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Contextualizing the Transition to Electrification of Utility Vehicle (UV) Express Operations

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ABSTRACT

This study examined the transition to electric and hybrid vehicle electrification in UV Express operations in the Greater Manila Area by centering on the lived managerial realities of operators, driver-operators, and cooperative officers. Other public utility vehicle modes were included only for contextual comparison, while the technological scope was limited to electric vehicles (EVs) and hybrid electric vehicles (HEVs) under the current modernization agenda. The study approached electrification as an unfolding cross-sectional modernization context, capturing how operators interpreted and responded to policy and technology uncertainties as these were being experienced in practice. Using a Constructivist Grounded Theory orientation with iterative and cyclical field engagement, the study generated qualitative evidence primarily through intensive semi-structured interviews conducted across two iterative rounds, supported by field notes, memos, non-participant observations, and relevant documents for triangulation. Interviews were audio-recorded with consent and analyzed through constant comparison, analytic memoing, and iterative coding to refine emerging concepts across cases. Purposive sampling focused on participants with sustained UV Express involvement, active operational engagement, and decision-making roles in route management, maintenance, dispatch, financing, and cooperative governance. Findings showed that electrification was not understood by operators as a simple vehicle substitution, but as a governance-and-continuity problem embedded in livelihood-dependent transport operations. Adoption became plausible when route viability and passenger trust could be maintained, livelihood investments were not overexposed to cash-flow pressures and downtime risk, and governance arrangements made the transition fair, credible, and operationally workable. The study advances a grounded explanation of electrification as a process of conditional alignment, in which strategic deferral may function as a rational form of livelihood protection under boundary-based operating conditions. It also offers a practice-oriented operational framework that may inform policy sequencing, cooperative planning, and service ecosystem readiness, particularly in relation to charging access, repair support, parts availability, technician capability, and credible service commitments.

Keywords: *UV Express, Vehicle Electrification, EV Transition*

INTRODUCTION

The Philippine public transport system is embedded within a highly fractured operational context. In 2023, the UP Center for Integrative and Development Studies described a landscape defined by disjointed networks, overcapacity transit lines, and traditional jeepneys nearing obsolescence. Within this environment, commuters with means insulate themselves in private vehicles, while Public Utility Vehicle (PUV) drivers and operators are left to absorb the daily operational and financial shocks of a fragile mobility ecosystem. Keeping routes active is a continuous exercise in navigating resource constraints, cost volatility, and institutional uncertainty. Consequently, any transition toward modernization is not merely a technical shift, but a complex managerial phenomenon where policy design intersects with the lived realities of ground-level operators.

The UV Express sector occupies a critical, yet precarious, space in this mobility landscape. Serving as a vital conduit, it connects Metro Manila to adjacent provinces, with the Department of Transportation recording approximately 6,755 authorized units catering to 865,000 daily passengers as of 2024. While state-driven initiatives like the Public Utility Vehicle Modernization Program (PUVMP) and the Electric Vehicle Industry Development Act (EVIDA) mandate a structural pivot toward electrification, these top-down policies often clash with localized realities. The technological transition frequently stalls precisely because small-scale operators must make sense of uncertain timelines, constrained financing, and limited institutional support while attempting to sustain their livelihoods.

Historically, the state's modernization narrative has disproportionately centered on traditional jeepneys—a highly visible, unorganized grassroots sector with a historical capacity for large-scale mobilization. Consequently, they have been prioritized in both policy intervention and public discourse. In contrast, UV Express operations have been marginalized in these planning stages, often mischaracterized by policymakers as a premium, financially self-sufficient paratransit mode. This flawed institutional assumption obscures the fragile, debt-driven realities of the UV Express ecosystem, leaving its operators to negotiate the heavy capital demands of electrification with minimal structural scaffolding.

Approaching this study as both a project management practitioner and an automotive engineer, I recognize the structural logic of system-wide modernization. However, this reflexivity also makes me acutely aware of how top-down reforms fracture during implementation when confronted with ground-level capacity and financing constraints.

On my way to EDSA to join the People's Rally for Good Governance on September 21, 2025, I met Mang Elmer, a 64-year-old widower with three children, the family's breadwinner, and a dedicated UV Express driver. His daily route stretches from Balibago Complex in Santa Rosa City, Laguna to Starmall in Mandaluyong City. He has relied on UV Express driving as his livelihood since 1993. He described how income in UV Express work can be unstable. Despite perceptions of financial comfort, high fuel costs, traffic congestion, and unexpected vehicle issues often leave him with barely enough to bring home. In those situations, he turns to loans or pawning valuables just to cover daily expenses.

As rush hour approached along EDSA and traffic slowed, I asked him about electric and hybrid vehicles. He did not dismiss the idea. Instead, his response carried a quiet heaviness, shaped less by resistance to technology and more by the reality that drivers like him have limited control over the conditions of transition. He senses the direction of policy and industry, but he also recognizes that the burden of adjustment often falls on public transport drivers and operators whose margins are already thin. Mang Elmer's story is not only personal. It is emblematic. It reflects the conditions faced by many UV Express operators who begin before dawn and work through long hours to keep food on the table and the light of their dreams on. His narrative is inextricably linked to broader systemic vulnerabilities. The transport inefficiencies characterizing the Greater Manila Area result in an estimated ₱3.5 billion daily loss to the Philippine economy. The UV Express sector functions as a vital circulatory system moving the workforce that sustains this macroeconomic structure. If the electrification mandate continues to bypass the

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visceral, ground-level realities of its operators and drivers, it risks precipitating a systemic hemorrhage that could lead to the irreversible collapse of the entire paratransit network.

By centering on how individuals like Mang Elmer navigate and make sense of modernization, this study seeks to explore how operators, driver-operators, and cooperative officers respond to the pressures of EV and hybrid adoption. Through the contextual analysis of the lived managerial dynamics and day-to-day constraints shaping the decisions in the UV Express Sector, the research strives to generate an explanatory proposition linking their perceptions of electrification with their operational and franchise-related realities. Ultimately, the study aims to contribute an operational framework that ensures the path to a greener horizon is paved with equity, dignity, and a clear plan for UV Express who have been driving us safely to work and to home for decades.

Vehicle electrification in the Philippines is gradually progressing. While private vehicle adoption has incrementally advanced, the transition within public transport remains uneven and uncertain. Over the past five years, jeepney drivers have launched protests, bus operators have been the subject of research, and taxi fleets have tested hybrid models. However, UV Express operators, who serve thousands of commuters across Greater Manila, remain underrepresented in both research and policy discussions. For UV Express operators, the potential benefits of vehicle electrification are well recognized, but these gains can be offset by operational realities, technological unfamiliarity, and unclear regulatory guidance. Their willingness or reluctance to adopt is further shaped by maintenance concerns, passenger perceptions, and uncertain financial returns. Underpinning the transition to EVs in UV Express operations are daily management decisions made at terminals, where operators and drivers balance compliance, cost, and sustainability. Understanding how they identify opportunities, interpret risks, and manage change is therefore pivotal to broadening and strengthening the discourse on public transport modernization. This study aimed to develop a proposition explaining how UV Express operators understand and navigate the transition to electric vehicles (EVs) within the context of vehicle management and franchise operations. It explored operators' perceptions of EVs, analyzed the steps they take to address operational challenges, and examined how they adapt to electrification. Based on these insights, the study proposed an operational framework to support fair, sustainable, and practical EV adoption in the UV Express transport sector. This study is guided by an overarching pair of interrelated questions: What proposition can be constructed to contextualize how UV Express operators discern and navigate the adoption of electric vehicles amid managerial and operational challenges, and what operational framework can be derived to accelerate the adoption?

To critically answer the fundamental research questions, there are four key inquiries that build this research:

RQ1. How do UV Express operators perceive electric vehicles within the context of their transport operations?

RQ2. What steps do UV operators take to address operational impediments in order to adapt to vehicle electrification?

RQ3. What proposition can be developed to explain how UV Express operators navigate electric vehicle transition?

RQ4. What operational framework, grounded in this proposition, can help overcome the management barriers and accelerate electric vehicle adoption in the UV Express Operations?

Together, these questions framed the study. Cognizant that UV Express operators have long been marginalized, I delved into their lived realities and examined their accounts to contextualize how management dynamics shape their capacity, willingness, and intention to adopt vehicle electrification. Through analysis of their personal epistemologies, I translated emergent propositions into an operational framework to guide sustainable adoption.

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LITERATURE REVIEW

Philippine Paratransit System

In 2024, the Management Association of the Philippines through its Transportation and Infrastructure Committee said Metro Manila should be placed under a "daily state of calamity" considering the estimated ₱3.5-billion daily economic losses incurred from traffic. He said the magnitude of the economic damage due to traffic exceeds the threshold for declaring a state of calamity, which typically stands at ₱1 billion (Manila Standard, 2024). Public paratransit comprising jeepneys, UV Express vans, and tricycles serves as the dominant mode of everyday transport in the Philippines. Despite policy efforts toward modernization, it operates within a hybrid system marked by informality, fragmented governance, and inadequate infrastructure. Paratransit plays a vital socio-economic role by providing affordable, flexible, and accessible mobility, particularly for low- to middle-income commuters underserved by formal mass transit systems. However, these advantages coexist with structural inefficiencies, operational disorder, and chronic exposure to traffic congestion. Studies on the jeepney industry have illuminated the institutional and financial challenges underlying modernization. Mateo-Babiano et al. (2020) emphasize that the PUVMP faces obstacles such as the high cost of fleet replacement, limited financing options, and weak cooperative capacity. The transition is thus not merely technological but managerial, demanding coordination among operators, regulators, and financial institutions. Operationally, paratransit quality and efficiency are shaped by traffic conditions. Persistent congestion in metropolitan areas such as Metro Manila significantly affects travel time reliability, fuel consumption, and vehicle productivity. The Congressional Policy and Budget Research Department (2024) reported that Metro Manila commuters lose an average of 240 hours annually due to traffic delays, directly impacting jeepney and UV Express operations through increased turnaround times and reduced daily income. Paratransit vehicles, which rely on passenger volume and trip frequency for profitability, suffer from these inefficiencies—forcing operators to work longer hours while reducing net earnings. Congestion also intensifies vehicular emissions and accelerates vehicle wear, thereby undermining both environmental and financial sustainability.

A growing body of global mobility studies reinforces CPBRD's findings on the severe time losses caused by traffic delays in the Philippines, showing that the country's congestion problem has drawn international attention. The TomTom Traffic Index, which benchmarks hundreds of cities worldwide, consistently ranks Metro Manila among the most congested urban areas globally, with drivers losing an estimated 257 hours per year, while recent editions place the metropolis at or near the top of global congestion charts. Similarly, the Waze Global Driver Satisfaction Index labeled Metro Manila as having the "worst traffic on Earth," reflecting the extremely poor commuter experience relative to other countries. A regional study by the Boston Consulting Group (BCG) further found that Filipino commuters lose roughly 16 days annually due to congestion and parking searches—figures that translate into tens of thousands of pesos in lost productivity. Meanwhile, the Japan International Cooperation Agency (JICA) has estimated the economic losses from Metro Manila traffic at ₱3.5 billion per day, potentially rising to ₱5.4 billion by 2035, a finding echoed by World Bank analyses that highlight the macroeconomic impact of chronic congestion. Complementing these, urban mobility assessments such as the UNESCAP Sustainable Urban Transport Index (SUTI) indicate that road-based modes—including UV Express—remain central to mobility in Metro Manila, even as they struggle with overcrowding, insufficient capacity, and irregular service.

Collectively, these international benchmarks affirm that the Philippines' transportation challenges are not merely local concerns but globally recognized mobility and economic issues, underscoring the urgency of strengthening and formalizing alternative public transport modes such as UV Express to alleviate daily travel burdens. Service quality studies reinforce the link between management practices and commuter experience. Tiglao et al. (2020) established that reliability, safety, and convenience are central determinants of passenger satisfaction in Metro Manila's paratransit systems. Ong et al. (2023) further

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demonstrated that cleanliness and affordability influence perceived quality among tricycle users, highlighting that management discipline, dispatch efficiency, and terminal organization can mitigate congestion related dissatisfaction. Similarly, Cua et al. (2023) found that structured, point-to-point operations improve travel time predictability and emission performance, implying that well managed UV Express and premium bus systems can alleviate congestion through route optimization and service coordination.

Across all modes, persistent challenges include fragmented governance, insufficient road space, and overlapping regulatory authority among the DOTr, LTFRB, and local government units. Limited infrastructure, outdated vehicle fleets, and weak enforcement mechanisms exacerbate congestion and safety risks. Gatarin and Galicha (2024) further caution that modernization efforts risk excluding small operators without equitable financing and transitional support. A number of research positions Philippine paratransit as a management dependent and congestion-vulnerable system. Its efficiency and service quality rely on coordinated governance, cooperative capacity, and adaptive management strategies that balance economic survival with sustainable mobility. However, the UV Express sector remains underexplored— particularly in understanding how management dynamics and congestion pressures influence readiness for modernization and eventual electrification.

UV Express Operations in the Philippines

The UV Express service in the Philippines traces its roots to the introduction of the Tamaraw FX by Toyota Motor Philippines in 1993. Originally, the Tamaraw FX was marketed as a UV with extra cargo space; over time, operators converted this capacity into passenger seating, effectively creating a shared van transport mode often called the “FX” or “Asian Utility Vehicle (AUV).” Over the years, the FX vans evolved into larger vans (e.g. Nissan Urvan, Hyundai Starex, Toyota HiAce) for public transport purposes, shedding cargo space to accommodate more seating. In time, the service branded as UV Express became a licensed share-van transport mode in the Philippines. It is distinguished from jeepneys by offering airconditioned vans, point-to-point routes, and more regulated stops. With franchises issued by the Land Transportation Franchising and Regulatory Board (LTFRB), UV Express services operate across Metro Manila and surrounding provinces. In efforts to regulate UV Express operations more strictly, the LTFRB mandated that UV Express services convert to point-to-point (P2P) routes, restricting loading and unloading of passengers between terminals. This was meant to streamline operations, reduce traffic disruption, and differentiate UV Express from flexible stop modes. Another milestone in its regulatory history is that the UV Express franchises were scheduled to expire in June 2023, mirroring jeepney franchise expirations under modernization reforms. The policy required operators to join cooperatives or corporations in order to renew or extend their franchises, pushing toward formal sector organization.

Regional use of UV Express is also documented. In Albay province, for example, UV Express connects the city of Legazpi with neighboring municipalities (Tabaco, Ligao, Polangui). A 2024 study by Gatarin and Galicha proposed a “UV Express system framework” using design thinking to improve operations, such as incorporating a booking system, Global Positioning System (GPS) tracking, and passenger feedback mechanisms. Despite these historical accounts, there is a notable absence of peer-reviewed literature that thoroughly chronicles the evolution of UV Express, its institutional development, fleet transitions, regulatory changes, and stakeholder responses under scholarly scrutiny. The existing narratives are largely descriptive or policy-driven rather than grounded in empirical research with theoretical framing. UV Express Operation has also been marginalized on both the Implementing Rules and Regulations (IRR) of the EVIDA Law and the PUV Modernization Program.

LTFRB Memorandum Circular No. 2020-066

The Land Transportation Franchising and Regulatory Board (LTFRB) Memorandum Circular (MC) No. 2020-066, issued in 2020, governs the continuity of operations for UV Express operators holding valid

Certificates of Public Convenience (CPCs) and outlines the process for extension of franchise validity. The MC. 2020-066 was implemented during the nationwide rollout of the PUVMP to prevent service disruptions among operators awaiting franchise renewal or cooperative consolidation. Specifically, the memorandum allowed duly franchised UV Express operators to continue operations provided that their CPCs remained valid and that they adhered to the prescribed route, vehicle type, and safety standards. It emphasized no transferability of franchises, requiring only legitimate grantees or registered cooperatives to apply for renewal or extension. Documentary requirements—such as updated financial statements, vehicle roadworthiness certificates, and tax clearances—were mandated to ensure transparency and regulatory compliance. Policy-wise, MC 2020-066 reflects LTFRB's effort to balance modernization goals with operational stability. It granted temporary regulatory relief while reinforcing stricter institutional and documentary requirements that signal a shift toward cooperative-based and professionalized management of UV Express operations. In effect, the circular bridged the gap between informal individual operators and the formalized, fleet-managed structure envisioned under the PUV modernization framework. Violations related to the improper operation of PUVs in the Philippines are met with progressive penalties that become more severe for repeat offenders.

One of the most serious violations is "colorum" operation, which refers to operating a PUV without a valid franchise. For the first offense, fines vary depending on the vehicle type—₱1 million for buses, ₱200,000 for vans, and ₱50,000 for jeepneys—and the unit is impounded for three months. A second offense leads to the revocation of all CPCs held by the operator and their permanent blacklisting. Another major violation involves the breach of franchise conditions, such as operating beyond the authorized route or engaging in trip-cutting. Penalties for this offense are ₱5,000 for the first violation, ₱10,000 and a 30-day vehicle impounding for the second, and ₱15,000 with CPC cancellation for the third. Overloading violations follow the same penalty scheme as franchise breaches: ₱5,000 for the first offense, ₱10,000 with 30-day impounding for the second, and ₱15,000 with CPC cancellation for the third. Beyond monetary fines, these offenses may result in the impounding of vehicles, cancellation of the operator's CPC, and potential blacklisting from the PUV system. Although pandemic-specific rules such as MC 2020-066 are no longer the main reference for enforcement, the LTFRB continues to uphold its established penalty system to ensure strict compliance with franchise regulations.

Philippine EVIDA Law and the PUV Modernization Program

The Electric Vehicle Industry Development Act (EVIDA), enacted in 2022 as Republic Act No. 11697, represents the Philippine government's most comprehensive legislative effort to institutionalize the transition toward sustainable and energy-efficient transport. The law seeks to establish an enabling ecosystem for EV through the Comprehensive Roadmap for the Electric Vehicle Industry (CREVI), which outlines strategies for manufacturing, infrastructure development, human resource capacity, and market incentives (DOE–DOTr, 2022). It mandates government agencies, large corporations, and transport operators to integrate EVs into their fleets, while requiring commercial and residential buildings to allocate parking spaces equipped with charging stations.

The benefits of EVIDA are both economic and environmental. It provides fiscal incentives such as zero excise tax for battery electric vehicles and reduced duties for hybrids, alongside non-fiscal incentives including priority registration, green-lane processing, and tax deductions for EV-related investments (DivinaLaw, 2022). These incentives aim to lower adoption costs, stimulate domestic manufacturing, and attract foreign investment into the EV supply chain. Moreover, by institutionalizing charging infrastructure requirements, EVIDA promotes accessibility and consumer confidence in electric mobility. Environmentally, the law contributes to greenhouse gas reduction goals under the Philippine Energy Plan and supports commitments to the Paris Agreement through lower transport emissions (Chambers & Partners, 2023).

In parallel, the PUVMP, launched in 2017, advances the government's agenda to modernize and decarbonize the public transport sector. The program mandates the replacement of traditional jeepneys, UV Express vans, and multicabs with safer, energyefficient, and eventually electric alternatives (DOTr, 2017). It also requires operators to consolidate into cooperatives or corporations, thereby formalizing management structures and improving regulatory oversight. Together, EVIDA and PUVMP represent the policy backbone for achieving a clean, efficient, and inclusive transport system, bridging industrial policy and mobility reform (Pineda & Calderon, 2025). However, several scholars emphasize that these frameworks have fallen short of addressing the structural and socio-economic challenges of Philippine paratransit. Research by Mateo-Babiano et al. (2020) notes that financial burdens, cooperative readiness, and institutional fragmentation continue to constrain small operators. High capital costs, inadequate financing mechanisms, and limited charging infrastructure further hinder EV adoption among paratransit sectors such as jeepneys and UV Express. Despite EVIDA's strong incentives, the law's benefits primarily accrue to private vehicle owners and large corporations, while small transport cooperatives face barriers in accessing credit and compliance support.

Moreover, the EVIDA and PUVMP frameworks largely focus on fleet modernization and technology adoption, often overlooking the operational realities of congestion, informal terminals, and fragmented local governance that define the paratransit landscape. As a result, the daily working conditions of drivers and operators remain largely unchanged, revealing a policy gap between legislative ambition and grassroots realities. In essence, while EVIDA provides the economic incentives, legal framework, and environmental rationale for electrification, and the PUVMP defines the operational structure for modernization, their full effectiveness depends on inclusive financing, local government engagement, and participatory implementation. Without addressing these human and managerial dimensions, the transition toward sustainable mobility may remain inequitable, particularly for paratransit operators navigating the shift to electric and hybrid fleets.

Barriers to UV Express Electrification

Emerging literature on Philippine public transport modernization consistently highlights that UV Express operators face structural, economic, technological, and institutional barriers that hinder their capacity to adopt electric vehicles (EVs). Although most studies address PUVs as a broader category, the constraints they identify directly apply—often even more acutely—to UV Express operations, which rely heavily on high daily mileage, limited terminal infrastructure, and individualized financing arrangements. One of the most widely cited constraints is the high upfront cost of EV units, which remains inaccessible for small operators and cooperatives with already thin margins. Guno, Collera, and Agaton (2021) emphasize that the required capital investment for EVs is significantly higher than for diesel units, making electrification economically prohibitive for many operators. Their PESTLE analysis notes that without substantial subsidies or financing support, operators perceive EV acquisition as financially unfeasible. Technological barriers also limit UV Express adoption. Range anxiety, long charging times, and the absence of strategically located charging stations undermine the operational reliability needed for fixed-route, high-frequency UV Express services (Guno et al., 2021).

The limited availability of EV-trained mechanics and spare parts exacerbates these concerns, increasing perceived maintenance risks. Castro et al. (2023) similarly argue that the lack of a robust support ecosystem—such as warranty networks, parts supply chains, and after-sales services—continues to deter operators from shifting away from internal-combustion engines. Institutional and regulatory barriers further constrain adoption. Studies highlight that uncertainty in modernization policies, inconsistent implementation timelines, and unclear compliance requirements create hesitation among operators (Figueroa et al., 2020). UV Express units, unlike jeepneys and buses, occupy a more fragmented regulatory space, which complicates their access to modernization programs, concessional loans, and fleet-based support mechanisms. As a result, electrification for this subsector becomes even less attainable under current policy structures. Given these intersecting barriers, existing literature indicates that the UV Express sector currently lacks the financial capacity, infrastructural support, and institutional stability required for EV adoption. These constraints collectively explain why electrification within this subsector remains limited, slow, and uneven despite national efforts to promote sustainable mobility.

Evolution of Electric Vehicle

The evolution of electric vehicles (EVs) and hybrid electric vehicles (HEVs) has unfolded as a complex interplay of technological innovation, environmental imperative, market forces, and policy interventions. Over recent decades, the global automotive landscape has gradually shifted from internal combustion engine (ICE) dominance toward diversified propulsion portfolios that include battery-electric, plug-in hybrid, and hybrid systems (Delso-Vicente et al., 2025). Vehicle electrification has evolved from a niche innovation to a cornerstone of global transport decarbonization. Advances in battery technology, power electronics, and charging infrastructure have improved performance and reduced costs, while supportive policies have accelerated adoption across vehicle segments. Electric vehicles include: 1. Battery Electric Vehicles (BEVs): Fully electric, powered by rechargeable batteries with no tailpipe emissions. 2. Plug-in Hybrid Electric Vehicles (PHEVs): Combine an electric motor and battery with an internal combustion engine (ICE); can operate in electric-only mode for short distances. Hybrid Electric Vehicles (HEVs): Pair an ICE with a small battery and electric motor; cannot be plugged in and rely on regenerative braking for energy recovery. All electric drivetrains use lithium-ion batteries, inverters, electric motors, and thermal management systems. Figure 1 shows the fuel configuration for each type of EVs.

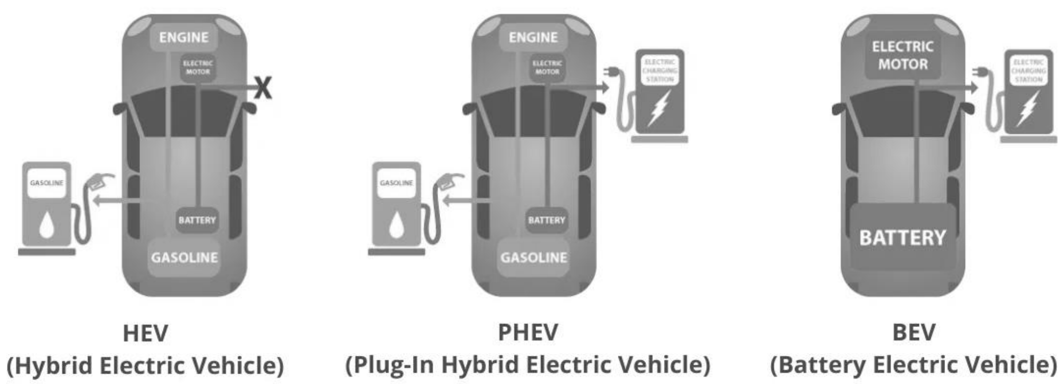

Figure 1. *Comparison of electric vehicle types: Hybrid Electric Vehicles (HEVs); Plug-in Hybrid Electric Vehicles (PHEVs) and Battery Electric Vehicles (BEVs).*

Early electric vehicles date back to the late 19th and early 20th centuries, but limitations in battery energy density and high costs relegated them to niche uses. The resurgence of interest in EV and HEV technologies in the late 20th and early 21st centuries was driven by improvements in electrochemistry (notably lithium-ion batteries), power electronics, and control systems (Hannan et al., 2020). Sanguesa et al. (2021) detail the evolution of EV battery technology, from lead acid to advanced lithium-ion chemistries (including graphene-enhanced variants), and the parallel development of battery management systems (BMS) and charging protocols.

On the HEV front, scholars have systematically reviewed the thermodynamic models and configurations (series, parallel, and mixed) employed in hybrid systems (León et al., 2021). Their review underscores how HEVs combine internal combustion engines with electric drives to balance autonomy and emissions reduction. Earlier foundational overviews also highlight energy management strategies, control algorithms, and trade-offs between fuel savings and system complexity (Shen et al., 2011). Several interrelated drivers have spurred the global adoption of EVs and HEVs. First, environmental and climate concerns have elevated pressure on nations to reduce greenhouse gas emissions and urban air pollution. Scaling EVs is aligned with commitments under the Paris Agreement and national decarbonization plans (Hannan et al., 2020). Second, policy incentives — such as subsidies, tax credits, purchase rebates, and regulatory mandates — have been critical in reducing the cost gap between ICE vehicles and cleaner alternatives. In many markets, EV adoption surges correlate with generous incentive programmes and supportive regulatory regimes (Delso-Vicente et al., 2025). Third, improvements in battery cost, energy density, charging speed, and durability have gradually improved the value proposition of EVs, thereby reducing range anxiety and spurring consumer confidence (Sanguesa et al., 2021).

The regional strategies of major manufacturers also influence the portfolio mix of EV and hybrid models. For example, a recent study of light duty vehicle deployment found that while BEV (battery electric vehicle) adoption is increasing, many manufacturers maintain hybrid and plug-in hybrid lines to address market-specific constraints such as charging infrastructure deficits or regulatory uncertainty (Ramji & Tayarani, 2023).

Global Sales Trend of Electric Vehicle

Over the past decade, the global sales of EVs have exhibited a steep upward trajectory, signaling a structural transformation in the light-duty automobile market. In 2023 alone, nearly 14 million new electric cars were registered globally—a 35 % year-on-year increase—bringing the global stock to about 40 million EVs, and comprising approximately 18 % of new car sales (IEA, 2024). This continual growth underscores the increasing adoption momentum of electrified mobility (IEA, 2024; IEA, 2023). Figure 2 illustrates the exponential growth of global EV sales over the past decade, disaggregated by region and vehicle type. BEVs and PHEVs show consistent year-on-year increases, with total global sales reaching nearly 18 million units in 2024. China remains the dominant market, contributing the largest share of BEV and PHEV sales, followed by Europe and the United States.

According to the International Energy Agency (IEA, 2024), EVs (BEVs + PHEVs) are projected to account for 20–25% of global new car sales by 2025. The "Rest of the World" category, though smaller in volume, exhibits gradual acceleration, indicating the global diffusion of electrified mobility. Forecasting studies indicate that the global EV market may expand dramatically over the next decade. Electrification of buses and heavy-duty vehicles is also advancing, particularly in East Asia and European cities, where air quality goals and depot charging feasibility support adoption. Chandra et al. (2025) project that if countries meet their electrification targets, global EV demand could reach 59 million to 73 million units by 2030 (Chandra et al., 2025).

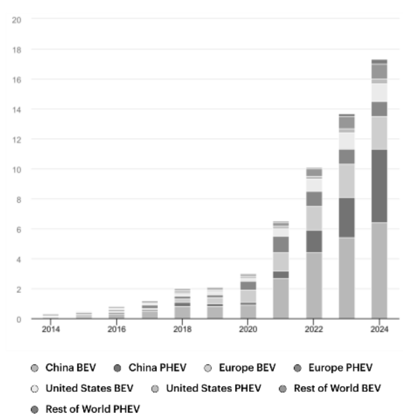

Figure 2. *Global Electric Vehicle Sales by Region and Powertrain Type, 2014–2024. Data source: International Energy Agency (IEA), Global EV Data Explorer, 2024.*

Similarly, Bhat (2025) identifies positive correlations between EV sales, GDP growth, urbanization, and population density—suggesting that structural economic and demographic dynamics will continue to drive EV adoption (Bhat, 2025). While growth has been impressive, challenges persist in modeling and projecting EV demand accurately. Domarchi et al. (2023) provide a comprehensive review of EV sales forecasting models, concluding that many existing methods struggle with structural shifts, policy volatility, and non-linear adoption dynamics. Their review calls for hybrid and adaptive models that better reflect real-world complexities (Domarchi et al., 2023). Automakers themselves are also responding to regional variation in EV demand by calibrating their product portfolios. Ramji and Tayarani (2023) analyze how original equipment manufacturers (OEMs) tailor their EV and PHEV offerings across regions to match infrastructure, consumer income levels, and regulatory incentives (Ramji & Tayarani, 2023). The regional differentiation of EV supply strategies suggests that sales trends are shaped not only by demand but also by the supply-side planning of manufacturers.

EV Sales in the Philippines

The Philippine EV and HEV market is growing but remains in an early stage. According to the Electric Vehicle Association of the Philippines (EVAP), the country expects an 8–12% annual growth rate, with revenues projected to reach ₱1.68 billion by 2024 from the sale and servicing of around 200,000 units (NTRC, 2023). With government incentives and an expanding market, electric car adoption in the Philippines is projected to continue growth in 2025. This growth will drive forecasts that suggest there could be 6.6 million EVs on the road by 2030. This is critical to meeting the country's goal of having EVs account for at least 50% of all vehicles by 2040. In parallel with the increasing sales of EV in the Philippines, the Department of Energy (DOE) has set an ambitious target of deploying 7,000 EV charging stations nationwide by 2028. As of early 2025, only 912 stations are operational, primarily concentrated in Metro Manila (Saflor et al., 2025).

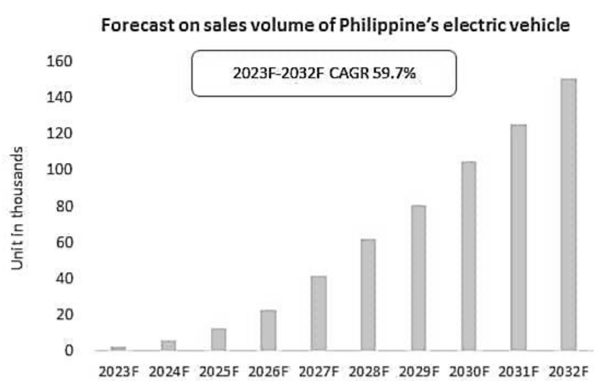

Figure 3. *Projected EV sales in the Philippines, 2023F–2032F: volumes rise steeply from a low baseline to ~150,000 units by 2032, reflecting a 59.7% CAGR*

The prevailing paradigm in electric vehicle (EV) adoption, largely shaped by Western markets, heavily relies on the fundamental assumption of "home charging." In developed nations, infrastructure planning and vehicle deployment strategies are predominantly predicated on the availability of private garages or driveways where overnight charging can occur efficiently. Research indicates that in these Western contexts, between 50% and 80% of all EV charging events take place at home, making residential access the undisputed cornerstone of the EV ecosystem (Qiu et al., 2022; Franke & Krems, 2013).

Consequently, Western policy frameworks and consumer EV models frequently assume that vehicle owners and operators possess the necessary spatial capacity to integrate charging infrastructure into their domestic environments. This individualized model significantly reduces the immediate need for extensive public charging networks and minimizes daytime grid strain by shifting energy demand to offpeak nighttime hours (U.S. Department of Energy, 2023). However, applying this Western-centric residential charging assumption to developing countries and hyper-dense urban areas, such as Metro Manila, presents a critical spatial and socioeconomic disconnect. In major Asian megacities, severe space constraints and high-density living arrangements render home charging inaccessible for the vast majority of urban residents, particularly public transport drivers who lack private parking infrastructure (Illahi et al., 2024). For public utility fleets like the UV Express, which operate under strict daily schedules and possess high energy demands, electrification necessitates a structural pivot toward depot-based or terminal-based charging infrastructure. Studies emphasize that in land-scarce, high-density environments, centralizing charging facilities at transit hubs or depots is not merely a logistical alternative, but a rigid operational requirement to ensure fleet readiness, mitigate range anxiety, and manage grid integration effectively (Liu et al., 2024).

Thus, imposing a home-charging expectation onto grassroots transport operators ignores the spatial realities of the Global South, where communal and terminal-based charging are the only viable pathways for commercial fleet electrification. This geographic concentration raises equity concerns, as rural and peri-urban areas remain underserved. The uneven rollout may exacerbate regional disparities in EV adoption, limiting the broader environmental and economic benefits of electrification.

Advantages and Disadvantages of Owning EV

Electric vehicles, including plug-in hybrids (PHEVs) and hybrid electric vehicles (HEVs), have gained global attention for their potential to reduce emissions and operating costs. Literature emphasizes both significant advantages and persistent limitations associated with their ownership. A primary benefit of EV ownership lies in lower operating and maintenance costs. With fewer mechanical components and the use of regenerative braking, EVs generally require less servicing than conventional vehicles (Palmer et al., 2018; Hannan et al., 2020). Over time, reduced fuel expenditure and declining battery prices contribute to favorable total cost of ownership, especially in high-mileage applications (Palmer et al., 2018). PHEVs and HEVs also deliver improved fuel efficiency by integrating electric propulsion with internal combustion systems, lowering energy consumption in urban cycles (Zhou et al., 2020). Environmental advantages are equally significant. Life-cycle analyses consistently show lower greenhouse gas emissions during operation, particularly when electricity is sourced from low-carbon grids (Hawkins et al., 2013). Although battery production entails high embodied emissions, these are offset during vehicle use (Ellingsen et al., 2016). EVs also reduce local air pollutants, improving urban air quality and contributing to public health gains. User experience factors further strengthen adoption motivation. High torque, smooth acceleration, and reduced noise enhance driver satisfaction (Hardman et al., 2018). Incentive policies, including subsidies and tax exemptions, enhance affordability and stimulate market penetration (Jenn et al., 2018; Narassimhan & Johnson, 2018).

However, the literature notes persistent challenges. High initial purchase prices, despite long-term savings, continue to deter consumers (Palmer et al., 2018). Charging infrastructure remains insufficient and unevenly distributed, creating accessibility issues and range anxiety (Coffman et al., 2017). Battery degradation, environmental impacts of raw material extraction, and uncertain resale values also influence ownership perceptions (Hannan et al., 2020; Ellingsen et al., 2016). Additionally, increased electricity demand and clustered charging can stress local grids if unmanaged (Wu et al., 2015).

Behavioral research shows that perceptions and preferences amplify or dampen these technical and economic factors. Meta-reviews find that perceived range, charging convenience, and purchase price remain top determinants of ownership decisions, while social influence and facilitating conditions can offset concerns when supportive policies and infrastructure are visible (Coffman et al., 2017; Hardman et al., 2018; Narassimhan & Johnson, 2018). In terms of weighing the advantages and disadvantages of owning EV, scholars conclude that EVs, PHEVs, and HEVs provide clear environmental and operational advantages but remain constrained by economic, infrastructural, and technological barriers. Continued cost reductions, battery innovation, and equitable infrastructure expansion are essential to achieve sustainable and widespread adoption. Owning an EV presents a balance of notable advantages and disadvantages that reflect both technological progress and infrastructural limitations. On the positive side, EVs offer significant long-term savings due to lower fuel and maintenance costs, as they rely on electricity instead of gasoline and have fewer moving parts that require repair. They also contribute to environmental sustainability by producing zero tailpipe emissions, reducing urban air pollution and dependence on fossil fuels. Moreover, governments often provide tax incentives and import duty exemptions to encourage adoption, making EV ownership increasingly attractive.

However, challenges remain— particularly the high upfront purchase cost, limited availability of public charging infrastructure, and long charging times compared to refueling conventional vehicles. Battery degradation and replacement expenses also raise concerns about long-term value, especially in countries with hot climates like the Philippines, where temperature can affect battery life. Despite these drawbacks, continued advancements in battery technology, expanding charging networks, and supportive policies are steadily shifting the balance toward the long-term advantages of electric mobility.

Cost of Owning Electric Vehicles in the Philippines

The economics of owning BEVs and HEVs in the Philippines are shaped by a combination of capital and operational factors. These include upfront costs, taxation, energy expenses, maintenance, depreciation, and infrastructure-related expenditures. Research shows that the total cost of ownership (TCO) in emerging markets like the Philippines is highly dependent on government incentives, energy pricing, and the maturity of the local EV ecosystem (Lopez et al., 2020; Lopez et al., 2021; Woody et al., 2024).

Upfront Price, Taxes, and Incentives. The initial purchase price remains one of the largest barriers to EV adoption in the Philippines. The initial acquisition cost of an EV is generally higher than an equivalent ICE vehicle due to the expensive components like the battery. However, more affordable entry-level models are now available, with some starting below ₱700,000. Lopez et al. (2021) emphasized that fiscal incentives are crucial to offset the relatively high upfront cost of EVs compared with internal combustion engine (ICE) vehicles. EVIDA and its implementing rules provide a framework for tax exemptions and market incentives to reduce ownership costs. Additionally, the extension of zero import tariffs for EVs and parts until 2028 is expected to narrow the price gap between EVs and ICE vehicles, thus improving their TCO profile (Reuters, 2024). These policy measures demonstrate how regulatory frameworks directly influence the economic feasibility of EV ownership.

Energy Cost versus Fuel Savings. EVs typically benefit from lower operating expenses due to cheaper energy per kilometer. In the Philippine context, the cost advantage is tied closely to the electricity tariff, which remains one of the highest in Southeast Asia. Lopez et al. (2020) found that EVs can yield long-term savings under stable electricity pricing, especially when charged during off-peak hours. Electricity is substantially cheaper than gasoline. A full charge for an EV that gives 300–500 km of range costs approximately ₱300–P800 when charging at home. Covering the same distance in a gasoline car can cost between ₱1,200 and ₱2,500, with prices fluctuating with the market. Consumer-based studies confirm that perceived savings and charging reliability are major determinants of purchase intention (Saflor et al., 2024). Therefore, while fuel cost savings favor EVs, the volatility of electricity prices may delay cost parity for some consumers.

Maintenance and Repairs. EVs incur significantly lower maintenance costs than ICE vehicles because they have fewer moving parts and require no oil changes. For an estimated distance that cover over 100,000 km, driving an EV could be 61% cheaper than an ICE car, with savings of ₱350,000 in fuel and maintenance costs. One study of the BYD Atto 3 EV projected fuel savings of over ₱464,000 over five years compared to a conventional car. EVs have significantly lower maintenance needs due to their simpler electric motor, which has fewer moving parts than a combustion engine. This eliminates the need for oil

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changes, spark plugs, timing belts, and other frequent upkeep. The average maintenance cost for an EV over the first three years is estimated at ₱3,881, compared to ₱11,494 for an ICE car. Philippine studies suggest that this contributes positively to lifetime savings (Lopez et al., 2020). However, hybrids present a mixed scenario; while they achieve fuel efficiency, their dual systems (electric motor and combustion engine) may increase maintenance complexity. Global analyses such as those by Woody et al. (2024) highlight that maintenance cost savings play a decisive role in TCO competitiveness, especially as the technology matures.

Battery Degradation and Replacement. Battery cost and longevity remain a pivotal uncertainty in EV economics. Lopez et al. (2021) noted that concerns over battery degradation and replacement significantly influence consumer hesitation. In regions with limited recycling and replacement infrastructure, such as the Philippines, these risks are often priced into ownership decisions. As global battery prices continue to decline, this cost component is expected to diminish, though local supply-chain readiness remains a constraint.

Financing, Insurance, and Depreciation. The total cost of ownership is also affected by the cost of financing and depreciation rates. Lopez et al. (2020) found that high interest rates and limited resale markets can increase perceived ownership risks, particularly during early adoption stages. These financial uncertainties underscore the importance of transitional incentives to sustain market confidence. As the secondary market for EVs expands, depreciation rates are expected to align more closely with those of conventional vehicles.

Charging Infrastructure and Ownership Barriers. A major cost factor in the Philippine EV market is charging infrastructure. While home charging is the most affordable, commercial public chargers are more expensive. For instance, Shell Recharge charges ₱28/kWh for AC and ₱35/kWh for DC fast charging. Saflor et al. (2024) observed that limited public charging facilities and high installation costs for residential chargers elevate perceived ownership costs. This infrastructure gap indirectly discourages adoption by increasing range anxiety and logistical inconvenience. Regional analyses (Champeecharoensuk et al., 2025) reinforce that infrastructure access and tariff design are decisive in determining whether EV ownership becomes economically viable.

Comparative Standing of Hybrid Vehicles. HEVs currently offer a transitional solution for Filipino consumers seeking lower operating costs without depending on charging infrastructure. Studies suggest that HEVs can deliver favorable ownership economics under the current tax and fuel price regimes (Lopez et al., 2020; Woody et al., 2024). Behavioral research also indicates that perceived economic value and fuel savings significantly influence hybrid purchase intentions (Ong et al., 2023).

In terms of the cost of electric vehicle ownership in the Philippines, the literature suggests that the cost of owning EVs and HEVs in the Philippines will continue to decline as fiscal incentives, infrastructure availability, and energy efficiency improve. In the short term, HEVs provide immediate affordability advantages, while EVs promise greater long-term savings once market and policy conditions mature. The evidence converges on one conclusion: with sustained policy support and grid readiness, the economic case for EV ownership in the Philippines can reach parity with traditional vehicles within the decade (Lopez et al., 2021; Woody et al., 2024).

Upfront Price Comparison of EVs and ICEVs in the Philippines

Philippine and regional literature consistently identifies high upfront purchase cost as one of the most binding constraints on electric vehicle (EV) adoption compared with internal combustion engine vehicles (ICEVs). Across policy reports, market analyses, and peer-reviewed studies, EVs are described as significantly more expensive to acquire than conventional gasoline or diesel units, even when their lifetime operating costs are lower. National policy documents under the Electric Vehicle Industry Development Act (EVIDA) explicitly acknowledge that EVs carry a higher initial purchase price than ICEVs. The Department of Energy's Comprehensive Roadmap for the Electric Vehicle Industry (CREVI) notes that, when total cost of ownership (TCO) is decomposed, "the purchase price of an EV is higher than that of an ICEV," although this premium can be partially offset by lower fuel and maintenance costs over the vehicle's life. CREVI's cost–benefit tables illustrate this upfront gap in the public transport segment: for example, the investment cost of a battery electric jeepney (e-jeepney) is estimated at ₱2.8 million versus ₱2.464 million for a conventional jeepney, reflecting a substantial capital premium even before operating savings are considered.

Similar conclusions appear in earlier government industry roadmaps, which frame "high acquisition cost" as a core barrier and a key justification for fiscal incentives and soft-loan schemes for EVs. More recent fiscal and industry profiles reinforce this pattern. A profile of the Philippine EV industry prepared for the National Tax Research Center (NTRC) observes that a brand-new EV is more expensive upfront than a comparable conventional vehicle; however, it argues that lower fuel and maintenance expenses can make EV ownership cheaper in the long run. This distinction between purchase price and lifetime cost is central to Philippine policy debates: high upfront prices limit adoption among pricesensitive households and small operators, even when models indicate favorable lifetime economics. Market-oriented analyses provide more granular comparisons. A 2025 assessment by the Manila Observatory reports that battery electric vehicles (BEVs) in the Philippines typically cost about 1.7 to 2.4 times more than comparable ICE cars, while plug-in hybrid electric vehicles (PHEVs) cost roughly 1.4 to 1.99 times more than their ICE counterparts.

The same report links this price gap to global battery costs, dependence on imported units, and the absence of local vehicle manufacturing, all of which magnify the retail price of EVs in a market where most models are fully built-up imports. These findings align with industry commentary that, although more affordable Chinese EV brands are entering the market, sticker prices remain substantially higher than popular gasoline or diesel sedans and utility vehicles targeting ordinary Filipino households and small business operators. Peer-reviewed research focused on the Philippines likewise treats vehicle cost—and specifically the initial purchase price—as a primary barrier to EV adoption. Saflor et al. (2024), using structural equation modeling and artificial neural networks, identify vehicle cost as one of the most influential deterrents in Filipino consumers' acceptance of EVs, alongside charging infrastructure and range anxiety.

At a broader regional scale, Lin (2025) shows that "high upfront costs" are the most frequently cited economic barrier to EV adoption across ASEAN emerging economies and notes that in the Philippines, limited financing options exacerbate the cost gap between EVs and ICEVs. These studies empirically support what policy documents and industry reports already suggest: even where long-run savings are compelling, the capital cost hurdle at the point of purchase remains difficult to overcome. Cost–benefit analyses deepen this picture by distinguishing between private and societal perspectives. Lopez et al. (2021) conduct a societal cost–benefit analysis of EVs in the Philippines and conclude that while ownership cost parity between EVs and ICEVs is still "far-fetched" under current price structures, EVs can achieve societal cost benefit parity within the decade due to avoided fuel imports, health benefits, and greenhouse gas reductions. Their work effectively confirms that from the standpoint of individual buyers and operators, high upfront costs still require subsidies, tax exemptions, and other policy support to make EVs attractive relative to ICE alternatives.

Taken together, this body of literature shows a clear and consistent pattern: in the Philippine context, EVs are substantially more expensive to purchase upfront than comparable ICE vehicles, typically ranging from a modest premium in public transport fleets (e.g., e-jeepneys versus conventional jeepneys) to 1.7–2.4× higher prices for private BEVs.

While TCO analyses and societal cost-benefit studies highlight long-term advantages of electrification, the initial capital outlay remains a major deterrent, especially for lower-income households and small public transport operators who cannot easily absorb high down payments or access concessional financing. This upfront price differential is therefore central to explaining the slow and uneven diffusion of

EVs in the Philippines, despite supportive legislation under EVIDA and the Public Utility Vehicle Modernization Program (PUVMP).

Theoretical Perspective

This study was guided by three sensitizing theoretical perspectives—Unified Theory of Acceptance and Use of Technology (UTAUT), Systems Theory, and Rational Choice Theory (RCT)—to explain how UV Express operators navigate the transition to electric vehicles. Rather than serving as rigid frameworks, these theories were used as flexible lenses to understand operators' experiences and decision-making processes. Systems Theory provided a macro-level view of transport operations as interconnected systems influenced by technical, financial, and regulatory factors, while UTAUT explained technology adoption through factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions. Together, these perspectives enabled a holistic understanding of EV adoption as both an individual and systemic process, supporting the development of a grounded and context-sensitive proposition.

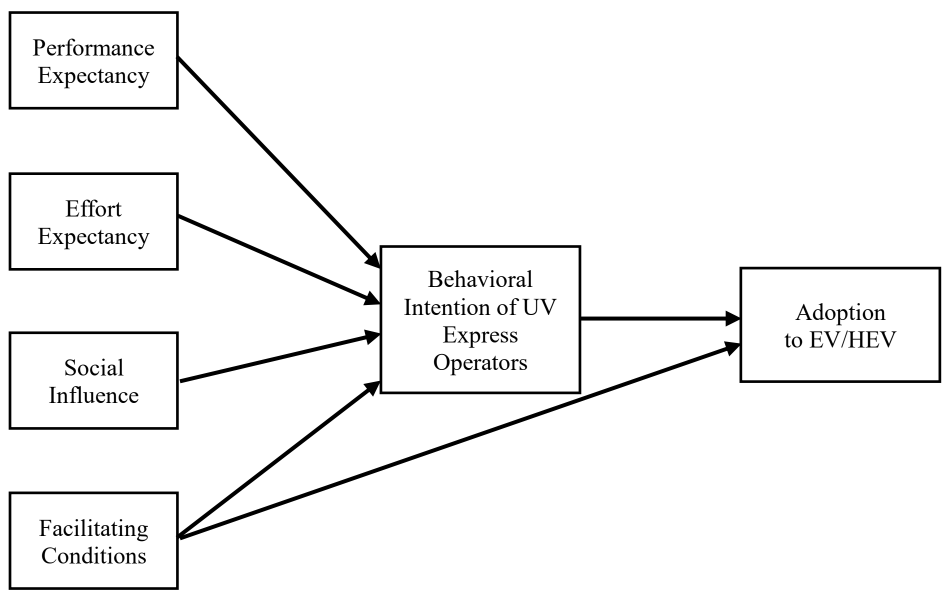

Figure 4. *Theoretical framework illustrating the Unified Theory of Acceptance and Use of Technology (UTAUT) model as applied to UV Express operators.*

This study integrated UTAUT, Systems Theory, and Rational Choice Theory (RCT) to explain EV adoption among UV Express operators. UTAUT identified four key belief dimensions—performance expectancy, effort expectancy, social influence, and facilitating conditions—that shape operators' intentions to adopt EV/HEVs. Systems Theory contextualized these decisions within interconnected transport systems influenced by technical, financial, and regulatory factors. Complementing these, RCT explained adoption as a rational decision-making process where operators weigh expected benefits against costs and risks under existing constraints. Together, these perspectives provided a comprehensive framework for understanding how beliefs, systemic conditions, and economic considerations influence EV adoption and supported the development of a practical operational framework. RCT as shown in Figure 5. explains behavior as the outcome of purposeful decisions made under constraints.

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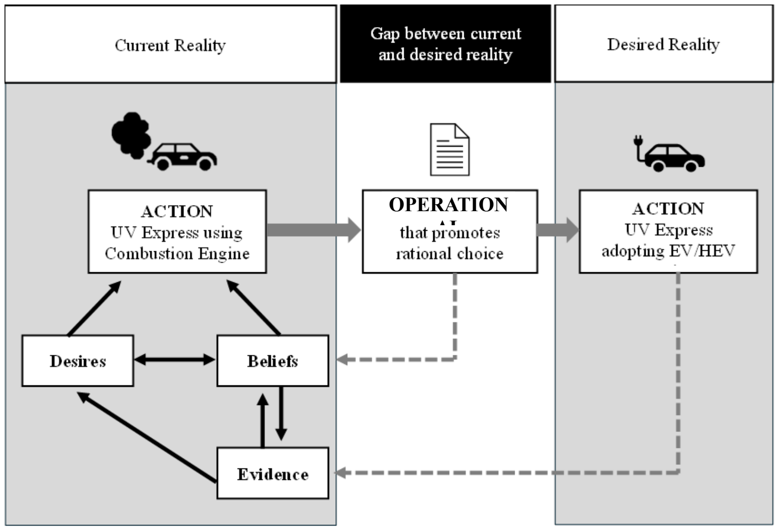

Figure 5. *Gap Analysis Model of Rational Choice Theory applied to UV Express Transition. The framework illustrates how operators' desires, beliefs, and evidence shape current actions— continued use of combustion engines—while operational framework that promote rational choice bridge the gap between current and desired realities, enabling the shift toward adoption of electric and hybrid electric vehicles (EV/HEV).*

This study employed an iterative, constructivist approach in integrating UTAUT, Systems Theory, and Rational Choice Theory (RCT) to explain EV adoption among UV Express operators. Initial constructs such as performance expectancy, facilitating conditions, interdependence, and utility maximization served as guiding concepts for data collection and analysis. However, these constructs were continuously refined through comparison with field data, allowing meanings to emerge from participants' lived experiences. UTAUT concepts were contextualized into operational realities, while RCT was applied abductively to explain adoption decisions based on perceived costs, risks, and benefits. This flexible theoretical approach enabled the study to move beyond predefined models and develop a grounded, localized proposition explaining how operators navigate the transition to electrification.

Conceptual Framework

The conceptual framework of this study served as the analytical guide for examining how UTAUT, Systems Theory, and Rational Choice Theory (RCT) interact in explaining the behavioral, managerial, and operational dimensions of EV and hybrid adoption in the UV Express sector. Grounded in Charmaz's Constructivist Grounded Theory, the framework supported an iterative and experience-based analysis, ensuring that findings emerged from operators' lived realities. Management dynamics were treated as key drivers influencing perceptions, readiness, and decision-making. UTAUT was used as a flexible heuristic to guide coding and category development, while the overall framework functioned as a funnel linking operators' experiences to the development of an empirically grounded and practical operational framework for EV adoption.

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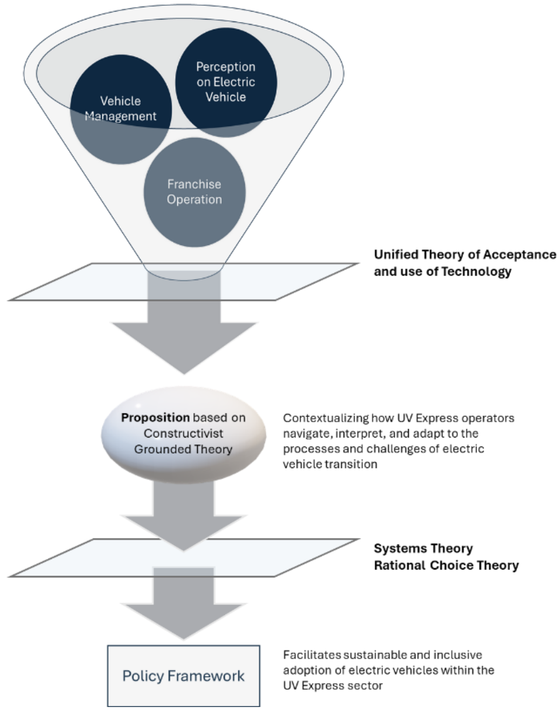

Figure 6. *Conceptual Framework. The conceptual framework is showing how UV Express operational experiences and EV perceptions inform a grounded proposition and lead to an operational framework for EV adoption*

This study synthesized insights from operators' vehicle management practices, franchise experiences, and perceptions of EVs to explain how daily operational realities shape acceptance of electrification. Using UTAUT, these insights were organized into key factors influencing adoption, while thematic analysis generated an emergent proposition explaining how operators navigate the EV transition. This proposition was further interpreted through Systems Theory and Rational Choice Theory (RCT) to identify operational levers, highlighting the interdependence of policy, infrastructure, financing, and governance, as well as operators' cost–benefit considerations under real constraints. The resulting proposition, grounded in participants' experiences, informed the development of an operational framework aimed at reducing management barriers and supporting sustainable, inclusive EV adoption in the UV Express sector.

METHODS

Research Design

This study adopted a Constructivist Grounded Theory (C-GT) approach, focusing on discovery rather than testing existing theories. It involved immersive engagement with UV Express operators to understand how they interpret their daily operations amid modernization pressures and electrification challenges. Knowledge was co-constructed through interaction, allowing meanings to emerge inductively from participants' lived experiences. The research emphasized reflexivity and dialogical inquiry, ensuring that findings were both theoretically grounded and contextually relevant, ultimately supporting the development of a practical operational framework for EV adoption.

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Research Locale

This study was conducted in the Greater Manila Area (GMA), covering Metro Manila and nearby provinces such as Bulacan, Rizal, Cavite, and Laguna. The area was selected due to its high passenger demand, traffic congestion, and varied infrastructure conditions affecting UV Express operations. Data were gathered from purposively selected terminals located in central business districts, transport hubs, and suburban areas to capture differences in operational scale and context. These sites provided a comprehensive setting for examining the challenges and realities faced by operators in the transition to electric vehicles.

Sampling Technique

This study employed purposive and theoretical sampling within a Constructivist Grounded Theory framework to develop an explanatory understanding of how management factors influence UV Express operators' decisions on vehicle electrification. Participants—including drivers, operators, and cooperative officers—were selected based on their active involvement in terminal operations across both high- and low-traffic routes to ensure diverse, experience-rich perspectives. Data collection and analysis were conducted iteratively, beginning with broad sampling to capture varied experiences, followed by more focused sampling to refine emerging categories. Guided by theoretical sufficiency, participant selection continued until no new insights emerged, ensuring a grounded and context-sensitive explanation of how operators navigate the transition to EV and hybrid mobility.

Metadata of Respondents

A total of 14 UV Express stakeholders participated in the study across two iterative phases (Iteration 1: n = 9; Iteration 2: n = 5), selected through purposive and theoretical sampling. Participants included drivers, driver-operators, cooperative officers, and boundary drivers, with 5 to 30 years of experience, ensuring diverse perspectives across roles, routes, and operational contexts. Data were collected through field interviews conducted in various terminals within the Greater Manila Area, capturing variation in demand, governance, and route conditions. Participant metadata were used as contextual descriptors to enhance credibility and interpret meaning rather than for statistical comparison. Iterative data collection and constant comparative analysis were employed until theoretical sufficiency was achieved, with converging insights across roles strengthening the validity and depth of the findings.

Research Instrument and Validation

A semi-structured interview guide was used as the primary data collection instrument, aligned with the Constructivist Grounded Theory approach. The guide focused on two key domains: participants' perceptions of EV and hybrid adoption and the factors influencing their willingness or reluctance to adopt, including operational realities. It was applied flexibly to encourage in-depth narratives while maintaining alignment with the study's objectives. To ensure analytic rigor, each interview was paired with reflective memo writing, documenting emerging concepts, contextual conditions, and analytical insights. This dual-layer process supported constant comparison, enhanced traceability, and facilitated the development of grounded theoretical propositions.

The semi-structured interview guide was pilot-tested across participants from different roles and routes to ensure clarity, relevance, and depth of responses. Revisions included removing leading questions, refining probes, and enhancing memo cues to support deeper analysis. Interviews, lasting 30–45 minutes, were audio-recorded with consent and supplemented with field notes, analytic memos, observations, and document review for triangulation. Credibility was strengthened through participant reflections, attention to divergent cases, and strict confidentiality measures. Instrument validation involved alignment review with research objectives, expert evaluation for relevance and cultural fit, and pilot testing in both Filipino and English. These procedures ensured that the instrument generated rich, reliable data necessary for developing a grounded and context-sensitive understanding of EV adoption among UV Express operators.

Data Collection and Analysis

This study employed Grounded Theory as its methodological framework, allowing explanations to emerge inductively through iterative and comparative analysis of participants' experiences. Data collection and analysis followed a cyclical process, where insights from each interview informed subsequent sampling and questioning until theoretical saturation was achieved. The constant comparative method was applied by systematically comparing incidents, codes, and categories across interviews, observations, and documents. As categories developed, theoretical sampling was used to refine and validate emerging concepts, leading to selective coding and integration into a coherent explanatory proposition. This approach enabled a contextually grounded understanding of EV adoption as a complex, dynamic process shaped by operational realities, constraints, and decision-making practices of UV Express operators.

This study utilized Constructivist Grounded Theory with coding as the primary analytic process, progressing through open, focused/axial, and theoretical coding stages. Data from interviews, observations, documents, and field notes were analyzed using constant comparison to identify patterns, refine categories, and develop themes grounded in participants' experiences. Analytic memo writing supported category development, theoretical sensitivity, and auditability, while triangulation strengthened credibility. The analysis followed Conditions–Actions–Consequences (CAC) logic, culminating in a grounded proposition explaining EV adoption and an operational framework translating findings into actionable strategies. Theoretical saturation was achieved when no new insights emerged, ensuring a robust, context-sensitive explanation of operators' decision-making processes.

Ethical Consideration

This study adhered to Philippine research ethics guidelines and the Data Privacy Act, ensuring participant dignity, confidentiality, and transparency throughout the research process. Informed consent was treated as an ongoing process, with participants fully informed of the study's purpose, procedures, risks, and their rights, including withdrawal at any time. Data collection prioritized minimal risk, with safeguards such as anonymization, use of pseudonyms, secure data storage, and restricted access to sensitive information. Ethical rigor was maintained through voluntary participation, culturally appropriate communication, and continuous reflexivity, ensuring that findings were responsibly reported while protecting the identities and welfare of all participants.

RESULTS AND DISCUSSION

Perceptions of UV Express Operators on Electric Vehicles in the Context of Transport Operations

This section presents the findings for RQ1 by synthesizing two iterations of thematic analysis. Operators' perceptions of electric vehicles (EVs) were not simply positive or negative; rather, they reflected a practical and ongoing evaluation of whether EVs could support the everyday realities of UV Express operations. Across narratives, operators assessed EVs in relation to livelihood sustainability, operational reliability, and the readiness of supporting systems.

Findings revealed a stance of conditional openness. While participants recognized potential benefits such as reduced fuel costs, quieter operation, improved passenger comfort, and lower emissions, these advantages were consistently weighed against concerns including high acquisition costs, limited charging infrastructure, potential downtime, insufficient repair support, battery-related risks, and uncertainties in franchise and route security. Overall, operators perceived EV adoption through three interrelated lenses: economic survivability, operational readiness, and institutional confidence. These perspectives highlight that electrification is viewed not merely as a technological shift but as a livelihood-sensitive decision tied to income stability and service continuity. Table 5 summarizes the identified themes and subthemes, which are discussed in detail in the succeeding sections.

Table 1. Perception of electric vehicles within the context of UV Express Operations

Overarching Themes	Subthemes
Theme 1. Economic survivability is the primary filter	1.1: Seeing EVs as cheaper to run, but the return of investment for high upfront cost is uncertain
	1.2: Judging EVs based on daily income and boundary needs
	1.3: Weighing franchise and route security before investing
	1.4: Considering battery replacement and major breakdowns as costly risks
	1.5: Accepting modernization only if it does not harm livelihood.
Theme 2: Operational readiness determines feasibility	2.1: Range anxiety and fear of being stranded mid-trip
	2.2: Charging stations are viewed as non-negotiable—especially along routes and at terminals
	2.3: Charging time is perceived as lost trips, which means lost earnings
	2.4: Lack of EV-capable mechanics and service centers increases perceived impracticality
	2.5: Training and clear guidance are required to reduce operational uncertainty
Theme 3: Confidence in EV is built collectively and institutionally	3.1: Modernization messages are perceived as unclear or not operationally grounded
	3.2: Hybrids are perceived as a safer first step because fuel backup reduces risk
	3.3: Seminars help awareness but may not provide enough operational detail
	3.4: Peer networks and cooperative learning shape credibility
	3.5: EVs are associated with comfort and reduced smoke, but practicality still decides

Theme 1: Economic survivability is the primary filter

In this theme, participants' perceptions of EVs were anchored in what can be described as *livelihood mathematics*—the practical, day-to-day calculations operators make to determine whether a decision will sustain income, control costs, and keep their households financially stable. Rather than viewing EV adoption as a purely technological shift, operators evaluated it based on its impact on earnings, expenses, and financial risk. This perspective highlights that decisions about electrification are grounded in survival-oriented reasoning, where maintaining steady income and minimizing uncertainty take precedence over potential long-term benefits.

Operators assessed the value of electrification through everyday accounting, where any new technology was judged by a simple but high-stakes question: does it protect the ability to earn today, and can it repay the money invested over time?

The government's modernization policy relies heavily on a linear financial paradigm, heavily anchored in calculating a 10-year Total Cost of Ownership (TCO). This macro-level perspective assumes annualized returns, framing electrification as a financially sound investment based on projected long-term fuel savings and reduced maintenance costs over a decade. Conversely, the lived economic reality of UV Express drivers operates on a strictly circular, micro-economic framework defined in this study as "Livelihood Mathematics." Within this daily cycle, financial viability is not measured by abstract yearly yields, but by the immediate "Daily Net Take-Home" pay calculated only after boundary fees, fuel/energy costs, and day-to-day operational expenses are settled. Consequently, the top-down narrative of long-term EV savings fundamentally misaligns with the operators' immediate economic thresholds, explaining why ground level adoption frequently stalls. From the driver's perspective, the "math" of modernization fails because the risk of a single operational disruption—such as a missed round-trip due to mid-route charging or extended terminal downtime—poses an immediate, existential threat to their daily subsistence. Regardless of the millions of pesos that might be saved over a five-year horizon, a disrupted operational day dictates whether a driver can purchase food or pay rent that same evening. Thus, resistance to electrification is not rooted in a failure to comprehend TCO, but rather in a rational, survival-driven prioritization of the circular daily boundary over the state's linear, annualized projections. Across the accounts, EVs were rarely discussed first as a "clean" or "modern" technology. Instead, participants framed EVs as an income-generating asset whose legitimacy depended on whether it could sustain trip frequency, absorb passenger demand fluctuations, and withstand the day-to-day operational realities of UV Express work. This pattern supported the argument of Figueroa et al. (2020) that the vehicle is not merely a transport unit but the material foundation of daily survival. It also aligned.

with studies showing that small transport operators are especially exposed to financial shocks when policy and technology transitions introduce uncertainty or added burdens. From the UV Express operators' standpoint, EV adoption became meaningful through a pragmatic financial question: will this stabilize or destabilize my ability to earn consistently and recover what I paid for the unit? This concern echoed studies emphasizing how purchase price, perceived payback timelines, and total cost of ownership expectations shape willingness to adopt (Lopez et al., 2020; Palmer et al., 2018). Even when operators acknowledged possible advantages, their narratives repeatedly returned to vulnerability. One wrong investment decision whether an expensive unit, uncertain durability, or major component failure could destabilize income and threaten household survival. What stood out to me was how operators treated the unit and livelihood continuity as inseparable. Even when interest in EVs was expressed, it was framed as a question of survivability: can the technology endure UV Express conditions without collapsing the operator's capacity to earn? In this sense, technological change was not experienced simply as innovation. It was experienced as a potential livelihood risk when operating conditions and institutional supports remained uncertain, consistent with transport modernization research (Figueroa et al., 2020; Mateo-Babiano et al., 2020).

Subtheme 1.1: Seeing EVs as cheaper to run, but the return of investment for high upfront cost is uncertain

In this subtheme, a recurring tension emerged in how operators evaluated the cost of EVs. While participants acknowledged the potential for lower operating expenses, particularly due to reduced energy costs, this did not translate into confidence in adoption. The high upfront purchase price, coupled with uncertainty regarding vehicle durability and long-term performance, made the payback period difficult to assess. As a result, EVs were perceived as financially risky, with operators hesitant to commit to an investment whose returns remained unclear within their livelihood context.

The analytic reasoning supporting subtheme 1 is substantiated by the following accounts:
"Kaya niyang (referring to EV) umabot ng mga 32 kilometers kada litro—sobrang tipid nun pero hindi rin ganun kadali para sa amin na basta na lang sumubok ng bago, lalo na kung mahal at hindi pa sigurado." (It can reach around 32 kilometers per liter—that's a huge savings but It's also not that easy for us to just try something new right away, especially if it's expensive and not yet certain.) (INT-01: T78)

This narrative captured how "trying" an EV was not framed as a simple upgrade but as a decision with serious financial consequences. Another participant hesitated mainly because of the price. For him, the cost made the shift feel like a gamble, with much to lose if the investment did not pay off.

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“Ang Electric Vehicle, matipid patakbuhin pero yung iba (referring to other operators) nagdadalawang-isip kasi mahal yung EV, hindi pa malinaw ano yung mga rules sa prangkisa, tapos may duda din sa maintenance.” (Electric vehicles are cheaper to run but others hesitate because EVs are expensive, the franchise rules aren’t clear, and there’s fear about maintenance.) (INT-02: T215)

I interpreted these accounts as a form of conditional reasoning: the idea of savings mattered only if operators could realistically imagine recovering the investment under the unstable conditions of daily UV operations (Woody et al., 2024). I noted that participants did not evaluate EV costs as a standalone concept. Their calculations were tied to daily boundary arrangements, changes in passenger volume, and the basic need to keep the unit running every day. This pattern was consistent with other EV adoption studies noting that high upfront cost remains a major barrier (Palmer et al., 2018), and that limited charging infrastructure, gaps in after-sales support, and policy ambiguity can suppress perceived value even when operating-cost advantages exist (Castro et al., 2023; Coffman et al., 2017; Guno et al., 2021).

Subtheme 1.2: Judging EVs based on daily income and boundary needs

In this subtheme, operators evaluated EVs through the lens of daily income realities and boundary obligations, grounding their judgments in routine operational accounting. Since earnings depended on completing multiple trips, any factor that reduced trip frequency—such as charging time, downtime, or repair delays—was viewed as a direct threat to daily cash flow rather than a minor inconvenience. This survival-oriented framing was intensified by existing challenges such as traffic congestion and unpredictable travel times, which already constrained productivity. Within this context, operators assessed EV viability based on whether it could sustain or disrupt their ability to earn consistently on a daily basis.

One participant framed EV value in relation to boundary expectations. Here, the EV was evaluated not through its environmental promise, but through whether it would preserve the daily financial arrangement that operators needed to meet.

“Sulit siguro ang EV kung hindi tataas yung boundary at kung tuloy tuloy ang byahe. Mahalaga kasi sa amin ang arawang kita…” (An EV might be worth it if the boundary doesn’t go up and the trips stay continuous. What really matters to us is our daily income.) (INT-07: T793)

Another account connected daily income directly to the risk of major cost shocks:

“Kapag nasira yung battery… mahal palitan tapos wala kang kita.” “If the battery gets damaged… replacing it is expensive then you won’t earn anthing.” (INT-01: T117)

A third account captured the non-negotiable pressure of daily operations even under fatigue and uncertainty. This narrative highlighted the everyday discipline of earning, where work continued regardless of uncertainty and where the need to produce income remained immediate.

“Puyat ako, pero kahit ganun, kailangan ko pa rin bumangon at lumabas para bumiyahe para kumita. Kasi sa amin, pag hindi ka naka byahe, wala kang kita. Ok naman yung EV basta makakaka byahe kami ng maayos” (I don’t have ample sleep. but even then, I still have to get up and go out to drive so I can earn. For us, if you don’t get to make trips, you don’t earn. EVs are fine as long as we can operate smoothly.) (INT-10: T04)

From these accounts, I saw how boundary and cashflow realities functioned as a practical filter that compressed EV evaluation into a simple lived question: will EV operations reduce trips, delay work, or increase deductions? In this framing, adoption was mediated by perceived feasibility and operational fit, not only by environmental appeal or technology interest. These concerns aligned with EV adoption research showing that perceived inconvenience, infrastructure limitations, and operational disruptions can constrain adoption even when attitudes toward EVs are generally positive (Coffman et al., 2017; Hannan et al., 2020).

Subtheme 1.3: Weighing franchise and route security before investing

In this subtheme, I ascertained that franchise and route security shaped whether operators felt safe enough to invest. By franchise and route security, I refer to participants' confidence that their franchise will remain valid, their route authority will be retained, and their right to operate will not be disrupted by sudden policy changes, shifting requirements, or unclear renewal decisions. Participants repeatedly emphasized the need for assurance before committing to a costly unit. One operator stated and in the same account, added the concern became more specific:

> *"Kung lilipat at gagamitin ang electric, dapat may kasiguruhan tungkol sa prangkisa at mga ruta…"* (If we switch to using electric vehicles, there must be assurance about franchises and routes…) (INT-03:T400) *"Mahirap lumipat sa EV lalo na kung hindi pa klaro kung ano magiging epekto nito sa prangkisa"* (It is difficult to transition to EV specially if the effect on the franchise isn't clear.) (INT-03: T342)

Another participant expressed this fear as a need for protection against sudden loss:

> *"Kailangan namin ng kasiguruhan na hindi basta-basta kukunin yung prangkisa…"* (We need assurance so franchises won't be taken away.) (INT13:T336)

A similar logic appeared in another account that linked willingness to adopt with how modernization was implemented:

> *"Eto totoo, sabihin ko sayo. Kung sasabihin sa amin na lumipat at mag palit ng unit mula diesel papuntang electric, wala naman masama dun. Ok naman yun pero kailangan ng suporta sa prangkisa, patas na assessment, at hindi minamadali yung pag-shift. Open naman kami sa ganun."* (To be honest, I'll tell you this. If they tell us to shift and replace our unit from diesel to electric, there's nothing wrong with that. That's okay with us— but there has to be support for the franchise, fair assessment, and the transition shouldn't be rushed. We're open to that.) (INT-10: T101)

These statements showed that participants were not only thinking about whether EVs would work technically, but also whether the rules governing their ability to operate would remain stable enough to make the investment recoverable. It is well supported that openness to transition was not presented as resistance versus acceptance. It was presented as conditional willingness shaped by governance signals, fairness, and pacing. This aligned with research cautioning that modernization can destabilize or exclude smaller operators when financing mechanisms and institutional supports are not sufficiently protective (Gatarin & Galicha, 2024; Mateo-Babiano et al., 2020). Within the current regulatory environment, UV Express operations and franchise continuity were directly shaped by policy instruments that structured legitimacy and operating permissions (Land Transportation Franchising and Regulatory Board [LTFRB], 2020). Regulatory clarity therefore functioned as a practical precondition for confidence. When franchise arrangements, route permissions, or modernization requirements felt uncertain or shifting, EV adoption was seen as a higher-risk decision. This pattern was consistent with modernization research showing that unclear timelines, inconsistent implementation, and uncertain compliance requirements often generate hesitation among operators (Figueroa et al., 2020).

The accounts, taken together with the cited studies showed that "perception" was not only about the vehicle itself. In the context of UV Express, it was also about whether operators could safely attach livelihood to a governance system they feared might change the rules midstream. This uncertainty has been repeatedly highlighted in modernization and electrification policy discussions, and it clearly shaped how operators evaluated the risks of investing in EVs.

Subtheme 1.4: Viewing battery replacement and major breakdowns as costly risks

In this subtheme, participants framed battery issues and major system failures as high-stakes risks rather than routine maintenance concerns. Instead of focusing on minor repair costs, operators emphasized the potential for costly breakdowns—particularly involving the battery and electrical components—which could result in prolonged downtime, accumulated debt, and immediate loss of daily income. This perception highlights how EV-related risks are evaluated not only in technical terms but in relation to their severe financial and operational consequences within the operators' livelihood context.

One participant stated the concern directly:

> *"Yung mga maliliit na parts, generic naman yun. Pareho lang ng sa diesel pero sa EV, kapag nasira yung battery… mahal palitan."* (The small parts are usually generic. They're pretty much the same as with diesel, but with an EV, if the battery gets damaged… it's expensive to replace.) (INT01:T117)

Another operator expanded the fear beyond the battery alone and included the broader electrical system

> *"Kapag may nasira sa battery o kaya sa… electrical system… mas mahal at mas mahirap ayusin…"* (If something breaks in the battery or… electrical system… more expensive and harder to repair…) (INT-10: T46)

From the first two accounts, it was evident that the worry was not just the cost, but also the difficulty of fixing EV-related problems compared to the diesel engine units were used to. Moreover, a third participant emphasized the operational impact of delays:

> *"Kapag hindi agad mapalitan yung battery, mas hahaba yung downtime at mas magiging mahirap yung repair"* (If the battery can't be replaced quickly, downtime can be longer and repairs can be more difficult.") (INT11:T139)

These micro narratives are evidence expressing how repair time and cost were experienced together. A battery problem was not only expensive; it could also remove the unit from service for longer, which meant fewer trips and reduced earnings. These interpretations aligned with EV research that identifies battery degradation, uncertainty around replacement, and limited repair ecosystem readiness as strong drivers of hesitation (Hannan et al., 2020; Lopez et al., 2021). Across the narratives, the battery became symbolically central. It was not treated as just one component of the vehicle. It was experienced as a potential single-point financial failure that operators felt they could not absorb, reinforcing why major breakdowns weighed heavily in their judgments about EV adoption.

Subtheme 1.5: Accepting modernization only if it does not harm livelihood

In this subtheme, modernization was perceived not as an abstract policy but as a set of changes that directly affected daily operations. Participants described modernization in terms of its practical implications, such as passenger limits, operating rules, compliance requirements, and cost structures. These changes were evaluated based on their impact on daily income, leading operators to view EV adoption as acceptable only if it did not intensify financial strain or reduce earning capacity. This perception was particularly evident in concerns about passenger capacity, which operators framed as a critical factor in sustaining their livelihood.

One operator expressed it as a straightforward request:

> *"Dati ang capacity ng Van sa isang byahe mga 16-18. Tapos nag pandemic kaya nagging 10 na lang. kung lilipat sa electric, ang hinihiling namin, manatili yung kasalukuyang passenger capacity para hindi mabawasan yung kita namin…"* (Before, a van could carry around 16 to 18 passengers

per trip. Then the pandemic happened, so it went down to just 10. If we switch to electric, our request is that the current passenger capacity remains so that our income is steady…) (INT-07: T793)

In this narrative, modernization was not judged by its stated goals alone, but by whether it would preserve the basic conditions that kept income stable. Another participant widened this point by linking modernization concerns to uncertainty in direction and the priority of consistent earnings:

> *"Ang hirap kasi maunawaan ng modernization na yan. Isipin mo diesel or electric? Hindi naman yun ang problema. Pagdating sa mas malalaking problema gaya nyang mga isyu sa modernization… wala pa ring malinaw na direksyon. Ang pinaka mahalaga sa amin yung tuloy tuloy na kita"* (It's hard to make sense of that modernization policy. Think about it—diesel or electric? That's not really the problem. When it comes to bigger problems such as modernization issues… there still isn't a clear direction. The most important thing for us is stable income) (INT-04: T432)

The second narrative articulated that unclear policy direction was not simply confusing. It created hesitation because it threatened planning and made livelihood outcomes feel uncertain. I also heard operators describe an active effort to cope with modernization pressure rather than simply resist it.

One participant explained openness as long as preparation could protect earnings. In this statement, openness depended on whether operators could prepare in ways that prevented income loss. The stakes were described plainly as household survival.

> *"Kahit may mga pagdududa, bukas naman kami—at puwede kaming mas maghanda at mas magkaalam para hindi maapektuhan yung kita namin. Kasi kung hindi, magugutom yung pamilya namin."* (Even if there are doubts, we are open and we can become more prepared and more informed so our income doesn't get affected, otherwise our family will starve…") (INT07:T820)

These narratives are showing that acceptance was tethered to lived feasibility. Modernization became "acceptable" only when it was experienced as supportive rather than punitive, and only when it protected the capacity to earn. This interpretation presented in subtheme 5 aligned with research cautioning that modernization can lead to exclusion and livelihood disruption when transitional supports are insufficiently protective or unevenly implemented (Gatarin & Galicha, 2024). It also validated the scholarly works emphasizing that modernization is not only technological but managerial and institutional, often creating added costs and coordination burdens that smaller operators struggle to carry (Mateo-Babiano et al., 2020). In this sense, the accounts reinforced the importance of inclusive financing, participatory implementation, and stronger governance capacity to make modernization and electrification transitions workable and fair. Operators accept modernization only if it does not harm livelihood Synthesizing all the subthemes within Theme 1, the accounts and my analytic interpretations converge to show that operators' perceptions were anchored in economic survival. In the micro-stories I examined, EVs were not treated simply as "clean technology." They were experienced as a high-stakes financial gamble. Operators' lived realities made them highly sensitive to uncertain payback, boundary pressures, and the possibility of catastrophic repair costs. This pattern closely aligned with EV adoption research highlighting high upfront costs, total cost of ownership uncertainty, and battery-related risk perceptions as major barriers to adoption (Lopez et al., 2020; Lopez et al., 2021; Palmer et al., 2018).

At the same time, I also saw that openness emerged when operators could realistically imagine EV adoption protecting, rather than threatening, income stability. This willingness became more likely when policy signals were clearer and when ecosystem conditions such as charging access, service support, and implementation fairness reduced operational risk and strengthened confidence (Castro et al., 2023; Figueroa et al., 2020; Woody et al., 2024).

The thematic analysis of the accounts showed that even positive ideas such as fuel savings and modernity were repeatedly pulled back into livelihood mathematics. The perception towards EV was constructed where cost, rule stability, and perceived risk of financial collapse met, within a national transition shaped by modernization and electrification policy frameworks.

Theme 2: Operational Readiness Determines Feasibility

In this theme, EV adoption was consistently framed by operators as an operational question—whether the vehicle could sustain the demands of UV Express operations without causing disruption. Feasibility was not evaluated based on the vehicle alone, but in relation to the readiness of the broader support system. Operators emphasized the importance of reliable charging infrastructure and robust after-sales support, including warranty coverage, availability of parts, accessible repair and maintenance services, and responsive technical assistance. These factors were seen as critical in ensuring continuous operations, highlighting that EV adoption depends not only on technology performance but also on the capacity of the surrounding system to support daily transport activities.

Under this theme, operators also evaluated whether EV routines could fit the high-frequency and time-sensitive demands of UV Express work. This emphasis echoed the literature on facilitating conditions, where visible infrastructure, service availability, and operational support strongly shape adoption decisions, often as much as the vehicle's features themselves (Hardman et al., 2018; Narassimhan & Johnson, 2018). Even when operators recognized potential improvements, their lived experience pushed them to prioritize reliability and uptime. They assessed EVs through practical concerns such as charging convenience, range adequacy, and operational fit, consistent with studies showing these factors strongly influence EV acceptance (Coffman et al., 2017; Hardman et al., 2018). Across interviews, operational disruptions were never treated as minor inconveniences. Operators translated disruption into concrete consequences: fewer trips completed and less income earned. This pattern matched broader findings that anxieties around range, charging access, and downtime become sharper when daily earnings depend on continuous operation.

What stood out to me was how operators explained EV risk through "what happens if" scenarios. They considered what would happen if the unit ran out of charge mid-route, if repairs took too long, or if charging was not available where they actually operated. These anticipatory narratives closely resembled what EV studies describe as range anxiety and infrastructure anxiety, where uncertainty about charging and support conditions shapes risk perceptions even when potential advantages are acknowledged.

Subtheme 2.1: Judging EVs based on daily income and boundary needs

In this subtheme, range anxiety was not expressed as an abstract concern about battery limitations but as a concrete operational risk associated with being stranded mid-trip. Operators framed this scenario as more than a technical issue, emphasizing its potential social and economic consequences. Running out of charge was seen as a disruption that could compromise passenger trust, damage cooperative credibility, and affect the operator's reputation as a reliable service provider. Thus, "range" was not perceived merely as a technical specification but as a critical factor influencing service continuity and operational integrity.

One operator captured the seriousness of this concern in a direct statement:

> *"Kapag naubusan ka ng charge sa gitna ng biyahe… malaking problema 'yon."* (If you run out of charge in the middle of a trip… that's a real problem.) (INT-03: T351).

Another account grounded the fear in route reality, by providing observation about the absence of charging station:

> *"Sa ruta aming, bihira kang makakita ng puwedeng pag-charge-an. Hindi katulad ng gas station, andami kahit saan"* (On our route, you rarely see places where you can charge. Unlike gas station, it is abundant. It is everywhere.) (INT-10: T54).

These accounts showed that the fear was not speculative. It was built from what operators routinely observed along their routes, where charging options were perceived as scarce and uncertain.

What I found particularly salient was how strongly this worry was anchored in route geography and operational rhythm. Operators did not work in a context where charging could be assumed to be "somewhere nearby." Because charging access was imagined as limited, operators evaluated EV feasibility under the assumption that emergencies could occur and that disruption would be hard to resolve quickly. The anxiety therefore extended beyond the vehicle to the broader infrastructure ecology the vehicle would have to depend on.

This pattern aligned with research suggesting that range anxiety becomes amplified in contexts where schedules cannot easily be adjusted, routes are repetitive and time-bound, and the consequences of failure are publicly visible (Coffman et al., 2017; Zhou et al., 2020). This resonance with EV adoption work is important because it highlights that reluctance is often driven by perceived risk and the high cost of disruption, including both income loss and reputational damage (Zhou et al., 2020).

Subtheme 2.2: Anticipating charging time as lost trips and lost daily earnings

In this subtheme, operators consistently framed charging time as a livelihood concern rather than a simple replacement for refueling. Charging was described as a time-consuming interruption that directly competed with trip volume. Since earnings depended on completing repeated trip cycles, time spent charging was perceived as lost income. This highlights how charging duration is evaluated not only in technical terms but as a critical factor affecting productivity and daily earnings.

One participant linked this concern to the operational rhythm of UV Express work and questioned whether an EV could sustain the daily workload:

> *"Maghapon kaming bumibiyahe, pabalik-balik ang pasada. Hindi ako sure kung kakayanin 'yan ng EV—lalo na 'yung battery. Baka hindi tumagal nang isang araw… Baka natipid ka nga sa gas, pero hindi ka naman nakabyahe sa tagal mag charge"* (We are driving the whole day, servicing repeated trips. I am not sure if an EV can handle that, especially the battery. It might not last a day… You might save on fuel, but if charging takes too long, you still won't be able to make trips.) (INT-06: T693).

This account showed that feasibility was assessed against a full day of continuous circulation, where the unit was expected to keep moving without extended stops. Another participant made the time-cost of charging explicit and described it as an operational loss. Here, charging was framed as something that could disrupt scheduling and reduce the number of trips completed, while also adding anxiety during operations.

> *"Pag nag pa-gas mabilis lang. Kung magcha-charge pa… kakain 'yan ng oras… maaapektuhan 'yung mga biyahe. Hindi ka puwedeng bumyahe na may takot na baka maubusan ka ng charge."* (When you gas up, it only takes a little time. If there's charging… that takes time… it affects trips. You can't hit the road with the fear of running out of charge.) (INT-03: T395).

Taken together, these accounts showed that operators' judgments were anchored in daily turnover, meaning how many trips cycles a unit can complete in a day and the earnings those repeated trips generate. Even if EVs promised long-term savings, those savings were treated as less meaningful if the operational routine could not sustain the required number of trips per day. This interpretation aligned with empirical work showing that EV acceptance is strongly shaped by perceived charging inconvenience and the opportunity cost of downtime, especially for users with high-frequency travel routines (Domarchi et al., 2023). I also noted that operators' time-economics were structured by turnaround. The ideal operation was continuous circulation: load, travel, unload, return, repeat. Any delay threatened boundary expectations and reduced daily take-home earnings.

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Charging was not merely a technical requirement. It became a structural tension with the rhythms of UV Express work. This echoed findings that in commercial and high-utilization settings, charging duration and scheduling constraints can significantly affect perceived operational viability (Ramji & Tayarani, 2023). As a result, charging time became inseparable from income protection, because every "lost hour" was experienced as a lost set of trips.

Subtheme 2.3: Assessing EVs as impractical when mechanics and service centers are limited

It is apparent as presented in this subtheme that limited access to EV-capable mechanics and service centers strongly amplified perceptions of impracticality. Operators did not frame maintenance as a routine matter of "repairs." Instead, they described EV maintenance as a vulnerability created by specialization. From their standpoint, if repairs required trained technicians, specialized tools, or scarce service centers, then repairs would likely become slower, more expensive, and less predictable. That uncertainty made EVs feel difficult to rely on for daily UV Express operations.

This concern surfaced clearly in participants' accounts. One operator explained the risk in terms of limited expertise, especially outside the city:

> *"Medyo delikado kasi kakaunti lang 'yung marunong mag-ayos ng EV… lalo na sa labas ng Metro Manila. Pag nagpagawa kabaka matagal, pila yan sigurado."* (It's quite risky because only a few people know how to repair EVs… especially outside Metro Manila. If you have it repaired, it might take a while—there's definitely going to be a line.) (INT-02:T207).

Another participant made a similar observation based on what he had seen, comparing EV readiness to more familiar vehicle brands:

> *""Sa nakikita ko, hindi pa gano'n karami 'yung mekanikong marunong sa EV, kumpara sa ibang brand—halimbawa Toyota o Nissan."* (As far as I see, there still aren't that many mechanics who know EVs unlike other brands, for example Toyota or Nissan.) (INT-11:T139).

A third account captured how this concern blended with other uncertainties, making EV adoption feel unstable overall:

> *"Sa EV kasi, ang daming hindi pa sigurado—'yung battery, charging, mekaniko, pati parts."* (With EVs, too many things are uncertain—battery, charging, mechanics, parts.) (INT-03:T330).

These accounts aligned with EV transition literature emphasizing that successful electrification depends not only on vehicles and charging infrastructure, but also on the surrounding service ecosystem, including mechanic capability, parts availability, and repair turnaround time (Shen et al., 2011; Sanguesa et al., 2021). What became clearer to me in Iteration 2 was how strongly downtime shaped this perception. Participants emphasized that even if an EV was technically usable, it became economically "unusable" when repair delays kept the unit idle. In their reasoning, impracticality emerged at the intersection of technical specialization and livelihood dependency.

This pattern also matched adoption research showing that ecosystem immaturity increases perceived risk and lowers confidence, especially among users whose mobility is directly tied to income generation (Hardman et al., 2018). Within the developing explanation of this study, these accounts suggested that EV "reliability" was not judged only by how often a unit might break. I have seen how this aspect was judged by how quickly it could return to service when something did break. For operators, a slow repair system was experienced as functionally equivalent to income collapse, because the unit only holds value when it is actively operating.

Subtheme 2.5: Feeling less confident without training and clear operational guidance

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In this subtheme, operators' confidence in EV adoption was strongly influenced by access to training and clear operational guidance. While infrastructure and service limitations posed challenges, uncertainty in procedures and unfamiliarity with the technology further discouraged adoption. Participants indicated that even when they were willing to comply with modernization efforts, hesitation arose when expectations and processes were unclear. Training was therefore not viewed as a secondary support but as a critical condition that made EV adoption more manageable, reducing perceived risk and increasing confidence in transitioning to new systems.

One participant expressed this link between capability and readiness directly:

> *"Kung may sapat na training… at malinaw na guidelines… siguradong kaya naming makisabay."* (If there's enough training… and clear… guidelines… we can adopt for sure.) (INT-05: T603)

Another participant emphasized willingness to comply but framed it as dependent on being properly prepared:

> *"Kahit may pag-aalinlangan, susunod pa rin kami. Sana lang mas maging handa kami at mas maging informed… Mahalaga yung training para alam naming."* (Even if there are hesitations, we will comply. I just hope that we become more prepared and more informed… Training is important so we know.) (INT-07: T820)

These accounts suggested that reluctance was not simply resistance to EVs. It was a response to uncertainty and the fear of making costly mistakes without clear guidance. One participant described cooperative learning as an active strategy:

> *"Ang ginagawa namin, sama-samang pag-aaral—uma-attend ng seminars, tapos nakikipag-usap din sa ibang cooperatives… Pag gagamit ng EV dapat may ganyan din."* (What we do is collective learning… attending seminars, and talking with other cooperatives... If we're going to use EVs, there should be something like that too.) (INT-14: T411)

The repeated request for training showed that informal learning and peer sharing were not enough when the stakes involved livelihood and operational continuity.

Importantly, operators framed training as practical and operational, not merely awareness-building. They wanted guidance that addressed real questions: how to manage charging routines, how to deal with EV-specific maintenance concerns, what procedures to follow when problems occur, and what rules apply to their franchises and daily operations. In this sense, formal and credible guidance reduced the "unknowns" and made adoption feel less like a gamble and more like a managed transition.

This emphasis also aligned with literature on perceived behavioral control, which suggests that willingness to adopt increases when people believe they can competently operate a technology within real constraints (Shen et al., 2011).

Overall, Theme 2 shows that operators perceive EVs as viable only when a supportive operational ecosystem is already in place. Through my reflexive engagement with participants' accounts, operators did not treat EV adoption as a matter of personal willingness; they treated it as a systems question: Can the surrounding environment— charging access, repair support, and practical guidance—keep the unit running within the high-uptime demands of UV Express work? This aligns with EV adoption literature emphasizing that "facilitating conditions" (infrastructure and service readiness) strongly shape perceived feasibility, even when attitudes toward EVs are positive (Hardman et al., 2018; Narassimhan & Johnson, 2018).

In operators' lived realities, willingness alone cannot prevent operational disruption. Because daily earnings depend on repeated trips and continuous operation, charging delays, range uncertainty, or prolonged repairs are experienced as immediate threats to income—echoing research linking charging

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convenience, range concerns, and downtime risk to lower adoption confidence. The interview accounts show that "system readiness" is concrete and route-level: charging scarcity along routes and terminals, limited EV-capable repair support that may lengthen downtime, and a skills/guidance gap that leaves operators uncertain how to manage EV routines. These conditions shape perception because they determine whether EVs can reliably sustain daily operations without costly interruptions.

Theme 3: Confidence in EV is built collectively and institutionally

In this theme, operators' perceptions of EVs were found to be socially and institutionally constructed rather than purely individual. Participants formed their views not only through personal judgment but also through exposure to modernization campaigns, training seminars, peer interactions, and observed experiences of fellow operators. These collective influences shaped how EV adoption was understood, evaluated, and accepted, highlighting the role of shared knowledge, institutional messaging, and social networks in influencing decision-making.

This pattern is consistent with technology adoption and diffusion scholarship showing that meanings of new technologies are often formed through social influence, interpersonal communication, and the credibility of information channels (Rogers, 2003; Venkatesh et al., 2003). Perceptions in the narratives were not simply "attitudes toward EVs"; they were interpretive outcomes produced through ongoing exposure to messages, institutional signals, and what operators see other operators actually doing (Bandura, 1977; Rogers, 2003).

Across accounts, perception is built through "credible proof" and interpretive frames that make EV adoption feel realistic rather than imposed. This resonates with evidence from EV adoption studies showing that peer testimony, visibility of EV use, and perceived legitimacy of information sources can increase (or weaken) willingness to consider adoption, especially when uncertainty remains high (Hardman et al., 2018; Rezvani et al., 2015).

A major outcome in this theme is "hybrid bridge" thinking: hybrids are perceived as a safer intermediate step because they reduce risk through fuel backup. In this research, it is seen as a staged transition logic. The operators lean toward gradual change when uncertainty is high, which parallels transition scholarship arguing that shifts in socio-technical systems often occur through intermediate configurations rather than immediate full substitution (Geels, 2002; Geels, 2011). In adoption terms, hybrids function as a "risk buffer": they preserve continuity while allowing experimentation and learning (Rogers, 2003).

Many operators locate their understanding of EVs in collective conversations— what other cooperatives experience, what seminars mention, what operators observe in other contexts. This collective meaning-making aligns with social learning theory and diffusion research emphasizing observational learning and interpersonal networks as mechanisms through which new practices become credible (Bandura, 1977; Rogers, 2003).

Subtheme 3.1: Perceiving modernization policies to be inadequate

In this subtheme, operators acknowledged modernization as a significant force shaping the future of UV Express operations, yet they often perceived its implementation as unclear and insufficient. Uncertainty regarding policy direction, execution, and fairness led to hesitation in adopting EVs. When policy signals were inconsistent or ambiguous, operators associated electrification with risk and anxiety rather than confidence, indicating that clear and stable policy guidance is crucial in fostering trust and encouraging adoption.

This concern was clearly reflected in participants' accounts. One operator explained that without concrete support and a realistic plan, modernization could worsen existing problems:

> *"Hangga't walang malinaw na tulong at realistic na plano, lalo lang nitong palalala-in 'yung problema imbes na masolusyunan."* (As long as there's no clear help and a realistic plan, it will only worsen problems instead of solving them.) (INT-03: T397).

Another participant described how the lack of clarity made long-term planning almost impossible:

> *"Kapag kulang sa malinaw at consistent na policy… ang hirap magplano, ang hirap mag-invest, ang hirap mag-isip pangmatagalan…"* (Lack of clear and consistent policy… hard to plan, hard to invest, hard to think longterm…) (INT-04: T477).

The same participant also pointed to implementation pace and the need for assurance:

> *"Kung biglaan 'yung implementation… tapos walang malinaw na assurance… maraming operator ang mahihirapan o lalaban…"* (If implementation becomes sudden… no clear assurance… many operators will struggle or resist…) (INT-04: T504).

These accounts showed that operators viewed the EV transition as policy dependent. Without clear assistance and a realistic rollout plan, electrification was expected to intensify operational strain rather than resolve it. Unclear and inconsistent policies weakened operators' ability to plan, invest, and commit long-term. This stance aligned with policy implementation and transition perspectives suggesting that uncertain governance signals can generate hesitation and defensive meaning-making among affected groups (Geels, 2011; Lipsky, 2018).

When implementation was perceived as sudden and unsupported, operators anticipated widespread difficulty and possible resistance—not as outright rejection of modernization, but as a rational response to insufficient assurance and limited preparedness.

Subtheme 3.2: Considering hybrids as a safer first step because fuel backup reduces risk

In this subtheme, participants often framed hybrids as a practical compromise. A hybrid was described as "modern," but without removing the safety net of gasoline. This framing suggested that operators were not necessarily against modernization.

Their stance was more risk-sensitive. Hybrids were repeatedly positioned as a transition step, a way to benefit from fuel savings while keeping a fuel backup that could protect daily operations from disruption. This logic appeared clearly in the accounts. One participant stated:

> *"Hybrid muna… kasi may gasolina pa rin na backup…"* (Hybrid first… there's still gasoline as a backup…) (INT-06:T684)

Another explained why this felt more feasible:

> *"Sa hybrid, mas nakikita kong posible… kasi hindi siya basta-basta mauubusan ng battery nang tuluyan…"* (With hybrid, I see it as more possible… because it won't just run out of battery completely…) (INT05:T548)

Across these narratives, hybrids were preferred as a step-by-step pathway because gasoline functioned as a practical safeguard against operational disruption. In my interpretation, the fuel backup served both psychological and operational functions. It reduced the perceived consequences of failure and preserved a sense of control, consistent with adoption work showing that people favor innovations that reduce perceived risk and maintain behavioral control (Ajzen, 1991; Rezvani et al., 2015). Hybrids also offered gradual learning and adaptation while protecting operational continuity. From a diffusion perspective, this resembled incremental trialability, where adoption begins with a step that allows learning without full exposure to uncertainty (Rogers, 2003).

From a transition lens, it reflected how intermediate configurations can stabilize change by fitting innovation into existing routines (Geels, 2002). Openness to hybrids was anchored in a fuel-savings rationale that promised immediate cost benefits while retaining the reliability of familiar fuel-based operations.

Subtheme 3.3: Looking at seminars as helpful for awareness but lacking enough operational detail

In this subtheme, it surfaced that seminars and official meetings helped raise awareness about EVs, but many operators felt the information remained too shallow to guide real operational decisions. Participants described EV discussions as brief mentions rather than sustained, practical explanations. As a result, awareness increased, but uncertainty remained because core operational questions were left unanswered.

One participant described this experience directly:

> *"Kapag uma-attend kami ng mga meeting na sponsored ng LTFRB o DOTr, tapos nababanggit 'yung EV… parang pahapyaw lang… hindi talaga siya napag-uusapan nang masinsinan…"* (If we attend meetings sponsored by LTFRB or DOTr, if EV gets mentioned… just brief… not discussed in depth…) (INT-05: T600)

Another account made clear what operators wanted from these sessions:

> *"Kung may sapat na training… at malinaw na guidelines… mas maiintindihan namin 'yung EV at malalaman namin kung viable ba talaga siya."* (If there's enough training… and clear… guidelines… we will better understand EV and assess if it's a viable option.) (INT-11: T803)

I interpreted these accounts as an awareness–readiness gap. Operators were exposed to the idea of electrification, but they still lacked the operational detail needed to judge feasibility within their routes, boundary arrangements, and daily schedules. This pattern was consistent with studies suggesting that information exposure alone is insufficient if it does not strengthen perceived competence and perceived behavioral control (Ajzen, 1991; Venkatesh et al., 2003). Seminars appeared to function as legitimacy signals that "this is the direction," but operators were searching for actionable knowledge: how EVs would work in daily operations and under local conditions.

This interpretation aligned with diffusion research showing that communication becomes persuasive when messages are credible and clearly relevant to lived realities (Rogers, 2003; Hardman et al., 2018). When meetings remained surface-level, uncertainty persisted and confident decision-making was delayed, especially because adoption carried livelihood risks.

Subtheme 3.4: Relying on peer networks and cooperative learning to judge credibility

In this subtheme, a strong pattern of collective learning emerged, particularly in Iteration 2. Operators did not rely solely on official information but actively engaged in peer discussions, cooperative meetings, and seminars to interpret EV adoption. Cooperative environments functioned as interpretive communities where participants collectively assessed what constituted credible information and acceptable risk. Through shared experiences and dialogue, operators co-constructed their understanding of electrification, highlighting the importance of peer networks in shaping perceptions and decision-making.

One participant described this process plainly:

> *"Kami sa cooperatiba, nag tatanungan, nag uusap. Yung mga issue at concerns pinag pupungan naming yan. Hindi lang kami dito, nag meeting kami kasa ng ibang coop, based sa mga meetings nay un nalalaman naming kung ano ang dapat gawin. Kung ano yung maganda…"* (We in the cooperative ask each other and talk things through. We sit down and discuss the issues and

concerns. It's not just within our group—we also meet with other cooperatives, and from those meetings, we learn what needs to be done and what works best...) (INT-14:T411)

This account showed that learning was not individualized. It was shared, discussed, and evaluated within peer networks. I also observed how "peer proof" shaped credibility under uncertainty. If other operators shared workable experiences, EVs (or hybrids) felt more believable. If peers reported problems, caution intensified. This reflected diffusion dynamics where adoption spreads through interpersonal influence and trusted peers, especially when uncertainty is high (Rogers, 2003). It also aligned with social learning theory, where people learn what is possible by observing comparable others and the consequences they experience (Bandura, 1977).

In the lived experience of the participants, peer testimony often carried more weight than official messaging because peers were perceived as operating under similar boundary pressures and route realities, making their accounts feel more relevant and trustworthy (Rogers, 2003; Rezvani et al., 2015).

Subtheme 3.5: Linking EVs with comfort and environmental benefits, while letting practicality decide

In this subtheme, operators associated EVs with tangible experiential and environmental benefits, including quieter rides and reduced smoke emissions in terminals and along routes. These advantages contributed to a generally positive perception of EVs as modern, cleaner, and more passenger-friendly. Such benefits enhanced the appeal of electrification, particularly in terms of comfort and environmental impact, even as other operational concerns remained.

The accounts that follow captured how operators attach health, comfort, and "modernity" benefits to EVs, especially in everyday terminal and trip conditions. Participants described comfort as something felt directly in daily operations. One operator said:

> *"Kung tahimik 'yung sasakyan, mas magaan 'yung biyahe—para sa driver at para rin sa mga pasahero tapos malinis pa kasi walang usok kaya maganda sa environment"* (If the vehicle is quiet, the trip feels better—for both driver and passengers, then its clean and does not emit smoke so it's better for the environment.) (INT-12:T210)

Another driver added:

> *"Parang ang modern ng EV… mas tahimik at mas komportable… kaya lang ang mahal, hindi ka pa sure kung uubra ba katuland ng mga units naming. Itong mga to (referring to the diesel units), pang harabas talaga*." (It seems like EVs are really modern—quieter and more comfortable—but they're expensive, and you're still not sure if they'll perform like our current units. These ones (referring to the diesel units) are really built for tough use.…) (INT-08: T888)

These accounts showed genuine positive valuation linked to everyday working and commuting conditions. At the same time, I see these positive perceptions remained subordinate to practicality. Comfort and cleanliness increased desirability, but they did not override concerns about reliability, charging access, service readiness, rules, and daily earning continuity. In my interpretation, this reflected a hierarchy of meanings: EVs could be seen as better for health, comfort, and "modernity," yet adoption still depended on whether the technology could reliably meet daily operational demands. This aligned with evidence that EV appeal can coexist with hesitation when functional constraints remain unresolved (Hardman et al., 2018; Rezvani et al., 2015).

Theme 3 shows that operators' perceptions are shaped by narratives and social learning. EVs become meaningful when modernization messages are coherent, operational details are accessible, and peer experiences provide credible "evidence" that EVs can work in real UV Express conditions. Hybrid bridge thinking emerges as a pragmatic way to modernize without risking livelihood collapse. Added narrative tie-

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back: The accounts demonstrate that trust is built relationally and institutionally—not solely through policy announcements, but through cooperative networks, peer stories, and observed evidence of feasibility.

How operators perceive EVs in their lived realities

1. Economic survivability is the primary filter (Theme 1). Operators perceive EVs as acceptable only when they can maintain daily earnings, recover investment costs, and avoid catastrophic repair risks.
2. Operational readiness determines feasibility (Theme 2). Charging access, repair infrastructure, downtime risk, and training shape whether EVs are perceived as usable in routine operations.
3. Confidence in EV is built collectively and institutionally (Theme 3). Operators interpret EVs through modernization narratives, peer proof, and a staged transition logic where hybrids function as risk-reducing bridges.

Thus, the combined answer to RQ1 is that UV Express operators perceive EVs as a conditional, system-dependent modernization pathway—desirable in principle for comfort and cleanliness, but risky in practice without economic protections and operational support. UV Express operators perceive electric vehicles as a modernization option that is attractive for its environment and comfort but is evaluated primarily through the lived realities of transport work: sustaining daily income, ensuring route and franchise stability, and maintaining uninterrupted operations. Their perceptions are characterized by conditional openness and uncertainty rather than simple approval or rejection. EV adoption becomes plausible only when operators believe that the investment can be recovered without worsening boundary pressures, charging infrastructure and maintenance ecosystems are sufficiently available to prevent downtime, and modernization policies are clear, fair, and paced in ways that allow learning and adjustment. In this context, hybrid vehicles are often perceived as a practical bridge that reduces risk by preserving gasoline backup while still aligning with modernization expectations.

Adaptive Strategies of UV Express Operators in Addressing Operational Impediments to Vehicle Electrification

This section presents the findings for RQ2 by synthesizing insights from thematic analysis grounded in participants' day-to-day UV Express operations. Rather than viewing "steps" as isolated best practices, operators' actions are interpreted as forms of situated adaptation work. These represent concrete and incremental strategies through which electrification becomes operationally understandable, financially viable, and procedurally manageable within the boundary-system realities of UV Express operations.

Across accounts, drivers, operators and cooperative members described adaptation as a form of readiness-building under uncertainty. They actively seek information, test practical assumptions, set conditions for investment, and coordinate with cooperatives and terminal networks to protect daily income continuity. The dominant conditions include policy ambiguity, high capital exposure, infrastructure gaps, and livelihood risk. Operators respond with sequential actions that reduce uncertainty and keep electrification within the bounds of operational viability and the consequences are conditional openness, staged adoption, and collective preparation rather than immediate, full transition. The findings conform with the studies of Mateo-Babiano et al., (2020) which show that electrification is not experienced as a purely technical upgrade. Instead, it is lived as a managerial and institutional transition that demands coordination, organizational capacity, and credible implementation support. Operators' action strategies also align with adoption perspectives that emphasize "facilitating conditions" and knowledge as prerequisites for sustained uptake, particularly when new vehicle systems require new competencies, repair ecosystems, and charging routines (Venkatesh et al., 2003).

Table 6. Steps taken by UV operators to address operational impediments in order to adapt to vehicle electrification

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Overarching Themes	Subthemes
Theme 1 — Building readiness through learning and information-seeking	1.1: Attending seminars/trainings to understand EV requirements
	1.2: Tracking LTO and LTFRB guidance to understand policy implications
	1.3: Consulting peers and cooperative networks to validate what works in practice
Theme 2 — Managing risk by staging adoption and setting conditions	2.1: Choosing hybrid-first as a transition strategy
	2.2: Delaying adoption until charging facilities improve
	2.3: Requiring assurance on after sales support before committing investment
	2.4: Complying with modernization while negotiating feasibility/fairness

Theme 1: Building readiness through learning and information-seeking

This theme, I established how operators-built readiness through active learning, information-seeking, and interpretation. They did not treat electrification directives as automatically clear. Instead, they tried to gather more information so they could translate broad policy messages into knowledge they could actually use in daily operations. Operators described attending seminars, following modernization guidance, and talking with peers to strengthen their understanding and reduce uncertainty. In line with the epistemology of this study, these practices worked as a way for participants to make an uncertain transition more understandable. They asked pragmatic questions about what electrification would mean for route rhythms, dispatch timing, boundary arrangements, and day-to-day income security (Weick, 1995; Weick et al., 2005). I interpreted this learning and information-seeking as a part of everyday risk management. When electrification felt uncertain, operators responded by trying to see more clearly, explain what was happening, and anticipate what could go wrong before making high-stakes decisions that might destabilize livelihood.

This learning curve was necessary because electrification affected many parts of operations at the same time. It involved unit costs and financing exposure, maintenance routines and skills requirements, charging practices and infrastructure availability, and cooperative compliance procedures that shaped participation in modernization programs (GIZ, 2019; WDI, 2025). As presented in the reviewed literature on the PUV modernization, when timelines, support mechanisms, and institutional coordination were uneven or unclear, operators often responded not with simple resistance but with more information-seeking and peer validation. These strategies helped them assess the transition in practical terms and decide whether it could be made workable and survivable (Gatarin, 2024; Mateo-Babiano et al., 2020).

Subtheme 1.1: Attending seminars/trainings to understand EV requirements

In this subtheme, I found that operators described seminars and trainings as a deliberate step to make electrification easier to understand. They did not assume that EV requirements were self-explanatory. Instead, they looked for structured learning spaces where specifications, compliance expectations, and practical challenges could be discussed in a more concrete way. The condition shaping this behavior was informational uncertainty. Operators wanted to know what was required, how their operations might change, and what support was actually available.

The action, then, was participation in trainings as a way to build competence and readiness. The consequence was not immediate adoption. Rather, seminars gave operators a more workable basis for evaluation. They allowed operators to compare EV promises with the realities of their routes and daily income constraints. These accounts also showed that operators defined readiness through two linked needs: system support, such as infrastructure, repairs, and parts, and capacity building through training.

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One operator described seminars as a key step in gradually understanding what electrification could mean:

> *"Pinaka mabuting hakbang yung uma-attend ng seminars at trainings… unti-unting inaaral 'yung benefits, costs at challenges."* (Main step… attending seminars and trainings… gradually study… benefits… costs… challenges.) (INT-07: T842)

Another participant similarly described ongoing attendance as part of preparation:

> *"Uma-attend ako ng seminars at orientations tungkol sa EVs at hybrids… na related sa public transport para maiintidihan ko kung paan oba yun gumagana, paano ba ang service nun. Sa mga seminars at training kasi may mga experts. Pwede ka mag tanong sa kanina, at nag tatanong talaga kami para alam namin."* (I attend seminars and orientations about EVs and hybrids—especially those related to public transport—so I can understand how they work and how the service operates. In seminars and trainings, there are experts, so you can ask them questions, and we really do ask so we know what we're dealing with.) (INT-02: T248)

Across these accounts, operators emphasized that EV adoption was not only about buying a unit. It also required understanding what the shift would demand operationally. In this sense, seminars and trainings became a practical mechanism for turning general requirements into usable guidance. Seminars and trainings helped operators clarify what was expected, check whether information matched route realities, and anticipate what adjustments might be needed (Hardman et al., 2018). I interpreted these practices as micro-steps that reduced uncertainty and strengthened operators' capacity to evaluate feasibility rather than forcing an immediate decision. In this way, learning became a form of preparatory work that supported operational continuity while operators assessed the transition.

Subtheme 1.2: Tracking LTO and LTFRB Guidelines to understand policy implications

In this subtheme, I discuss the premise that operators described policy updates as part of their effort to keep electrification within the bounds of operational viability. They did not treat advisories and guidelines as announcements to receive and forget. Instead, they treated them as practical resources that needed to be interpreted and translated into daily implications for routes, terminal routines, income stability, and repair and maintenance realities. Operators explained that they monitored modernization directives and sought clarification from formal sources to understand how electrification would affect franchise conditions, compliance requirements, and operating rules.

One account captured this process clearly:

> *"Binabasa namin yung mga advisories… tapos pinag-uusapan namin kung paano 'to tatama sa UV Express sa actual na operasyon."* (We read advisories. discuss how they will affect UV Express on the ground.) (INT12:T244)

Another participant emphasized how unclear guidance, especially around franchises, made it difficult to plan:

> *"Sana malinaw din yung guidelines ng LTFRB. Ang biggest challenge talaga yung pabago-bagong direksyon at polisiya ng LTFRB—lalo na pagdating sa prangkisa."* (Hopefully the LTFRB guidelines are also clear. The biggest challenge is the changing direction and policies of the LTFRB— especially regarding franchises.) (INT-04: T467);

These accounts showed that policy information was treated as something that had to be operationalized in relation to boundary arrangements, route routines, and renewal prospects. Tracking inconsistent guidelines and interpreting ambiguous policies create uncertainty about both the technology and the operational implementation. In response, operators took capability-building steps such as attending

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seminars, monitoring updates, and consulting peers. The goal was to make electrification cognitively and practically manageable. However, unclear timelines, shifting requirements, and uneven guidance produced hesitation and required operators to read between the lines of directives, especially within fragmented regulatory spaces (Tiglao et al., 2020; Ong et al., 2023).

It is that the search for LTO and LTFRB guidance are an active readiness practice embedded in the operational routine of participants. Operators tracked, interpreted, and translated policy signals into decisions that protected franchise security, route routines, and income stability, making informational clarity itself a form of transition support under uncertainty.

Subtheme 1.3: Consulting peers and cooperative networks to validate what works in practice

It was evident that participants turned to peer networks to validate whether EV claims held in UV Express realities. Beyond formal channels, they consulted fellow operators, cooperative officers, and contacts with hybrid experience. The condition shaping this behavior was credibility uncertainty.

Electrification could sound promising, but operators wanted evidence that it worked under traffic, passenger variability, terminal queuing, and boundary arrangements. The action was peer consultation and social learning. The consequence was the development of shared working knowledge about what seemed feasible, what felt risky, and what needed to change before adoption could become viable.

One driver described learning through comparisons of consumption and maintenance and linked this to seeing hybrid potential:

> *"Napag-usapan namin 'yung pinagkaiba ng diesel at EV sa konsumo at maintenance… doon ko na-realize na may potential talaga 'yung hybrid…"* (We talked about the difference between Diesel and EV consumption and maintenance… I realized hybrid really has potential.) (INT-05:T552);

Another account showed how attention to modernization could rise and fall over time:

> *"Two years ago… mainit na mainit sa amin 'yung usapan tungkol sa modernization, pero ngayon hindi na masyadong napag-uusapan"* (Two years ago… talks during the modernization are hot topics for us, now it is not discussed anymore.) (INT-01:T72);

Participants also described seeking out peers who were more updated or who had direct experience:

> *"Nakikipag-usap ako sa kapwa operators na mas updated, pati sa mga may experience na sa hybrid vehicles…"* (I talk with fellow operators who are more updated and with some who have experience with hybrid vehicles…) (INT-06:T739);

Some extended learning beyond face-to-face conversations through shared online materials:

> *"…tapos minsan nanonood din ako ng videos tungkol sa EV operations sa ibang bansa. Minsan sinesend 'yan ng kapwa drivers—galing YouTube, minsan Facebook."* (...and sometimes I watch videos about EV operations in other countries. Some of the videos are forward by fellow drivers. These clips are from YouTube, sometimes Facebook…) (INT-14:T349)

Across these accounts, I saw operators building understanding through what they trusted most: practical experience and peer validation. Online content did expand exposure, but it was still filtered through peer sharing and peer trust. This pattern aligned with research arguing that peer proof and social narratives shape uptake decisions in transport modernization contexts (Figueroa et al., 2020; Gatarin & Galicha, 2024). These accounts showed that adaptation was enacted through micro-steps that reduced uncertainty and protected operational continuity. Operators were not simply waiting for policy outcomes. They actively constructed readiness through learning, interpretation, and shared evaluation.

As meanings coalesced in Theme 1, the data illuminate that steps towards EV readiness for modernization emerges not as a static attribute but as a dynamic, continually negotiated process shaped by operators' deliberate efforts to learn, make sense of policy shifts, and reduce uncertainty. Faced with a modernization agenda that is technologically demanding, financially risky, and institutionally fragmented, participants actively construct their preparedness through a constellation of information-seeking practices. They attend seminars, monitor regulatory directives, consult peers, and translate policy narratives into actionable knowledge that can guide day-to-day decision-making. These practices function as adaptive strategies that help them navigate inconsistent timelines, unclear compliance requirements, and the broader unpredictability of the transport reform environment.

Within this landscape, learning becomes both a protective mechanism and a practical tool for evaluating the feasibility of electrification. Seminars and policy briefings serve as formal testing grounds where operators assess whether proposed arrangements align with their operational realities, while informal evaluations such as peer consultations provide social validation, emotional reassurance, and experiential insights that formal channels often fail to supply.

The interplay between institutional information and peer-based sensemaking reflects patterns observed in Philippine transport studies, where modernization pressures are experienced simultaneously as technological, managerial, and bureaucratic challenges. Through these layered learning practices, operators bridge the gap between abstract policy intentions and the concrete demands of everyday operations. Their readiness is therefore not merely about acquiring knowledge but about constructing a workable understanding of modernization that allows them to anticipate disruptions, evaluate risks, and position themselves within an evolving regulatory landscape. In this sense, readiness is an ongoing accomplishment, one that is continually shaped by the quality, accessibility, and interpretability of information available to them.

Theme 2: Managing risk by staging adoption and setting conditions

Theme 2 showed how operators handled electrification as a high stakes investment risk that was tied to daily livelihood realities. Participants did not describe the transition as a simple choice to adopt or refuse. Instead, they spoke in conditional and staged terms. They often moved through small steps that felt safer and easier to reverse. They learned first, watched what happened to other operators, considered interim options such as hybrids, and delayed major commitments until safeguards were in place. In this way, electrification was treated less as a one-time purchase and more as a transition pathway that had to fit route operations, boundary arrangements, and the need for stable daily income.

I interpreted these actions as protective decision making under livelihood exposure. Operators earned through repeated trips and uninterrupted operations. Because of this, they avoided choices that could lead to long downtime, debt pressure, or sudden income loss. Many participants set conditions before they were willing to invest. They wanted charging access that worked with dispatch timing. They wanted repair support and parts availability that could prevent long unit inactivity. They also wanted clearer modernization rules so their franchise security would not be threatened after they invested. These concerns were not immaterial. A major breakdown, a charging delay, or a policy shift could quickly become missed trips, reduced boundary remittances, and immediate strain at home.

The accounts also showed that reluctance did not simply mean resistance to change. It reflected a practical response to risk that operators carried personally and daily. This interpretation was consistent with modernization barrier literature that identified high upfront costs, uncertain support mechanisms, and readiness gaps in the broader ecosystem as persistent constraints shaping adoption decisions (Castro et al., 2023; Guno et al., 2021). Operators also suggested that readiness was not only about whether EV units were available. It was also about whether institutions and operations around them could absorb transition shocks.

Within this theme, staging adoption became a practical way to cope with uncertainty. Operators kept electrification within the bounds of operational viability by waiting for credible enabling conditions, seeking guarantees that could share or reduce risk, and assessing whether the transition could happen without harming income stability. In doing so, they showed strategic pragmatism. They remained open to

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modernization, while managing the conditions that would make electrification financially and operationally survivable.

Subtheme 2.1: Choosing hybrid-first as a transition strategy

In this subtheme, it made sense how participants frequently expressed hybrid bridge thinking. They framed hybrids as a transition option that lowered risk because a hybrid retained fuel backup while introducing some features associated with electrification. For drivers and operators, this mattered because UV Express work depended on daily trip volume, predictable dispatch timing, and stable income flow.

A hybrid was therefore seen as a practical transition strategy. It allowed operators to align with modernization narratives without fully exposing themselves to charging uncertainty, battery-related anxiety, or unfamiliar repair pathways. This preference was repeated across the following accounts. Operators described hybrids as safer because gasoline remained available as a fallback:

> *"Kung may puhunan ako at kung may option naman kami, ako ang pipiliin ko hybrid muna. Bakit? Kasi sa tingin ko hindi pa hinog yung pure electric; For the meantime, mas maganda kung hybrid muna, para may krudo tapos may motor battery din."* (If I had the capital and we had the option, I'd choose a hybrid first. Why? Because I don't think pure electric is mature enough yet. For now, it's better to go with a hybrid first, so you still have fuel, and it also has a battery-powered motor.) (INT-06: T700); (INT05:T548); (INT-04: T443);

One participant also linked this preference to a developing understanding of consumption and maintenance tradeoffs:

> *"Napag-usapan namin yung difference ng Diesel at EV sa consumption at maintenance… narealize ko na malaki talaga potential ng hybrid."* (We talked about the difference between Diesel and EV consumption and maintenance… I realized hybrid really has potential.) (INT-05:T552)

Across narratives, hybrids functioned as a safer first step because they felt operationally familiar. Operators described maintenance routines, parts access, and mechanic support as closer to what they already knew, which made the transition feel less disruptive to routine work and livelihood stability. This preference reflected adoption patterns where people lean toward options that preserve control, reduce perceived risk, and fit existing routines (Ajzen, 1991; Rezvani et al., 2015).

Participants voiced uncertainty about charging access, ecosystem readiness, and long-term durability. They questioned whether charging could be integrated into terminal routines and whether EV reliability could withstand high-frequency operations without costly downtime. These concerns aligned with research showing that charging inconvenience, range concerns, and support gaps can suppress adoption even when benefits are recognized (Coffman et al., 2017; Hardman et al., 2018; Hannan et al., 2020). Because of this, participants consistently expressed a preference for a hybrid-first transition, viewing hybrids as a practical interim option that preserves operational continuity through fuel backup while the broader EV ecosystem remains uneven. I interpreted this as staged modernization. Hybrids allowed continued operations even when charging infrastructure was limited, while still offering fuel savings and a sense of compliance with modernization direction. This resembled incremental trialability, where adoption proceeds through smaller steps that allow learning before full commitment. It also aligned with transition perspectives that intermediate configurations can stabilize change by fitting innovation into existing routines (Geels, 2002). Taken together, hybrid first was not a preference for partial modernization. It was a practical risk management step that kept modernization within the bounds of operational viability.

Subtheme 2.2: Delaying adoption until after sales support and charging facilities improve

In this subtheme, I found that many operators described delay not as resistance, but as a waiting strategy rooted in operational realism. They were not rejecting electrification in principle. Instead, they framed adoption as something that must match the readiness of the ecosystem. In their accounts, an EV was only as workable as the charging access, repair options, and parts supply that sustained it. Without these supports, electrification was difficult to integrate into UV Express routines built on repeated trips, quick turnaround, and minimal downtime. Participants described repair delays as a direct threat to livelihood:

> *"Kapag nasira at hindi agad maayos… tengga lang sa garahe; Ang tagal maghintay ng piyesa, tapos minsan hindi pa sure kung meron at kung okay yung kalidad; Hindi ka pwedeng maghintay ng dalawang linggo para sa piyesa o para lang may technician."* (When it breaks down… can't be repaired quickly… parked in the garage; Waiting time for parts is long, and quality or availability isn't always certain; You can't wait two weeks for parts or for a technician.) (INT-07: T804); (INT-02: T210); (INT-12: T217)

Charging concerns were also framed as both range risk and operational disruption:

> *"Concern talaga yung charging stations at yung range… kasi hindi pa talaga common yung charging stations. Problema rin kung saan at paano magcha-charge… lalo na kung mahaba ang pila o sunod-sunod yung biyahe; Concern din yung charging time… sayang oras 'yan… sa UV Express, oras talaga ang pera."* (Concern about charging stations and range… Charging stations still aren't that common… It is also a problem of where and how to charge… long queue or continuous trips; Charging time is also a concern… that's wasted time… In UV Express, time is money.) (INT- 06: T698); (INT-12: T218)

Across these accounts, waiting was an active form of risk management. Operators assessed whether charging could realistically fit dispatch timing and terminal routines, and whether access was predictable enough to avoid disruptions in trip frequency and boundary remittances. They also thought ahead to breakdowns. Because UV Express work was livelihood-based, a breakdown was not treated as a technical inconvenience. It was an income shock. Operators therefore linked readiness to accredited repair capacity, technicians who could work on EV systems, and parts that could be sourced quickly and affordably.

From an adoption perspective, facilitating conditions matter when users believe there are adequate resources, infrastructure, and organizational supports that allow continued use (Venkatesh et al., 2003). In the operators' lifeworld, facilitating conditions were not isolated. They were experienced through charging stations that were reachable within route patterns, service centers that responded quickly, and parts supply chains that prevented prolonged immobilization. Without a dependable ecosystem, electrification was constructed not as innovation advantage but as operational hazard. Delay served as protection. It kept electrification within the bounds of operational viability until the ecosystem could better absorb the demands of high-frequency UV Express operations.

Subtheme 2.3 Requiring franchise assurance and battery guarantee before committing investment

In this subtheme, I found that electrification was treated as a high exposure investment. It became thinkable only when risk was buffered through credible assurance mechanisms. Participants did not frame these assurances as simple consumer preferences. They treated them as operational safeguards against catastrophic loss, such as battery failure, prolonged downtime, and repair uncertainty that could erase daily earnings and intensify debt pressure.

Operators also extended assurance beyond the vehicle. They required institutional continuity. They wanted clearer commitments that franchise renewal and route security would not be jeopardized after investing in an EV. In their accounts, an EV purchase felt impractical if regulatory outcomes remained ambiguous, because investment only made sense when the right to operate remained predictable.

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This requirement emerged clearly in the following accounts:

"Walang klarong assurance na pag lumipat ka sa EV, sure na mare-renew yung prangkisa mo. Kailangan may assurance sa prangkisa at ruta… na hindi ka mawawalan ng prangkisa… at mas madali yung renewal." (There's no clear assurance that if you shift to an EV, your franchise will definitely be renewed. There must be assurance about franchises and routes… you won't lose your franchise… renewals… easier.) (INT02:T205); (INT-03: T400)

Participants also emphasized warranties and durability guarantees:

"Kailangan may assurance, mahabang warranty at hindi basta masisira. Hangga't walang guarantee, sa akin hindi pa siya worth it para sa UV Express." (Assurance… long warranty and won't easily fail. As long as there are no guarantees like that, for me, it's not worth it yet for UV Express.) (INT-01:T116); (INT-03:T407)

"Mahal yung battery, oo, pero kung may warranty at malinaw yung life cycle, ibang usapan.." (Battery cost is high, yes, but there's a warranty and a lifecycle to consider.) (INT-02:T196)

Across these narratives, the condition presents compounding uncertainty: high capital exposure, uncertain repairability, and unstable institutional guarantees around franchise and route continuity. The preferential actions demand assurance mechanisms that redistributed risk across technical, financial, and regulatory domains, including battery warranties, maintenance support, insurance provisions, and clearer commitments regarding franchise renewal. The consequence was conditional commitment. Operators could imagine adoption when electrification felt protected and predictable enough to make operations workable and the investment defensible.

Without these assurances, modernization was experienced as institutional risk, and operators responded through postponement, cautious planning, or staged participation until the transition environment became more predictable (Tiglao et al., 2020; Ong et al., 2023). Subtheme 2.4: Complying with modernization while negotiating feasibility/fairness In this subtheme, participants repeatedly expressed that compliance with modernization was not optional. Continued operation depended on meeting regulatory requirements, cooperative rules, and terminal governance. At the same time, compliance was rarely passive. Operators described complying while also negotiating feasibility and fairness.

Their accounts showed how they evaluated modernization through operational realism and livelihood protection:

"Magiging realistic at fair lang yung modernization kung isinasaalangalang yung totoong operasyon ng UV Express… para talagang kumita at mabuhay yung operators." (Modernization becomes more realistic and fairer if it considers the actual UV Express operation… operators can truly earn and survive) (INT-07: T795)

"Dapat fair at makatao yung implementation, hindi yung isasakripisyo yung kabuhayan namin." (Implementation fair and humane, without sacrificing… livelihoods…) (INT-05: T633)

Some participants pointed to alignment with real demand and the need for reform:

"Kailangan may franchise reform, yung modernization dapat naka-align sa totoong demand." (Franchise reform, modernization should be aligned with actual demand.) (INT-11: T167)

Operators also described what would make them more prepared:

> *"Kung may consultation, pilot testing, at malinaw na direksyon… mas magiging handa yung operators."* (If there is consultation, pilot testing, and a clear direction… operators will be more prepared.) (INT-05: T625)

The broader context of this subtheme showed constrained participation. Operators complied to maintain legitimacy, but they also raised concerns, asked for clearer guidance, and requested timelines and support arrangements that reflected operational realities and livelihood exposure. Studies similarly noted that uneven implementation capacity, policy ambiguity, and shifting requirements can intensify vulnerability and prompt demands for clearer, more workable transition pathways (Mateo-Babiano et al., 2020; Ong et al., 2023; Tiglao et al., 2020). Within this logic, power was asymmetric under mandatory modernization. Noncompliance carried severe consequences, while operators had limited influence over policy design. The condition was high consequence compliance with limited control. The action was pragmatic compliance paired with negotiation for workable implementation, including phased timelines, accessible financing terms, and ecosystem readiness such as charging and repair capacity. The consequence was continued participation while attempting to shape transition terms toward viability and equity. From an adoption lens, this negotiation can also be read as an effort to secure resources, guidance, and institutional supports needed for sustained uptake rather than precarious compliance (Venkatesh et al., 2003).

Theme 2 showed that operators navigated electrification primarily as livelihood risk that had to be managed through staging, conditions, and protective sequencing. Electrification became workable only when it could align with trip frequency, boundary arrangements, dispatch timing, and income continuity. Participants did not describe adoption as a single leap. They described a conditional pathway. They tested transition through micro steps, choosing hybrids as a bridge, delaying full adoption until charging and service ecosystems stabilized, and demanding assurance mechanisms that made investment defensible.

Across the accounts, readiness was constructed as the presence of safeguards that prevented electrification from turning into prolonged downtime, debt pressure, or franchise insecurity. Risk was governed through practical strategies rather than outright refusal. Operators complied because they needed legitimacy within regulatory and cooperative systems. At the same time, they negotiated feasibility and fairness, asking for realistic timelines, support arrangements, and clearer guarantees. In this sense, staging adoption was not hesitation for its own sake. It was protective decision making that kept electrification within the bounds of operational viability while operators attempted to shape the transition environment toward predictability, support, and survivable implementation.

The adaptive steps taken by the UV Express operators towards electrification in their lived operational realities

1. Readiness is built through active learning and sensemaking (Theme 1). Operators attend seminars, track policy updates, and consult peers to translate abstract modernization directives into actionable knowledge for routes, terminal routines, compliance demands, and income protection.
2. Risk is managed through staged adoption and conditional commitment (Theme 2). Operators reduce exposure by using hybrids as bridges, delaying full EV adoption until charging/repair ecosystems stabilize, requiring warranties and franchise security, and complying while negotiating feasibility and fairness.

Thus, the thematic answer to RQ2 is that UV Express operators adapt to electrification through a sequence of situated micro-steps that reduce uncertainty and protect operational continuity—building readiness, managing investment risk, and negotiating implementation conditions rather than immediately shifting to full EV adoption. UV Express operators address operational impediments by treating electrification as a transition that must be made workable within the realities of boundary-based transport work. Their adaptation practices are incremental and strategic. They build knowledge through trainings and policy monitoring, validate feasibility through peer networks, and pace their decisions based on whether

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charging access, repair capacity, parts availability, and institutional rules can support high-frequency operations without destabilizing daily income.

Adaptation becomes plausible when operators can secure facilitating conditions and protective assurances including clear guidance, credible ecosystems for charging and service, and guarantees that reduce catastrophic cost exposure and franchise insecurity. Their actions reflect conditional openness rather than simple compliance or resistance: they remain engaged with modernization while continuously negotiating feasibility and fairness so the transition can be operationally survivable, financially defensible, and institutionally predictable.

A Grounded Proposition Explaining How UV Express Operators Navigate the Transition to Electric Vehicles

In this part of the discussion, I addressed Research Question 3 by moving directly from the integrated interpretation of RQ1 and RQ2 toward a grounded explanation. Rather than merely restating the earlier themes in more abstract terms, I drew together the specific worries, constraints, and adaptive responses expressed by participants to show how their micronarratives formed a patterned story that tells how operators actually navigated electrification in practice.

What emerged from my interpretation was not a simple chronicle of acceptance or resistance. I did not encounter electrification in the conversations as a neat policy choice or a straightforward technological upgrade. Instead, I came to understand it as a continuing struggle to protect operational continuity under conditions of uncertainty. The interviews showed me that operators were not simply deciding whether EVs were desirable in principle; they were asking whether the transition could be endured without damaging the fragile systems that sustained their everyday livelihood. Again and again, their voices returned to what had to be protected: the running unit, the completed trip, the waiting passenger, the daily boundary, the household budget, and the cooperative or terminal arrangements that made continued work possible.

When I viewed these codes through a Conditions–Actions–Consequences logic, the transition appeared as an ongoing process of practical negotiation. Participants described electrification as something they had to weigh against the possibility of disruption, not only in technical terms, but in deeply survival terms. I came to see that fear of battery depletion mid-route was not simply a concern about machine performance; it was also a fear of stranded passengers, lost income, damaged trust, and public embarrassment. In the same way, uncertainty over charging access was not just an infrastructure issue. It carried the emotional burden of not knowing whether the next day's operations could proceed as planned. Repair delays, battery replacement costs, and weak after-sales support were also more than abstract disadvantages. Participants experienced these as threats of immobility, suspended earnings, and prolonged financial strain.

I realized the necessity to ground the proposition not only in thematic categories, but in the concrete burdens and calculations that participants carried. As already shown in RQ1 and RQ2, I found that operators understood electrification not merely as a transport innovation, but as a managerial and institutional transition that required coordination, credible support, and workable governance. High acquisition cost, franchise insecurity, regulatory ambiguity, and the uneven capacity of cooperatives were not peripheral concerns. In my interpretation, these shaped whether transition could be trusted at all. Participants spoke from within systems where even a single operational error could trigger missed trips, unstable boundary remittances, household stress, and weakened confidence in both the vehicle and the policy environment surrounding it.

For this reason, I did not interpret their responses as expressions of preference alone. What I saw instead was something far more careful, burdened, and strategic. Operators assembled signs of readiness, tested what seemed feasible, staged their adjustments, and negotiated what counted as fair exposure to risk. In doing so, I did not read their stance as a rejection of modernization. Rather, I understood it as an effort to make modernization survivable within the lived realities of UV Express work. The proposition I developed, therefore, is not simply about openness or hesitation toward electrification. It is about how

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operators, situated within precarious but disciplined systems of livelihood, interpreted transition through the moral and practical imperative to keep life, work, and service intact.

The Grounded Proposition

UV Express operators navigated the transition to electrification by testing whether specific operational, financial, and governance gaps could be reduced to a survivable level within everyday transport work. Electrification became more acceptable when operators gained sufficient confidence that:

1. route-level service continuity could be protected through dependable charging access, workable trip-energy planning, reliable repair support, and operator familiarity with EV use under actual corridor conditions;
2. livelihood exposure could be contained through affordable financing, believable payback, manageable battery-related risk, and protection from income loss caused by downtime; and
3. transition demands were backed by credible and inclusive institutional arrangements, including clear rules, franchise security, cooperative support capacity, and rollout conditions that did not disproportionately burden small operators.

When these gaps remained unresolved, operators did not simply reject electrification. Instead, they protected livelihood through strategic deferral, selective engagement, hybrid-first preference, observational learning, and limited-risk participation while waiting for stronger proof, better support systems, and more credible transition arrangements. In the discussion of results, proposition is defined as evidence linked explanatory statement that summarizes a patterned relationship found in participants' accounts. It explains how and why UV Express operators respond to electrification by linking what conditions they face, what actions they take, and what consequences follow.

It is not a hypothesis for statistical testing; it is an interpretive claim contextualized from the participants' dialogues. A condition refers to a key requirement or enabling circumstance that shapes whether EV adoption is viewed as feasible or acceptable. Conditions describe the situation operators must have in place, or must be confident about, before they are willing to commit to adoption. Attributes are the specific, observable elements that make up a condition. They are the concrete indicators participants pointed to when describing whether a condition was present or missing. For example, a condition like route viability can be reflected through attributes such as charging access and repair reliability. In the proposition, I present the emergent understanding that participants repeatedly evaluate electrification against operational feasibility, financial defensibility, and institutional legitimacy conditions which explain their behaviors (acceptance or rejection of vehicle electrification).

Condition 1: Viable Route Operations and Passenger Trust

This condition may be specified more precisely by linking it to the operational uncertainties surfaced in RQ1 and RQ2. Participants did not only express abstract concern about EV reliability. They repeatedly referred to the possibility of losing charge in the middle of the journey, disruptions in dispatch rhythm, delays in returning to the terminal, and the reputational consequences of service interruption in front of passengers. These concerns showed that route viability was being judged at the level of actual trip execution.

In this study, fear of being stranded mid-route was not merely a technical misunderstanding, although it partly reflected limited experiential familiarity with EV range behavior under real operating conditions. It was better understood as a combined knowledge-and-system gap. On one hand, the concern pointed to the need for practical training in route-energy estimation, battery monitoring, charging planning, eco-driving, and contingency handling. Such training could improve operators' confidence in interpreting battery status, estimating usable range under traffic conditions, and planning charging windows more effectively. On the other hand, participant accounts also showed that training alone would be insufficient when charging stations were inaccessible, charging turnaround was too slow, or repair ecosystems remained weak. In this sense, the concern about battery depletion functioned as an example of how perceived risk emerged from the interaction between limited EV familiarity and incomplete ecosystem readiness.

Charging infrastructure is non-negotiable

Across participants' narratives, charging infrastructure was repeatedly treated as a non-negotiable requirement for route viability. Operators did not speak about charging in broad national terms. They located the need in specific places and time windows: at terminals, along routes, and within schedules permitted by dispatch routines. This emphasis reflected Philippine EV barrier studies that identified limited and poorly distributed charging infrastructure as a major deterrent, especially for high utilization transport operations (Guno et al., 2021; Saflor et al., 2024). In my contextual interpretation, charging readiness was judged through operational fit. Charging needed to be reachable, predictable, and compatible with trip sequencing. If charging introduced long queues, waiting time, or uncertainty about availability, operators anticipated cascading disruption. This also strengthened range anxiety because congestion already made travel time harder to plan.

Repair ecosystem readiness and the protection of passengers should be secured

Repair ecosystem readiness was equally central because it shaped how quickly service could resume after problems. In this study, the repair ecosystem referred to the network of support that keeps vehicles serviceable, including EV capable mechanics, service centers, diagnostic tools, warranty coverage, and the availability of parts and replacement components. Passenger facing reliability referred to the consistency that passengers directly experience, such as units not breaking down mid trip, predictable trip availability, and timely return to service after repairs. Operators distinguished between the chance of failure and the consequences of failure. Even if EV breakdowns were believed to be rare, the transition still felt risky if repair turnaround was slow, parts were scarce, and EV trained mechanics were limited. This attribute aligned with EV transition studies emphasizing that adoption depends on the surrounding service ecosystem, including warranty networks, parts supply chains, technician competence, and after sales support (Castro et al., 2023; Sanguesa et al., 2021).

From the operators' perspective, a weak repair system threatened passenger trust because a unit that could not return to service quickly disrupted route capacity and terminal routines. In this sense, repair readiness was not only a maintenance issue. It was a service reliability issue. When this attribute was missing, operators expected electrification to weaken the dependable service identity they needed to retain passengers and remain credible in a competitive transport environment.

Condition 2. Financially workable and operationally viable

The second condition concerns whether EV adoption can be absorbed within the thin-margin livelihood structure of UV Express operations. Earlier findings showed that operators did not treat vehicle acquisition as a simple business upgrade. Instead, they evaluated it in terms of daily boundary expectations, household cashflow, downtime exposure, battery replacement risk, and uncertainty over whether cost recovery would be achievable under actual operating conditions. Their hesitation was not simply about being unwilling to modernize, but about protecting income from investments that could become financially destabilizing.

Part of this financial hesitation may be reduced through clearer financial orientation, cooperative education, and practical training on EV cost structures, lifecycle expenses, maintenance planning, and payback estimation. Such interventions may help operators more accurately interpret long-term operating cost differences between conventional, hybrid, and electric units. However, the findings indicate that financial concerns are not purely informational. Even with better knowledge, operators may remain cautious if acquisition costs are too high, financing terms are misaligned with real income cycles, battery replacement remains prohibitively expensive, or downtime directly reduces daily earnings. In this sense, financial workability depends not only on improved understanding, but also on external support mechanisms such as affordable financing, subsidy alignment, risk-sharing arrangements, and realistic modernization pacing that does not overexpose operators to livelihood loss.

This condition aligned with studies showing that high upfront cost remains a central barrier to EV adoption for small operators and cooperatives (Guno et al., 2021). IN developing countries like the Philippines, technology transitions become livelihood risks when financing mechanisms and institutional supports do not protect small operators from exposure (Mateo Babiano et al., 2020; Gatarin & Galicha, 2024).

Within UV Express operations, where margins can be thin and income depends on repeated trips, the purchase price was described less as a normal investment and more as a high stakes gamble. The literature on total cost of ownership helped explain why lower running costs did not automatically translate into adoption confidence. Studies showed that purchase price, payback expectations, depreciation uncertainty, financing cost, and weak resale markets shape willingness to adopt even when energy costs per kilometer appear lower (Lopez et al., 2020; Lopez et al., 2021; Woody et al., 2024). In the interviews, operators reasoned in similar ways, but with sharper pressure because of boundary arrangements. Every day of downtime could affect household stability. For this reason, long term savings mattered only if operators believed they could survive the short-term risks of acquisition and operation.

Battery replacement and major component failure emerged as a key fear, not just functionally but financially. Operators did not talk about battery issues as routine maintenance. They framed them as single point failures that could lead to debt and prolonged income loss. This concern matched EV economics research showing that battery degradation and replacement uncertainty can drive hesitation, especially where repair infrastructure and supply chains are still immature (Hannan et al., 2020; Lopez et al., 2021). In the UV Express setting, the battery became a sign of potential collapse, because its cost could exceed what an operator could absorb while still meeting boundary obligations. Battery failure is linked to high cost. To explain this condition in the proposition, I identified two attributes that describe this condition.

Affordability and conditional viability

Affordability strain appeared as the first major failure point for livelihood investability. In the interviews, operators often acknowledged that EVs could offer fuel savings and improved comfort. However, these benefits did not automatically translate into willingness to invest. The decision kept returning to the upfront price of the unit, the structure of financing terms, and whether payback could realistically happen within their operating conditions. When acquisition costs felt too high, when interest or amortization felt too heavy, or when the payback timeline felt too long or uncertain, operators withheld commitment.

This pattern was consistent with related literature showing that vehicle cost remains a major deterrent in Philippine settings, alongside charging limitations and range concerns (Saflor et al., 2024). What became clear in the narratives was that "viability" was not treated as a fixed technical claim. Operators described viability as conditional. Electrification felt feasible only when affordability matched ecosystem readiness. Even if a unit was available, operators questioned whether they could sustain the early months of adjustment when charging routines were still uncertain, repair support was still limited, and rules were still shifting. In this sense, affordability was never just about the sticker price. It was also about whether the surrounding system could reduce the probability of downtime and protect daily income while the investment was still being paid off.

When affordability failed, operators described practical ways of protecting livelihood. Some delayed purchase and chose to wait until prices dropped or financing terms improved. Others limited exposure by holding off on full electrification and observing pilots first. Many leaned toward bridging technologies that reduced the downside, such as hybrids, because these options allowed modernization participation while keeping operational continuity through fuel backup. These actions reflected risk management rather than refusal. Operators were not simply saying "no." They were saying "not yet," until the financial terms and the operating environment could support a safer investment decision.).

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In the UV Express' lived realities, conditional viability worked as a practical rule: electrification became acceptable only when affordability, financing support, and ecosystem readiness aligned closely enough to make investment recovery believable and livelihood disruption manageable.

Sustainable cashflow, and the minimal downtime

The participants also evaluated EVs based on their daily requirements. I repeatedly heard this logic in different forms: will electrification reduce trips, delay work, or increase deductions. Charging time and repair delays were not only operational problems. They can be experienced as income shocks.

Congestion and traffic conditions intensified this pressure because it reduced turnaround and forced longer working hours for the same or lower net earnings. Under these circumstances, the opportunity cost of downtime became decisive. Even small increases in non-operational time could cascade into boundary shortfalls and household strain. Participants consider imminent costs of battery repairs and replacement as threat to livelihood.

It is convincing that attribute 2 explained why operators gravitated toward staged adoption. Instead of adopting immediately, they took micro steps that protected daily income. They learned first, observed other operators, tried intermediate options, and set conditions before investing. In this context, staging was a livelihood protection practice. It reflected the view that modernization would only succeed if the transition stayed within survivable limits. While the "Hybrid Bridge" emerged as the strongly preferred technological pathway, a critical theoretical distinction must be made regarding the permanence of this mindset. The findings indicate that the preference for hybrids, and the psychological "security of a gasoline backup," is not a rigid, culturally ingrained requirement of Philippine paratransit operators. Rather, it is a highly conditional, temporary stance directly tethered to the current immaturity of the EV ecosystem. The operators' reliance on combustion redundancy is a calculated defense mechanism against existing infrastructural voids—specifically, the lack of terminal-based charging and localized repair capabilities that threaten their daily "Livelihood Mathematics." Consequently, the data suggests that if the systemic ecosystem were to sufficiently mature—where charging access becomes ubiquitous and "Uptime-indexed Risk" is neutralized by readily available parts and localized technical expertise—the operational necessity for a gasoline backup would dissolve. The "Hybrid Bridge" is therefore theorized not as a permanent technological destination, but strictly as a temporal coping strategy. Once the operational ecosystem can guarantee the same level of route completion and income security as traditional combustion engines, the operators' pragmatic focus on operational efficiency would naturally facilitate a full transition toward Battery Electric Vehicles (BEVs).

Condition 3: Credible and Inclusive Policy

The third condition concerns whether the institutional environment provides a credible basis for transition. Findings from the earlier research questions showed that operators' willingness to engage with electrification was shaped not only by the vehicle itself, but also by the reliability of rules, franchise continuity, route security, implementation timelines, cooperative capacity, and the consistency of government direction. Participants did not simply ask for more information; they sought assurance that the transition would unfold under arrangements that were fair, knowable, and workable in practice.

Some aspects of this condition may be strengthened through orientation programs, policy briefings, cooperative-level information sessions, and training designed to improve operators' understanding of regulatory requirements, transition procedures, and institutional responsibilities. These interventions may reduce confusion arising from ambiguous or inconsistent communication. However, the findings also show that uncertainty often came from the governance environment itself rather than from a mere lack of awareness. When timelines were unclear, compliance demands were unstable, or franchise-related issues remained unresolved, confidence weakened regardless of how much information was provided. For this reason, governance legitimacy depends not only on communication and training, but also on credible policy execution, inter-agency coordination, inclusive planning, and institutional arrangements that allow operators to attach livelihood decisions to modernization without excessive uncertainty.

This pattern of reasoning was consistent with modernization research showing that unclear timelines, inconsistent requirements, and fragmented institutional coordination generate hesitation among operators (Mateo-Babiano et al., 2020). Operators were not simply asking for information. They were asking for credible governance signals that made planning possible. This also echoed broader observations that governance fragmentation and overlapping authority in the transport sector complicate implementation and intensify uncertainty (Gatarin & Galicha, 2024). Governance legitimacy also mattered at the level of service operations. Operators described how policies and terminal arrangements shaped everyday viability through passenger caps, dispatch procedures, terminal organization, and compliance burdens. These operational rules influenced whether service remained stable and dependable. Related studies supported this view by showing that management discipline, dispatch efficiency, and terminal organization can reduce commuter dissatisfaction and improve service quality (Tiglao et al., 2020; Cua et al., 2023). At the same time, operators judged governance not only by the presence of rules but by whether the rules felt feasible and fair. When modernization was perceived as punitive or misaligned with lived operational realities, legitimacy weakened. Under those conditions, electrification was framed as an imposed burden rather than a dignifying service improvement.

Within the Philippine paratransit landscape, governance legitimacy is not merely a product of administrative compliance, but is deeply rooted in the "realpolitik" of collective mobilization. While the modernization program emphasizes the transition of transport groups into formal cooperatives for better administrative capacity, the true management leverage of these entities lies in their capacity for collective disruption. The findings suggest that cooperatives view their organizational structure as a dual-purpose mechanism: a vehicle for accessing state-led financing and a consolidated platform for political influence. In this context, the threat of a transport strike (tigil-pasada) serves as a potent tool of governance legitimacy, forcing the state to recalibrate its modernization timelines and subsidy allocations whenever the collective power of the sector is activated.

This dynamic reveals that the transition to electrification is as much a political negotiation as it is a technological shift. For the UV Express manager or cooperative officer, the ability to sway policy is indexed to the sector's perceived power to paralyze urban mobility. Consequently, the state’s pursuit of a "better commute" through electrification is often moderated by the need to maintain social order and avoid crippling transport strikes. This collective power forms a critical layer of the operational framework, where the legitimacy of the electrification mandate is constantly contested and renegotiated through the lens of political leverage, rather than purely through technical or environmental merit.

Crucially, cooperative capacity emerged as a mediating institutional structure. In the accounts, strong cooperatives could transform individual risk into collective capability through group financing, shared charging and maintenance arrangements, and coordinated learning. Conversely, weak cooperative capacity increased vulnerability by leaving operators isolated in managing high-cost transition demands. For this reason, cooperative readiness also emerged as a key constraint in reform implementation. To elaborate the third condition of the proposition, I have put together two attributes.

Clear regulations and secured franchise

In this attribute, I posit that regulatory clarity and franchise security shaped the basic investment logic of operators. Operators treated EV adoption as a long-horizon decision. It only became reasonable when the time horizon for payback felt credible. In practical terms, an EV unit could be expensive, and recovery depended on being allowed to operate consistently for years. Because of this, operators looked to governance signals as proof that the investment would not be stranded by policy change. Across interviews, operators linked willingness to invest with predictable franchise renewal, stable route allocations, and consistent compliance requirements. When rules felt unclear or shifting, they hesitated. They worried about investing heavily and then facing unexpected changes in renewal decisions, route permissions, or

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modernization requirements. The contextual definition of "security" did not only mean holding a franchise on paper. It meant confidence that the franchise would remain valid, that route authority would be retained, and that operating rights would not be disrupted by sudden policy shifts. This is why regulatory clarity functioned as a gatekeeping attribute. Without it, operators could not plan the payback path, and electrification became financially unsafe. This pattern aligned with literature on transport modernization warning that small operators can be destabilized or excluded when transitional supports and protections are weak, uneven, or unclear (Gatarin & Galicha, 2024; Mateo-Babiano et al., 2020). In my analysis, operators responded to unstable policy signals with a protective sequence of decisions.

Participants delayed major EV commitments and prioritized compliance actions that protected the right to operate. In CAC terms, unclear policy signals served as the condition. Strategic deferral and selective engagement became the action. The consequence was a staged and mixed transition, where operators remained open to modernization in principle but avoided irreversible investments until the governance environment felt stable. This is why "delay" in the proposition was not treated as apathy. It was governance-sensitive investment protection.

Cooperative capacity and inclusive rollout

Cooperative In this attribute, I theorized that cooperative capacity conditions whether operators could navigate electrification as a collective transition rather than as an individual burden. Participants rarely described electrification as something they could manage alone. Many of the requirements involved shared arrangements such as financing, charging access, maintenance support, and coordinated compliance. In the interviews, cooperative structures appeared as the practical space where operators tried to reduce uncertainty and distribute risk. Participants described cooperatives as platforms for shared learning, peer validation, and the exchange of operational information. They talked about attending seminars together, discussing what they heard, and comparing interpretations of rules and requirements. They also used cooperative conversations to assess charging and maintenance preferences, and to weigh what kind of vehicle pathway felt feasible. In this sense, the cooperative was not only a social influence channel. It served as an institutional mechanism where planning could happen and where high-cost decisions could be discussed as a group.

More importantly, cooperative capacity mattered because it could convert individual exposure into collective capability. Where cooperative capacity was strong, operators could imagine group financing, shared charging arrangements, and pooled support systems that reduced perceived risk. These arrangements made electrification more thinkable because they offered a way to buffer costs and shorten the distance between policy demand and operational reality. Where cooperative capacity was weak, participants expected negative outcomes. They anticipated that transition costs would be borne individually, that information would remain fragmented, and that support would be inconsistent. Under those conditions, hesitation increased because operators felt isolated in managing a high stakes transition.

This is why inclusive rollout became part of the attribute. Operators' accounts suggested that electrification could only feel legitimate if participation was not limited to a few well-resourced groups. A rollout felt inclusive when cooperatives had the support, time, and capacity to help members comply without displacing smaller operators. In my proposition, this particular attribute of the third condition reinforced the notion that governance legitimacy was not only about the credibility of regulators. It also depended on the internal organizational strength of the cooperative and terminal ecosystem that mediated daily operations and determined whether electrification could be implemented in a fair and workable way.

Having elaborated the three conditions, I find it important to note that the mechanism of the proposition does not move in only one direction. Instead, it branches into two possible pathways. When one or more of the practical tests remain unmet, the pathway tends toward protective deferral and selective engagement. When credible proof, readiness, and support begin to accumulate, the pathway shifts toward phased commitment. In this sense, the proposition does not describe a fixed stance toward electrification, but a conditional movement shaped by how operators interpret risk, feasibility, and survivability in their everyday work.

Taken together, these three conditions suggest that operators did not assess electrification through a singular attitude toward technology. Their responses were not simply expressions of optimism or hesitation. Rather, they evaluated whether the operational, financial, and governance gaps identified in RQ1 and RQ2 could be narrowed to a level that felt survivable and workable within the realities of UV Express operations.

Where the gap appeared to be partly capability-based, I found that interventions such as training, orientation, demonstrations, and cooperative learning could strengthen readiness and reduce uncertainty. But where the gap was structural—such as the absence of charging infrastructure, unaffordable financing, weak repair ecosystems, or unstable governance arrangements—operators remained cautious, because these were not problems that knowledge alone could solve.

One of the most analytically important contributions of this proposition, in my view, is the idea of protective deferral. This reinterprets delay not as simple resistance, but as an adaptive and reasoned response to unstable conditions. In my memoes, operators delayed in order to avoid exposure to risks they believed could seriously disrupt livelihood. They waited for proof, limited investment, watched pilot experiences carefully, and preserved fallback options. What might appear on the surface as reluctance emerged as a form of practical self-protection rooted in responsibility to passengers, family, and daily income. Closely related to this is selective engagement, which I elucidate as the companion action of protective deferral. Operators did not remove themselves from the discourse of modernization. They did not simply reject the transition and turn away from it. Instead, they engaged in partial, cautious, and strategic ways that allowed them to build readiness while keeping the option open. For some, hybrid-first strategies emerged as a bridge pathway. These strategies offered a way to participate in modernization while still retaining the operational safety net of gasoline. In this sense, selective engagement reflects not indecision, but a careful effort to move without becoming overexposed.

The credibility of these enabling conditions depended not only on technology or operator willingness, but also on policy and institutional arrangements. This is consistent with the broader literature suggesting that adoption is shaped not only by perceived usefulness, but also by facilitating conditions that make implementation realistic in practice (Venkatesh et al., 2003).

Likewise, incentives and regulatory measures may improve EV ownership feasibility by narrowing the acquisition gap and improving total cost of ownership, but their actual effect depends on whether such measures are accessible, understandable, and trusted by small operators (Lopez et al., 2021). In this research, I framed policy credibility as a lived perception rather than a purely formal policy attribute. Contextually, it refers to whether the rules are stable enough for operators to plan around, whether support measures are realistic enough to be relied upon, and whether the governance system feels capable of protecting rather than punishing them during transition. This distinction matters because operators were not responding to policy texts in the abstract; they were responding to how governance was experienced in practice. Where policy felt unclear, unstable, or unevenly enforced, hesitation deepened. Where credible proof began to accumulate, I observed a subtle shift in the narratives.

Modernization was less often regarded as an imposed threat and more often imagined as a possible route toward improved service dignity—cleaner rides, quieter units, and a more professional passenger experience. Even so, this positive reframing did not emerge automatically. It appeared only when the enabling conditions became convincing enough to reduce fear and make transition feel materially supportable

An Operational Framework for Overcoming Management Barriers and Accelerating Electric Vehicle Adoption in UV Express Operations

This section addresses Research Question 4 by presenting an operational framework grounded in the proposition developed in RQ3. The framework translates the study's findings into practical guidance aimed at overcoming management barriers and accelerating electric vehicle adoption within the realities of UV Express operations. Rather than serving as a conventional implementation plan, the framework functions as a qualitative tool that clarifies how identified conditions can be strengthened, how operators' actions can be supported and sequenced, and how transition outcomes can be stabilized. In doing so, it ensures that proposed strategies remain aligned with the lived experiences, constraints, and meanings expressed by participants.

In the UV Express EV operation, transition is encountered not primarily as a technical replacement of a drivetrain but as a continuity problem within a boundary-based paratransit livelihood. Participants' willingness or reluctance to transition emerged as work in progress rather than a single event. They repeatedly test EV feasibility against conditions such as route-level reliability demands, boundary economics, and governance legitimacy, and they move in incremental ways that protect income continuity and cooperative–terminal arrangements. This stance supports vehicle modernization scholarship emphasizing that paratransit transition is managerial, first and foremost.

The actions at UV Express cooperative level as meaningfully framed in the interviews surfaced institutional coordination, credible implementation support, and workable governance arrangements rather than merely a matter of technology availability (Mateo-Babiano et al., 2020). It also reflects adoption perspectives that emphasize the decisive role of facilitating conditions and institutional support in enabling sustained uptake, particularly in environments where new systems require new operational competencies and risk-bearing arrangements (Venkatesh et al., 2003).

From a qualitative standpoint, I frame this operational framework as a midrange, context-grounded model that is sensitive to the "how" of transition. My stance as a researcher position that the framework must not merely persuade; it must reorganize feasibility by increasing the likelihood that the positive conditions towards electrification are satisfied. This assumption resonates with socio-technical transition perspectives that stress phased change, intermediate configurations, and trialability as realistic pathways under uncertainty rather than instantaneous substitution (Geels, 2002; Geels, 2011). In the UV Express context, acceleration is not best conceptualized as speed of purchase. It is better conceptualized as speed of alignment. It is the speed at which route viability, investability, and governance legitimacy can become simultaneously satisfiable and recognizable to operators as dependable.

The operational framework I develop supports the EV transition by continuously evaluating three practical conditions framed in the proposition: viable route operations and passenger trust, financially workable and operationally viable arrangements, and credible and inclusive policy rollout. When any key condition falls below expectation —most often due to affordability pressures, risks in charging or repair continuity, or low policy credibility, participants safeguard their livelihoods through strategic deferral and selective engagement.

In the framework, I position this deferral not as a deficit but as an empirically grounded response to unbounded risk. As a sensitizing lens, Rational Choice Theory supports this interpretation by treating operators' actions as protective choices under constraint. The implication for framework design is direct. The framework must reduce unbounded risk by making the three conditions more dependable in daily operations.

Operational Framework for Overcoming Management Barriers and Accelerating Electric Vehicle Adoption in UV Express Operations

To respond to the management barriers implied by the proposition and to support accelerated EV adoption, I developed a cyclic operational framework with three focus areas that follows the contexts of participants' own evaluation. Each pillar corresponds to one condition in the proposition. Each area is supported by two operational components, which directly reflect the two attributes I identified under that condition. The framework is not intended to function as three separate silos. The areas are interdependent, and this interdependence is central to how operators judge readiness. Charging and repairs shape downtime.

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Downtime shapes cashflow. Cashflow shapes tolerance for transition. Policy credibility shapes whether operators believe they will operate long enough to recover investment costs. Cooperative capacity shapes whether compliance and risk-sharing can be executed in practice.

Because of this interdependence, the framework is designed to reduce the need for protective deferral by strengthening readiness across operational, financial, and governance domains at the same time. In my interpretation, participants do not reject EVs outright. They defer when risks feel unbounded, when service continuity feels threatened, or when policy signals feel unstable. They engage selectively when they can learn, observe pilot proof, and limit exposure through staged decisions. The framework therefore treats staged engagement as a legitimate pathway that can be supported and stabilized until full adoption becomes practicable. In this study, affordability did not emerge as a fixed monetary threshold or universal standard. Rather, it was understood contextually as the degree to which EV acquisition and operation could be absorbed within boundary-based earnings without destabilizing daily cash flow, household needs, and route continuity during the payback period.

Figure 7. Operational Readiness Framework for UV Express Vehicle Electrification.

The operational framework has three readiness areas: Service Continuity, Financing Viability, and Inclusive and Enabling Policy Rollout. Each area is supported by two operational components. I discuss these components in sequence because they mirror the practical conditions operators repeatedly introspect in their narrative, even as the operational areas remain mutually reinforcing in practice. The circular structure of the operational framework reflects my interpretation that readiness is continuously produced and re-evaluated. Service continuity influences financing viability because downtime affects income stability. Financing viability influences service continuity because financial strain shapes whether operators can sustain maintenance routines and absorb early adjustment costs. Policy rollout influences both domains because governance signals shape risk perception and investment confidence.

At the same time, service and financial experiences shape how policy is judged. When operators experience instability in charging and repairs, they interpret rollout as unready. When they experience affordability strain, they interpret modernization as misaligned with their livelihood mathematics. When they experience clarity and empowerment, they interpret electrification as safer and more legitimate. This circular logic also clarifies why deferral is common in the narratives. Deferral is not simply personal hesitation of participants. It is their response to a readiness cycle that has not yet stabilized. Operators continue to engage because they want to keep options open. They look for proof that the system is becoming reliable. They move toward commitment when the three readiness areas become mutually reinforcing in ways that they can recognize and trust.

In the operational readiness framework, describe the focused areas as the three core readiness domains that must be sufficiently established for electrification to become workable in UV Express operations. The cyclical representation does not suggest a fixed linear process or a single starting point. Rather, it signifies that readiness is continuously produced, experienced, and re-evaluated through the interaction of these areas in actual operations. In practice, operators may enter the cycle from any one of the three domains depending on which concern is most urgent, although service continuity often emerges as the most immediate practical test because it directly affects route reliability and passenger trust. The arrows therefore represent mutual influence and recursive assessment, not a stepwise sequence.

Service Continuity

Service Continuity captures the first condition in the proposition, which is viable route operations and passenger trust. This focused area served as an ideal starting point, one this easiest to achieve. In the lived experiences of the participants, UV Express work is high frequency and time sensitive. Operators depend on repeated trips and quick turnaround. They also depend on maintaining passenger reputation for continuous commuter demand. Because of this, participants evaluated electrification through a practical question. They asked whether EVs can keep the route running reliably without disrupting dispatch rhythm and without weakening passenger confidence. This framing is consistent with transition scholarship that treats technological change as inseparable from changes in everyday practices, infrastructure, and system coordination (Geels, 2002).

The accounts illuminate that service continuity is not a purely technical idea. It is an operational and relational requirement. Operators spoke about passengers as social actors who respond to reliability and safety cues. If an EV breaks down mid-route or becomes unavailable for dispatch, operators anticipate reputational harm. They anticipate commuter frustration and weakening of terminal credibility. This is why service continuity becomes a gatekeeping readiness domain. If service continuity cannot be protected, electrification remains unsafe to adopt. For adoption to accelerate, the system must make reliability more dependable in daily operations, because facilitating conditions are decisive when a new system demands new routines and new support structures (Venkatesh et al., 2003).

Operational Component 1: Available Charging Facilities

Available Charging Facilities corresponds to the attribute I identified as charging infrastructure as non-negotiable. In the interviews, operators did not treat charging as a national policy ambition. They treated it as a daily operational requirement. They located charging needs in specific places and time windows. They emphasized terminals, route corridors, and operational schedules. They described charging as something that must fit the rhythm of dispatch and turnaround. This operational emphasis aligns with evidence that charging reliability and access influence confidence and adoption, because unreliable stations and failed charging events undermine willingness to depend on EVs for routine mobility and work (Powell et al., 2024).

In this framework, "available" does not only mean that a charger exists somewhere. It means the charger is accessible in practice. It means operators can reach it without losing too much time. It means charging can happen within feasible windows that do not erase trips. It also means queues and waiting do not create unpredictable delays that disrupt dispatch. In my analysis, charging becomes a service continuity issue because time spent charging competes with trip turnover under boundary-based earnings. Even when the consequence is financial, the lived experience is operational disruption. When charging availability is uncertain, operators anticipate cascading problems in dispatch. They also experience stronger range anxiety because traffic already makes travel time hard to predict. Charging uncertainty adds another layer of unpredictability that threatens route reliability. The broader EV adoption literature similarly recognizes charging access and infrastructure as core barriers when they make daily use uncertain (Pamidimukkala & Kermanshachi, 2023).

Because of this, I make the operational recommendation logic explicit. Charging development for UV Express should be planned as an operational system, not only as geographic coverage. Implementers should prioritize terminals and route corridors where turnaround is concentrated, and they should manage access through predictable operating rules so that operators can plan charging without sacrificing trip productivity. I also recommend that charging performance be treated as a service standard rather than as a simple installation target. Station uptime, reliability, and successful charging completion should be monitored and enforced because these directly shape whether charging is experienced as manageable or as disruptive.

For this reason, the framework positions charging availability as one of the two primary supports of service continuity. When charging facilities are available in a way that aligns with dispatch routines, electrification becomes more thinkable. When charging facilities are scarce, congested, or operationally inaccessible, operators protect livelihood by delaying adoption or by choosing transitional options that preserve operational continuity.

Operational Component 2: Reliable After Sales Support

Reliable After Sales Support corresponds to the attribute I defined as repair ecosystem readiness and the protection of passengers should be secured. In the narrative of the participants, they distinguished between the chance of failure and the consequence of failure. Even when they believed EV problems might be rare, they hesitated when repair pathways were unclear. They feared prolonged downtime, parts scarcity, and limited EV-capable technicians. These fears were not framed as minor concerns. They were framed as livelihood threats because a unit that cannot return to service quickly disrupts income and service reliability. This concern is consistent with research that treats EV adoption barriers as multi-dimensional and includes service and maintenance ecosystem gaps alongside infrastructure and cost barriers (Pamidimukkala & Kermanshachi, 2023).

In this framework, after-sales support is not only about maintenance. It functions as a route continuity safeguard. It includes service centers, diagnostic capability, warranty clarity, parts supply, and turnaround time. It also includes confidence that assistance will be available when something goes wrong. Operators tied this directly to passenger trust. A breakdown mid-route was narrated as a reputational event that can damage passenger confidence and reduce demand. In this sense, after-sales support protects the social integrity of the service. When support is reliable, risk becomes bounded. When risk is bounded, operators can imagine sustaining service reliability even during early transition months. This aligns with transition theory, which emphasizes that adoption depends on coordinated changes in infrastructure, industry networks, and support systems, not on the vehicle alone (Geels, 2002).

The action implication is direct. I recommend that EV deployment for UV Express should not proceed without a visible after-sales readiness plan that operators can evaluate. This plan should specify service coverage, technician capability development, parts supply assurance, and warranty rules that are understandable and enforceable for small operators. I also recommend that cooperatives and regulators require service-level commitments from suppliers, including turnaround expectations, because turnaround time is the continuity variable that operators experience most strongly. These commitments translate "support" into a predictable recovery pathway, which reduces the need for protective deferral.

I therefore position reliable after-sales support as the second core support of service continuity. Together, charging availability and after-sales reliability form the operational backbone that protects passenger confidence and keeps routes dependable.

Financing Viability

Financing Viability is my operational translation of the second condition in the proposition, which is financially workable and operationally viable arrangements. In the interviews, participants repeatedly framed EVs as income-generating assets. They evaluated electrification through daily survival logic. They asked whether the vehicle can be paid for under boundary-based earnings. They asked whether cashflow can remain stable. They asked whether downtime will increase deductions and reduce trips. They also worried about catastrophic costs, especially related to batteries and major components. This framing is consistent with total cost of ownership evidence, which shows that feasibility is shaped by upfront price, battery-related costs, maintenance, and the realism of operating conditions, not by sticker price alone (Felizola Romeral et al., 2025).

From an interpretive standpoint, financing viability is not only about price. It is about whether the investment can be recovered under real operating constraints. It is also about whether the transition can be survived during adjustment months when routines are changing and uncertainty is still high. Operators do not reject electrification because they dislike the technology. They delay when the investment threatens daily stability. This is why financing viability becomes a central readiness domain in the framework. It also reinforces the adoption literature point that facilitating conditions and system support shape whether high-effort adoption becomes possible (Venkatesh et al., 2003).

Operational Component 3: Affordable Financing Options

Affordable Financing Options corresponds to the attribute I described as affordability and conditional viability. Participants repeatedly returned to upfront cost, financing terms, and payback uncertainty. They described the EV purchase as a highstakes gamble when the price felt too high and when the terms felt too heavy. They also treated viability as conditional. Even if the EV promised savings, operators did not trust those savings if charging and repairs were uncertain. They could not commit to longhorizon recovery if early months could trigger cashflow collapse while amortization obligations continued. This aligns with TCO syntheses showing that cost competitiveness is highly sensitive to battery costs, financing conditions, and real-world usage contexts (Felizola Romeral et al., 2025). Affordability, as

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it emerged in this study, did not refer to a fixed price threshold or universal financial benchmark. Instead, it referred to whether the acquisition and operation of an EV could be realistically absorbed within boundary-based earnings and household-dependent cash flow without creating unmanageable exposure during the payback period. In this sense, affordability was evaluated together with financing terms, expected downtime, battery-related risk, and the dependability of charging and repair support. In this framework, affordability is a transition-enabling support. Operators need financing options that match the realities of boundary-based earnings. They need terms that do not force collapse during adjustment periods. They also need risk exposure to be bounded because battery replacement and major component failure were framed as potential single-point collapse events. In my interpretation, it is not enough to offer loans. The terms and protections must make the investment survivable. This is also where a just transition lens becomes operationally relevant. Evidence from Philippine transport modernization studies emphasizes that consolidation and financing can become exclusionary when risks and burdens are concentrated on smaller operators (UP CIDS, 2023; PIDS/WSF, 2024). For this reason, I recommend that affordability interventions be designed as risksharing arrangements rather than as simple credit access.

Programs should include protections such as transition buffers for early months, clear insurance and warranty coordination, and financing structures that do not penalize operators immediately when operational uncertainties occur. I also recommend that financing be paired with the service-continuity plans, because affordability is not credible when charging and repairs are still unstable. When financing options are absent or not trusted, operators respond through protective deferral and selective engagement. They wait for price drops, observe others first, and choose bridge technologies to limit exposure. When financing is judged as fair and survivable, adoption becomes more likely because electrification is no longer experienced as a debt trap.

Operational Component 4: Profitable Operations

Profitable Operations corresponds to the attribute I described as sustainable cashflow and minimal downtime. In my analysis, operators evaluate profitability through daily trip productivity. They do not measure profitability primarily through long-term projections. They measure it through whether daily work remains viable. Charging time and repair time were repeatedly described as income shocks, and these shocks are intensified by congestion and variability in demand. When downtime increases, trip volume declines and boundary obligations become harder to meet. This interpretation is consistent with TCO research that shows real-world operations, maintenance uncertainty, and downtime-sensitive costs strongly shape feasibility (Felizola Romeral et al., 2025).

In this framework, profitable operations do not mean high profit margins. It means the operation can sustain boundary remittances, household needs, and routine costs without constant shortfall. Operators often framed this as stability rather than growth. Profitability is experienced as the ability to keep operating without repeated loss events. This links directly to service continuity. If charging access is poor and repairs are slow, profitability suffers. When profitability suffers, operators delay. This is why profitable operations must be treated as a readiness component, not as a result that appears after adoption.

The recommendation implication is that operational planning must be treated as part of the adoption package. I recommend that implementers, cooperatives, and suppliers support scheduling practices and maintenance routines that minimize downtime, because downtime is the variable that connects operational feasibility to financial survival. I also recommend that early deployments be designed as learning oriented

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pilots with performance monitoring that focuses on downtime and trip productivity, because operators' acceptance depends on whether the EV can preserve daily viability under real route conditions.

This connects back to the transition perspective that treats phased implementation and practical learning as necessary for system change under uncertainty (Geels, 2002). I position profitable operations as the second support of financing viability because it captures how operators evaluate whether electrification will actually work under real-world UV Express conditions.

When operators can see that EV routines will not erase trips, increase downtime, or destabilize daily cashflow, electrification becomes acceptable.

Inclusive and Enabling Policy Rollout

Inclusive and Enabling Policy Rollout is my operational translation of the third condition in the proposition, which is clear and inclusive policy. In my data, governance legitimacy operated as a gatekeeping condition. Operators treated EV investment as a long-horizon decision. They needed confidence that rules would remain stable long enough for cost recovery to be credible. They also needed confidence that compliance requirements were workable. When guidance was inconsistent, when timelines were unclear, and when authority felt fragmented, operators hesitated. They treated hesitation as investment protection rather than refusal. This is consistent with transition research that recognizes regulation and institutional coordination as central to stabilizing expectations and enabling adoption pathways (Geels, 2002). At the same time, cooperative capacity and inclusion shaped how policy was experienced. Operators described the cooperative as the space where they seek information, compare interpretations, and support one another. They also described fears of exclusion when modernization demands exceeded their capacity. This is why I frame the policy domain not only as rule clarity, but also as empowerment.

A rollout becomes enabling when it supports operators to comply and participate. A rollout becomes excluding when it burdens small operators and concentrates participation among only well-resourced groups. Philippine just transition analyses of modernization reinforce this concern by documenting how financing and consolidation requirements can marginalize smaller operators when supports are insufficient (UP CIDS, 2023; PIDS/WSF, 2024).

Operational Component 5: Clear Policy Guidelines

Clear Policy Guidelines corresponds to the attribute I described as clear regulations and secured franchise. In this framework, clarity refers to the ability of operators to plan. Operators need stable guidance on requirements, timelines, and compliance expectations. They also need assurance that franchise and route authority will remain secured. In my analysis, franchise security is not only a legal status. It is a lived confidence that the operator can keep working under predictable rules. This confidence anchors the payback horizon. Without it, an EV purchase becomes unsafe because the investment can be stranded.

Clear guidelines function as an enabling signal. When policy guidance is stable and consistent across institutions, operators can shift from waiting to planning. When guidance is fragmented or shifting, operators return to deferral. They continue to engage selectively, but they avoid irreversible investments.

The implication is that implementing agencies should treat consistency and predictability as operational requirements, because credibility is a prerequisite for long horizon investment.

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Operational Component 6: Community Empowerment Initiatives

Community Empowerment Initiatives correspond to the attribute I described as cooperative capacity and inclusive rollout. In the interviews, operators rarely imagined managing electrification alone. They described shared learning, peer validation, and group discussions as crucial. They also described cooperatives as channels for seminars, information exchange, and collective interpretation of rules. In my interpretation, these accounts point to a deeper requirement. Electrification becomes possible when institutional capacity is built where operators actually operate and decide.

In this framework, empowerment initiatives refer to practical supports that strengthen cooperative and community capacity. This includes learning systems, compliance support, coordinated planning, and mechanisms that reduce individual exposure by distributing risk. Empowerment also means inclusive participation. Operators emphasized that electrification should not become a pathway that only a few can enter. Inclusion becomes part of legitimacy. When rollout is inclusive and capacity is built, policy becomes credible. When rollout is perceived as punitive or exclusionary, policy loses legitimacy, and operators respond through protective deferral.

The recommendation implication is that empowerment must be treated as a core implementation track, not as an optional add-on. I recommend that capacity building be designed to make compliance workable, to strengthen collective planning, and to improve operators' ability to negotiate and evaluate technical and financial offers. This recommendation also aligns with adoption theory because facilitating conditions and social influence become stronger when support systems are local, accessible, and trusted (Venkatesh et al., 2003).

I therefore position empowerment initiatives as the second support of enabling policy rollout. This is important because clarity alone is not enough. Operators may understand what is required and still be unable to comply. Empowerment closes that gap by converting requirements into workable participation.

In summary, the three sections and their six Operational Components clarify how the transition to electrification becomes workable only when operators can protect continuity, protect cashflow, and trust governance. In my analysis, these are not abstract conditions. They are daily tests that operators apply to decide whether electrification is safe to attempt. Service Continuity addresses whether an EV can keep the route running without disrupting dispatch rhythm and passenger confidence. Financing Viability addresses whether adoption can be survived under boundary-based earnings without turning modernization into a debt trap. Inclusive and Enabling Policy Rollout addresses whether rules and institutional arrangements are credible enough for operators to plan and invest. Across these domains, the core insight is that electrification accelerates when the system reduces unbounded risk and converts uncertainty into manageable exposure.

The Service Continuity areas show that operators do not separate technology from operations. Operational Component 1 emphasizes that charging must be planned as an operational resource that fits terminal realities, route corridors, and dispatch windows. "Availability" therefore means practical access, predictable use, and reliable performance, because charging delays translate into lost trips and reputational strain. Operational Component 2 extends this logic by treating after-sales support as a continuity safeguard. Operators are willing to consider EVs when breakdowns are recoverable within predictable timeframes and when warranty, parts, and technician capability are visible and dependable. In transition terms, these supports stabilize the socio-technical system around EV use, because infrastructure and service networks must develop alongside vehicle deployment for adoption to become routine rather than risky.

The Financing Viability Pillar explain why affordability is experienced as survivability rather than as price alone. Operational Component 3 shows that financing must match the rhythm and volatility of boundary-based earnings. Operators evaluate loans through the risk of early cashflow collapse, especially when charging and repairs remain uncertain. For this reason, affordability interventions need to function as risk sharing arrangements that protect operators during adjustment months and reduce catastrophic exposure linked to major components such as batteries. Operational Component 4 reframes profitability as stability. Operators define viability as the ability to sustain boundary remittances, household needs, and routine costs without repeated shortfall events. This is why operational planning to minimize downtime must be treated as part of adoption support, not as an outcome that appears after purchase. The logic aligns with adoption frameworks that emphasize facilitating conditions as decisive when adoption requires new routines and new support structures.

The Inclusive and Enabling Policy Rollout Pillar complete the framework by clarifying how governance legitimacy shapes the investment horizon. Operational Component 5 shows that policy clarity is an operational resource because it determines whether operators can plan and whether franchise security is credible enough to justify long-horizon payback. When guidance is inconsistent or timelines are unstable, operators interpret modernization as stranded-asset risk and respond through protective deferral. Operational Component 6 then emphasizes that inclusion is not achieved through rules alone. It requires cooperative empowerment and capacity-building where operators actually decide and coordinate. Empowerment initiatives convert requirements into workable participation by strengthening shared learning, compliance navigation, and collective risk-sharing. These governance supports matter because major transitions depend on coordinated changes in regulation, institutions, and networks, not on technology availability alone.

Taken together, these sections and Operational Components explain why acceleration is best understood as acceleration of alignment rather than acceleration of purchase. Operators move toward adoption when the route can keep running, when the numbers can work without collapsing daily stability, and when governance signals are credible and inclusive. The framework therefore identifies a practical pathway for overcoming management barriers by strengthening the specific conditions operators use to judge readiness. When charging and after-sales support bound operational risk, when financing and profitability supports protect cashflow stability, and when policy clarity and cooperative empowerment make participation workable, operators can shift from selective engagement to sustained adoption because electrification becomes livable, investable, and legitimate in everyday UV Express operations.

Summary

The findings present a progressive explanatory synthesis, moving from operators' interpretive perceptions (RQ1), to their adaptive strategies (RQ2), to a grounded proposition (RQ3), and finally to an operational framework (RQ4). Across these stages, electrification is understood not as a binary choice but as a continuous evaluation of whether the transition is survivable, workable, and legitimate within livelihood-based transport operations.

For RQ1, operators' perceptions of EVs were characterized by conditional openness grounded in *livelihood mathematics*, where decisions were evaluated based on their ability to sustain daily income and minimize risk. While EVs were seen as modern and environmentally beneficial, adoption remained contingent on cost recovery, operational reliability, and protection against downtime.

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For RQ2, operators responded to electrification challenges through *rational staging*, gradually building readiness rather than committing to immediate adoption. This involved seeking information, relying on peer validation, prioritizing hybrid pathways, and delaying investment until support systems such as charging infrastructure and after-sales services became reliable. These steps reflect a strategic effort to reduce uncertainty and protect income continuity.

For RQ3, the grounded proposition explained transition behavior as the pursuit of *triple alignment* across operational viability, financial sustainability, and institutional credibility. Operators adopted or deferred EVs based on whether these three conditions were met, with deferral occurring when risks—particularly those affecting uptime and income stability—remained high.

For RQ4, the operational framework advanced *accelerated alignment* by organizing interventions into three key areas: service continuity, financing viability, and inclusive policy rollout. Each area addressed specific barriers through practical components such as charging access, after-sales support, financing mechanisms, and clear policy guidance. The framework emphasized that successful adoption requires aligning technical, financial, and institutional conditions with the lived realities of operators, supported by evidence-based implementation pathways that demonstrate viability in actual operational contexts.

CONCLUSION

The most consequential conclusion of this dissertation is that electrification in UV Express operations is a phenomenon of Strategic Continuity Management under institutional pressure, rather than a linear process of innovation adoption. From a management standpoint, this transition is defined not by technological preference, but by a complex, high-stakes navigation of resource dependency and operational resilience. Operators do not evaluate Electric Vehicles (EVs) through generalized environmental narratives; instead, they function as micro-firm managers performing a sophisticated risk-return analysis. They evaluate the transition through a lived calculus of Business Continuity, asking whether service reliability can be maintained, whether household capital can be shielded from insolvency, and whether the governance framework provides the "institutional thickness" necessary to make long-horizon capital investments credible.

First, Service Continuity functions as the primary strategic gatekeeper. What is traditionally labeled as "range anxiety" is redefined in this study as systemic operational risk—a threat to trip turnover, dispatch rhythms, and brand equity within the terminal ecosystem. In this management context, technical viability is inseparable from social and economic consequence; a mid-route failure is a breakdown of the "service-profit chain." Operators effectively distinguish between the probability of failure and the severity of failure. Consequently, they judge feasibility by the system’s recovery capacity—the speed at which service can be restored after a disruption—positioning charging and repair access as essential infrastructure for "Uptime-indexed" survival.

Second, adoption emerges as a state of conditional strategic alignment. The managerial decision to transition is not a single point of purchase but a continuous evaluation of three interdependent pillars: Operational Fit (route and passenger trust). Financial Viability (investability under boundary-based cash flows), and Institutional Legitimacy (regulatory and cooperative stability). When any pillar remains volatile, strategic deferral is not a sign of resistance, but a rational, defensive management action. This "process view" validates selective engagement—learning, pilot observation, and "Hybrid-First" staging—as a legitimate, risk-adjusted pathway for firm survival in a turbulent regulatory environment.

Third, cooperatives and terminals must be recognized as decentralized governance infrastructure. They are the critical sites of Sensemaking, where top-down policy is interpreted, negotiated, and translated into workable routines. Implementation efforts that bypass these meso-level structures suffer from institutional mismatch because they ignore the organic networks where operators collectively stabilize market meaning and manage risk exposure. Sustained uptake, therefore, is less a matter of individual psychological readiness and more a function of the facilitating conditions provided by these institutional supports.

Finally, this study concludes that accelerating vehicle electrification must be conceptualized as the velocity of alignment, not the velocity of sales. Adoption becomes plausible only when the ecosystem bounds the managerial risk: when infrastructure protects route continuity, when financial instruments mirror the circular realities of boundary-based cash flows, and when policy inclusiveness builds long-term credibility. When these systemic supports converge, protective deferral shifts into phased commitment, transforming electrification from an imposed disruption into a sustainable strategic transition.

Recommendations for Policy Regulatory Actors

Policy interventions may shift from generic modernization mandates toward route- and terminal-specific transition support. A foundational step may be route dutycycle mapping for priority corridors to document dispatch rhythm, dwell time, realistic charging windows, and service continuity thresholds. These baselines may guide EV specification, charging design, and rollout pacing so that procurement targets do not undermine operational fit.

A key policy gap identified in this study is the limited translation of modernization policy into route-level operational guidance. Existing policy directions may be strengthened by developing corridor-specific implementation guidelines that clarify vehicle suitability, charging compatibility, expected turnaround allowances, and continuity safeguards for UV Express operations. Another gap concerns the absence of concrete readiness criteria for determining when a route, terminal, or cooperative is operationally prepared for electrification.

This may be enhanced through the development of readiness assessment tools that include indicators for charging access, repair support, technician availability, financing fit, and dispatch continuity.

Regulators may also strengthen credibility mechanisms through clearer timelines, published eligibility criteria, and more stable franchise and route security signals. In the accounts, ambiguity around franchise outcomes functioned as a gatekeeping condition. A structured clarification channel with documented responses and consistent templates may reduce transaction burden and uncertainty.

Policy may likewise incentivize risk-sharing design rather than focusing mainly on unit acquisition. Programs may incorporate enforceable warranty standards, repair turnaround commitments, downtime contingency provisions, and charging access guarantees tied to continuity indicators. This may more directly address operators' central concern that downtime and catastrophic exposure determine whether electrification remains survivable.

A further area for enhancement is the weak policy recognition of downtime and income interruption as central adoption barriers. Policy support may therefore move beyond procurement incentives alone by incorporating continuity-oriented protections, such as temporary transition support during prolonged repairs, service recovery protocols, and clearer accountability arrangements for charging and after-sales service providers.

In the same way, policies may be strengthened by requiring closer coordination among regulators, cooperatives, terminal managers, financiers, and service partners so that implementation responsibilities are not fragmented across institutions.

Concurrently, the financial and administrative responsibility for the structural environment must be assumed by the Department of Transportation (DOTr) and Local Government Units (LGUs). Rather than placing the burden of route-mapping and infrastructure planning on small-scale cooperatives, the state must fund and execute the "Electrification Suitability Mapping" of existing franchises.

This involves identifying optimal locations for terminal-based charging and assessing grid readiness at the local level. By decoupling the cost of infrastructure mapping and grid upgrades from the operators' "Livelihood Mathematics," the state can lower the barrier to entry, ensuring that the financial viability of the transition is supported by a robust, government-funded foundation rather than solely by the debt capacity of the individual operator.

Recommendations for Cooperatives and Terminal Management

Cooperatives and terminals may formalize their role as transition governance hubs by standardizing information systems, compliance assistance, and fairness safeguards for members. They may also strengthen collective procurement and negotiation, which can reduce cost exposure and improve bargaining power for financing terms, warranties, and maintenance commitments.

Cooperative-led proof pathways may be introduced early as an operational mechanism rather than treated only as an optional communication activity. Route-based pilots, peer mentoring, and transparent sharing of uptime and cost data can help convert rumor-driven uncertainty into grounded confidence. These proof activities may remain anchored in route baselines so that learning reflects actual corridor conditions.

Terminal management may also integrate continuity planning into daily operations by mapping charging options near terminals, negotiating access rules, and establishing operational contingency protocols for EV disruptions. This framing treats charging and downtime recovery as part of operational infrastructure rather than as purely external constraints.

In addition, cooperatives and terminal managers may develop practical readiness checklists for members and units under consideration for electrification, so that adoption decisions are based on documented operational and financial preparedness rather than general optimism alone.

Recommendations for Financiers, Manufacturers, and Service Ecosystem Partners

Financing packages may be redesigned to better fit boundary economics. Staged down payment structures, income-aligned amortization, transparent route-grounded total cost calculators, and bundled battery warranty and insurance products can help convert interest into investable commitment. Where feasible, cooperative-level financing instruments may also be developed to reduce individual exposure and support fairness safeguards through collective risk pooling. This recommendation is consistent with EV adoption research showing that purchase price, financing terms, and uncertainty around payback influence willingness to adopt even when operating costs appear favorable.

Manufacturers and service partners may prioritize service ecosystem readiness by expanding technician training, establishing local parts stocking strategies, developing mobile service options for terminal-based operations, and offering enforceable service level agreements that specify repair turnaround expectations. In the logic of this study, these are not merely after-sales add-ons. They can be understood as central adoption conditions because repair uncertainty translates directly into downtime risk and livelihood exposure.

Evidence transparency may also be treated as part of product and program design. Manufacturers, charging providers, and cooperatives can publish route-based performance metrics from pilots, including uptime, charging time, cost per kilometer, and repair turnaround. Making these indicators visible may support credibility-building and allow operators to evaluate feasibility through locally relevant proof rather than generalized claims, consistent with the study’s finding that proof pathways help bridge cautious waiting into phased commitment.

To operationalize the proposed transition framework, a clear demarcation of institutional responsibilities must be established, moving beyond generalized policy goals to specific stakeholder accountabilities. Technical responsibility must be squarely assigned to vehicle manufacturers and industry players, who must move past theoretical laboratory specifications to provide "route-proven" performance data. These manufacturers should be mandated to conduct real-world range testing on specific, high demand

UV Express routes (e.g., Calamba–Makati) under full-load and peak-traffic conditions. By providing empirical proof of range and energy efficiency that accounts for the "Uptime-indexed Risk" identified in this study, manufacturers can transition from being mere vendors to becoming active partners in mitigating the technological anxieties of operators.

Recommendations for Future Research

Future studies may extend this dissertation in several directions. A longitudinal design may follow operators through pilot participation, financing decisions, and operational adjustments to examine how alignment shifts over time and how proof pathways translate into sustained commitment. Comparative research across regions and route typologies may test the analytic transferability of the proposition beyond Greater Manila and clarify which enabling conditions are context-specific. Multi-stakeholder sampling that includes commuters, charging providers, financiers, and regulators may strengthen system-level understanding of coordination failures and legitimacy dynamics. Mixed-method designs may also complement grounded explanations with operational metrics such as uptime, downtime, charging delays, and cost per kilometer to examine the effectiveness of specific framework elements when implemented in practice.

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