs) into Zambia's supply chain. The analysis focuses on evaluating the existing infrastructure, understanding stakeholder perceptions, identifying key challenges and opportunities, and assessing the policy and regulatory environment. A total of 194 surveys were completed by supply chain stakeholders, complemented by in-depth interviews with 20 key informants.

4.1 General Demographic Details of the Respondent

This section presented an analysis and interpretation of the respondents' general demographic characteristics, including gender, age range, level of education, job roles, sector of operation, fleet size, vehicle type, and areas of operation within Lusaka. These demographic attributes provided important contextual background and helped assess the capacity, experience, and relevance of respondents in contributing informed perspectives on the readiness for integrating Electric Motor Vehicles into the supply chain sector.

Table 1: Gender Distribution of Respondents (N = 109)

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	146	75.3	75.3	75.3
Female	48	24.7	24.7	100.0
Total	194	100.0	100.0	-

Source: Field Data (2025)

Table 1 presented the gender distribution of respondents in the survey. The findings showed that out of the 194 respondents, majority, 146(75.3%) of the respondents were male, while 48(24.7%) were female. The findings reflect the current gender demographics within leadership and operational roles in Zambia's automotive, logistics, and transportation sectors. This is an important factor to consider when analyzing perceptions and readiness for new technologies like EVs.

These results indicate a significant gender imbalance in the study sample, with males constituting nearly three-quarters of the respondents. This suggests that participation in the sector or organizational category under study is male-dominated. The relatively low representation of female respondents (24.7%) might reflect broader gender disparities in access, involvement, or leadership within the industry being examined.

From an analytical perspective, this imbalance has implications for interpretation of the findings, as the views captured are predominantly those of male respondents. While the data remain valid and reliable for the sampled population, the gender distribution can be acknowledged when discussing inclusivity, stakeholder representation, and policy implications arising from the study.

Table 2: Age Range Distribution (N=194)

Age Range	Frequency	Percent	Valid Percent	Cumulative Percent
Below 20 years	2	1.0	1.0	1.0
21 - 30 years	35	18.0	18.0	19.0
31 - 40 years	65	33.5	33.5	52.5
41 - 50 years	60	30.9	30.9	83.4
51 years and above	32	16.5	16.5	100.0
Total	194	100.0	100.0	-

Source: Field Data (2025)

Table 2 presented the age distribution of respondents in the study. The findings indicated that the majority of respondents fall within the economically active and mid-career age groups. Out of 194 respondents, 65 respondents (33.5%) were aged between 31-40 years, representing the largest proportion of the participants. This was followed by 60 respondents (30.9%) in the 41-50. Adding the two categories, they account for 64.4% of the total respondents, suggesting that the survey captures the perspectives of experienced professionals who are likely in decision-making or senior operational positions. Their experience was critical for assessing the practical challenges of EV integration.

The 21-30 years age group comprised 35 respondents (18.0%), while 32 (16.5%) of the respondents were aged 51 years and above, and 2 (1.0%) were below 20 years, showing minimal participation from very young individuals.

The cumulative percentages confirm a steady distribution across age categories, suggesting that the study predominantly captured perspectives from individuals in their prime working years (31-50 years). This age composition strengthens the credibility of the findings, as respondents were likely to possess adequate knowledge, experience, and decision-making exposure relevant to the subject under investigation. However, the relatively lower representation of respondents below 30 years might imply limited youth participation within the sector or organizational context being studied.

Table 3: Education Level Distribution (N=194)

Education Level	Frequency	Percent	Valid Percent	Cumulative Percent
Certificate	25	12.9	12.9	12.9
Diploma	55	28.4	28.4	41.3
Bachelor's Degree	85	43.8	43.8	85.1
Master's Degree	25	12.9	12.9	98.0
PhD	2	1.0	1.0	99.0
None of the Above	2	1.0	1.0	100.0
Total	109	100.0	100.0	-

Source: Field Data (2025)

The findings in Table 3 indicated that the majority of respondents possess relatively high levels of formal education. About 85(43.8%) of the respondents hold a Bachelor's Degree, followed by 55 (28.4%) with a Diploma qualification, 25 (12.9%) hold Master's Degree. These three categories when combined, they account for 85.1% indicating a well-educated respondent base capable of understanding the technical and business implications of transitioning to electric vehicles.

Additionally, 25 respondents (12.9%) possessed a Diplomas, while 2 (1.0%) of the respondents reported having a PhD, and another 2 (1.0%) indicated to hold any of the education mentioned in the study, reflecting minimal representation from individuals without formal qualifications or with alternative educational backgrounds.

However, the cumulative percentages showed a steady increase across educational categories, reaching 100%, and the valid percentages correspond with the overall percentages. Generally, the results suggested that the respondents were well-educated, with more than half (57.7%) holding at least a Bachelor's Degree or higher. This high level of educational attainment strengthens the reliability of the study findings, as respondents were likely to have the analytical capacity and technical understanding necessary to provide informed responses. Nevertheless, the limited representation of respondents without formal education suggested that the perspectives of less-educated stakeholders might be underrepresented in the study.

Table 4: Distribution of the Respondents by Job Title (N = 194)

Position Category	Frequency	Percent	Valid Percent	Cumulative Percent
Management Director	58	29.9	29.9	29.9
Operations / Logistics	75	38.7	38.7	68.6
Sales /Technical	45	23.2	23.2	91.8
Administrative / Other	16	8.2	8.2	100.0
Total	194	100.0	100.0	-

Source: Field Data (2025)

Table 4 presented the distribution of respondents according to their job titles or position categories within their respective organizations. The findings indicated that 75 (38.7%) of the respondents were from the Operations/Logistics, suggesting that a significant share of the respondents was directly involved in the operational and technical execution of organizational activities, which might provide practical understandings into the subject under investigation.

Management Directors constituted 29.9%, representing nearly one-third of the respondents, indicating a relatively high representation of senior management as these individuals were typically involved in strategic decision-making and policy direction. Their inclusion implies that the findings reflect perspectives from those with authority to influence organizational adoption, investment, and implementation decisions.

Furthermore, 45 respondents (23.2%) fall under the Sales/Technical category, indicating moderate representation of staff engaged in customer relations, technical support, or product-related functions. And 16 respondents (8.2%) were categorized as Administrative/Other, showing limited representation from support roles. These findings demonstrated a balanced mix of strategic (management-level) and operational-level respondents, with a stronger emphasis on operations and logistics. This distribution enhanced the credibility of the findings, as it captures both policy-level and implementation-level perspectives.

However, the relatively smaller proportion of administrative roles suggested that support-function insights might be less pronounced in the overall analysis.

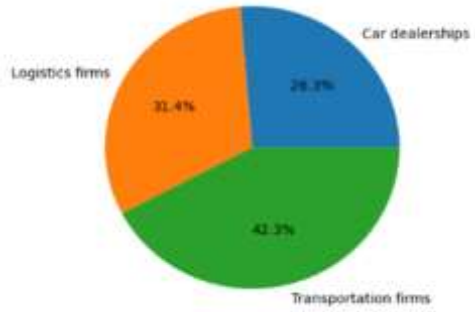

Figure 2 Distribution of the Respondent by Nature of Business

Source: Field Data (2025)

Figure 2 showed that most respondents (42.3%) were from transportation firms, followed by logistics firms (31.4%) and car dealerships (26.3%). This indicated that the study was largely informed by businesses directly involved in transport and supply chain operations. The distribution ensured representation across key sectors, with greater emphasis on transportation and logistics.

4.2 Qualitative Analysis

Many key informants from various institutions expressed varying views regarding the reliability of electricity supply and its influence on EMV adoption. A senior official from ZESCO Limited stated "*I for see the adoption of electric mobility as viable, but reliability of supply was the cornerstone of confidence.*" *While*

electricity coverage in urban operational bases was relatively strong, periodic load management and peak demand pressures might affect consistency. I also foresee fleet operators investing in electric vehicles only when they are assured of predictable and stable power availability."

One senior manager TotalEnergies Filling Stations expressed that "*it will be commercially risky to invest in charging stations where power interruptions are frequent.*" This was an indication that electricity reliability directly affected their willingness to diversify into charging infrastructure. Thus, electricity supply reliability must improve before they can confidently reposition their business models to support EMVs. At the Road Transport and Safety Agency (RTSA), a Transport official observed that transport operators prioritize operational continuity.

In personal statement: "*I noted that unreliable electricity could lead to vehicle downtime, which, in the context of commercial transport, translates directly into financial losses for operators. I explained that these disruptions not only affect operational efficiency but also undermine the profitability and reliability of transport services. I further observed that, from a regulatory perspective, ensuring a stable and reliable electricity supply is a critical enabling factor for the sustainable integration of EMV systems, as consistent power is essential for both the functionality of electronic fare collection and the broader objectives of modernizing urban transport infrastructure.*"

From a regulatory standpoint, the agency viewed supply reliability as a critical enabling factor for sustainable EMV integration. A senior policy officer from the Ministry of Transport and Logistics expressed that "*electric mobility cannot advance independently of energy sector stability.*" The official highlighted that transport sector transformation required coordinated infrastructure planning, adding that without dependable electricity at operational bases, adoption rates would remain cautious. Similarly, a senior engineer from the Ministry of Energy emphasized that "reliability challenges are acknowledged, but they are being systematically addressed." *The official maintained that Zambia's generation potential provided a strong foundation for EMVs, yet admitted that "consistent delivery at the point of use is what ultimately shapes investor and operator confidence.*"

4.3 Discussion of Results

This section discusses the findings of the study in relation to the research objectives and existing literature on assessing the readiness of integrating Electric Motor Vehicles (EMVs) into the supply chain in Zambia. The discussion focuses on demographic characteristics, electricity infrastructure readiness, and stakeholder preparedness.

General Demographic Characteristics

The demographic findings provided important insights into Zambia's transport and logistics sector. Out of 194 respondents, 75.3% were male and 24.7% female, reflecting the gender composition commonly found in transport and automotive industries. Most respondents were within economically active age groups and 57.7% possessed at least a Bachelor's degree, indicating relatively high educational attainment among participants. Transportation firms represented the largest category of respondents (42.3%), while 74.3% of firms operated fleets exceeding 20 vehicles, suggesting medium- to large-scale operational capacity. Furthermore, 77.3% of respondents operated in industrial zones, making these areas critical for future EMV charging infrastructure planning.

Zambia's Electricity Infrastructure for Commercial EMV Charging

The findings revealed that electricity infrastructure remains one of the most significant determinants of EMV readiness in Zambia. Existing literature emphasizes that electric mobility transitions depend heavily on grid reliability, generation capacity, and charging infrastructure adequacy (African Development Bank, 2021; IEA, 2022). In Zambia, the electricity sector remains heavily dependent on hydropower, making supply vulnerable to drought-related disruptions.

The study found that conventional fuel vehicles still dominate the sector, with 46.4% of respondents operating entirely diesel-powered fleets and only 7.2% using hybrid or electric vehicles. This finding aligns with the International Energy Agency (2023), which reported that heavy-duty electric vehicle adoption globally remains relatively low due to high infrastructure and investment requirements. The findings also support the World Bank (2022), which identified high capital costs and weak charging infrastructure as major barriers to freight electrification in developing economies.

The concentration of fleet operations within industrial zones presents both opportunities and challenges. Centralized depot charging may reduce dependence on dispersed public charging networks; however, it also creates concentrated electricity demand requiring significant grid upgrades. Respondents identified power outages, inadequate depot-level capacity, and high electrical upgrade costs as major concerns. These findings correspond with the African Development Bank (2019), which found that unreliable electricity infrastructure limits industrial electrification across Africa.

Knowledge and technical preparedness were also limited. The study revealed that 30.9% of respondents had no knowledge of EMVs, while 28.4% reported limited knowledge. Overall, 85.1% fell within low-to-moderate knowledge categories. These findings support the United Nations Environment Programme (2020), which found that limited technical literacy slows EV adoption in developing countries. Similarly, the International Renewable Energy Agency (2021) emphasized that successful EMV integration depends on technical skills development and institutional preparedness.

Electricity reliability emerged as a major operational concern. Most respondents rated electricity supply as unreliable or only moderately reliable, while key informants from ZESCO Limited and government institutions highlighted the risks posed by load-shedding, voltage fluctuations, and insufficient transformer capacity. These findings reinforce the World Bank (2019), which argued that distribution-level reliability is more critical for technology adoption than national generation capacity alone.

Concerns regarding charging infrastructure were equally prominent. Respondents rated power outages and infrastructure upgrade costs as the most significant barriers to charging deployment, while physical space for charging stations was considered less problematic. This aligns with findings from the International Council on Clean Transportation (2021), which emphasized that visible, reliable, and scalable charging infrastructure strongly influences fleet electrification decisions.

Awareness of public charging stations in Lusaka was also very low. Approximately 46% of respondents were unaware of any charging stations, while only 8% knew of multiple facilities. This demonstrates that infrastructure awareness itself remains limited, further constraining adoption intentions. Similar findings by the International Council on Clean Transportation (2021) showed that perceived infrastructure scarcity discourages investment even where some charging facilities exist. Overall, the findings indicate that Zambia demonstrates only partial readiness for integrating EMVs into commercial supply chains. While there is growing awareness of electric mobility's strategic importance, significant infrastructural, technical, and operational barriers continue to limit large-scale adoption. The study therefore confirms existing literature that successful EMV integration in developing economies requires simultaneous investment in electricity infrastructure, technical capacity development, charging networks, and institutional support systems.

5 Conclusion and Recommendations

5.1 Conclusion of the Study

The study established that Zambia demonstrates partial readiness for integrating Electric Motor Vehicles (EMVs) into its supply chain system. Findings showed that although EMVs offer long-term benefits such as reduced energy and maintenance costs, high upfront purchase prices and limited access to financing remain major barriers to adoption. Respondents emphasized the importance of government incentives, including VAT reductions, import duty exemptions, subsidies, and favourable electricity tariffs, in improving economic feasibility.

The study further revealed that inadequate charging infrastructure, unreliable electricity supply, limited technical expertise, and unclear policy frameworks significantly constrain operational readiness. Shortages of trained EV technicians and limited awareness of charging infrastructure reduce confidence among transport and logistics operators. While Zambia possesses foundational advantages such as hydroelectric energy potential and growing institutional recognition of electric mobility, infrastructural and policy gaps continue to hinder large-scale implementation.

Overall, the study concludes that successful EMV integration in Zambia will require coordinated investment in charging infrastructure, grid modernization, technical skills development, and supportive policy reforms. Without these interventions, adoption within the commercial transport and logistics sector is likely to remain slow. The study contributes context-specific evidence to the growing literature on electric mobility transitions in developing African economies.

5.2 Recommendations of the Study

The findings of this study established that the successful integration of Electric Motor Vehicles (EMVs) into Zambia's supply chain requires a coordinated and comprehensive approach involving government, private sector actors, and regulatory institutions. The following recommendations are proposed:

- Provide Financial Incentives and Financing Support: The government should introduce targeted fiscal incentives such as VAT reductions, import duty exemptions, subsidies, and preferential electricity tariffs to reduce the high upfront costs of EMVs. Financial institutions should also provide accessible financing mechanisms such as low-interest loans, leasing arrangements, and flexible repayment models to improve affordability for fleet operators.
- Invest in Charging Infrastructure and Grid Modernization: There is a need for investment in a reliable and widely distributed charging network across major commercial and industrial areas. Collaboration with ZESCO Limited should be strengthened to upgrade grid capacity, improve electricity reliability, and support depot-based commercial charging systems.
- Strengthen Technical Capacity and Skills Development: Government and training institutions should establish specialized programmes in EV maintenance, battery management, and charging systems. Partnerships with international EV manufacturers and technical institutions should also be encouraged to enhance knowledge transfer and workforce preparedness.
- Develop a Comprehensive National Electric Mobility Policy Framework: The government should formulate a clear national electric mobility policy that provides guidance on vehicle standards, charging regulations, licensing, taxation, registration procedures, and environmental compliance to create investor confidence and regulatory certainty.
- Enhance Stakeholder Awareness and Institutional Coordination: Awareness campaigns, demonstration projects, and pilot fleet programmes should be implemented to improve public and institutional understanding of EMVs. Coordination among key institutions such as the Road Transport and Safety Agency and the Transport Association of Zambia should be strengthened to ensure effective and synchronized implementation.

Declaration of Competing Interests

The authors declare that they do not have any known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethical considerations

The article followed all ethical standards appropriate for this kind of research.

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