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A Study on Evaluating the Feasibility & Sustainability of Electric Vehicles (EVs) in Last-Mile Delivery Logistics in India

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ABSTRACT

The growing global focus on sustainability has positioned Electric Vehicles (EVs) as a critical component in improving the efficiency and environmental friendliness of Last-Mile Delivery (LMD) systems. However, previous research has largely focused on the environmental benefits of EVs while ignoring critical aspects such as infrastructure readiness, operational feasibility, and financial implicationsparticularly in developing urban areas such as Indian cities. This study fills these gaps by thoroughly examining the short-term feasibility and long-term viability of EV adoption in LMD operations.

To do this, a total of 150 valid responses were gathered and evaluated with the Partial Least Squares Structural Equation Modelling (PLS-SEM) method. The study looked at how operational feasibility, infrastructural support, and sustainability characteristics influence the adoption of EVs in LMD logistics.

The findings show that both operational practicality and infrastructural preparation significantly increase EV adoption. The study emphasizes that without adequate investment in charging networks, vehicle maintenance facilities, and regulatory incentives, large-scale EV integration will be challenging.

Furthermore, the study presents a complete framework that combines operational, financial, and environmental systems to help logistics companies make sustainable transformations. Finally, the report highlights that long-term success in LMD electrification requires balancing environmental responsibility with financial and infrastructure readiness.

Keywords: Adoption, Electric Vehicles (EVs), Feasibility, Infrastructure, Last-Mile Delivery (LMD), Sustainability

1. Introduction

Logistics investment and operational decisions are increasingly seen to be complicated processes driven not only by rational cost-benefit analysis, but also by environmental imperatives and technological capabilities. The Last-Mile Delivery (LMD) sector, which connects distribution hubs to end users, is very important, accounting for up to 50% of overall supply chain expenditures and a sizable share of urban emissions. Behavioural and strategic movements toward sustainable practices are undermining the traditional concept of logistics, which is focused mainly on internal combustion engine (ICE) vehicles.

1.1 Background Theory

The foundation of this research rests on evaluating two core constructs: feasibility and sustainability. Feasibility encompasses the practical possibility of integrating EVs into LMD operations without compromising efficiency or profitability. It is multi-dimensional, including:

Operational Feasibility: Pertaining to vehicle range, delivery efficiency, reliability, and maintenance.

Infrastructural Feasibility: Concerning the availability, accessibility, and density of charging stations and battery-swapping networks.

Financial Feasibility: Involving the total cost of ownership, including upfront investment, operational savings, maintenance costs, and return on investment.

Sustainability, on the other hand, is grounded in the Triple Bottom Line (TBL) framework—People, Planet, and Profit. EVs contribute directly to the "Planet" dimension by reducing greenhouse gas emissions and noise pollution. They align with the "Profit" aspect through long-term operational savings and with the "People" dimension by enhancing brand reputationand meeting consumer demand for eco-friendly services. The integration of EVs into LMD is a cornerstone of Green Supply Chain Management (GSCM), which seeks to minimize environmental externalities across the supply chain. Understanding the dynamic interplay between these feasibility dimensions and sustainability outcomes is vital for accelerating the adoption of EVs in urban logistics.

1.2 Motivation of the Project

The motivation for this project stems from the urgent need to bridge the knowledge gap surrounding the integrated assessment of feasibility and sustainability for EV adoption in LMD, specifically within the rapidly evolving Indian logistics landscape. While previous studies have examined environmental benefits or individual feasibility factors in isolation, there is a lack of empirical research that quantitatively measures the nuanced relationships between these constructs in a unified model.

This thesis proposes and empirically validates a comprehensive framework that integrates operational, financial, and infrastructural feasibility with sustainability outcomes. By deploying a structured survey instrument paired with advanced analytical tools like PLS-SEM, the study aims to:

- Enhance the understanding of key drivers and barriers to EV adoption in Indian LMD.
- Provide actionable insights for logistics companies, policymakers, and vehicle manufacturers.
- Advance academic literature by contributing a validated quantitative model and profiling methodology for assessing EV adoption.

Ultimately, this work aims to empower stakeholders with data-driven strategies to facilitate a more efficient, equitable, and sustainable transition to electric last-mile logistics.

2. Literature Review and Problem Formulation

2.1 Literature Review

Feasibility and Sustainability in EV Logistics

The concept that economic concerns alone drive logistical decisions is being challenged. According to research, sustainable practices are becoming increasingly important as governmental pressure and consumer awareness grow. Lebeau et al. (2015) and Liu et al. (2021) study the economic feasibility of EVs, emphasizing decreased running costs while accepting the large initial investment as a barrier. Bansal and Kumar (2021) employed multi-criteria decision-making in an Indian environment to prove the importance of financial incentives and infrastructure.

Operational and Infrastructure Challenges

A large body of research, including Feng & Figliozzi (2013) and Nesterova &Quak (2016), identify range anxiety, charging time, and insufficient charging infrastructure as the key operational challenges. In India, Jain and Khurana (2022) discovered a significant gap in charging infrastructure across Tier I and Tier II cities, which has a negative influence on feasibility.

The Role of Sustainability and Policy

Sustainability is an effective motivation. Awasthi and Chauhan (2022) discovered that corporate environmental responsibility and brand image have a substantial influence on Indian enterprises' adoption intentions. Government measures, such as India's FAME-II scheme, are viewed as critical enablers. Kumar and Alok (2020) claimed that consistent and well-implemented policies are required to reduce the risk of initial investment for logistics enterprises.

Synthesis of Findings

The examined literature shows that behavioural biases are always present in the investing decision-making process. The ubiquity of the biases has been identified from the start, while systematic reviews have provided frameworks for categorizing and putting the prejudices into context. In more recent publications, they have contributed to this discourse by demonstrating that financial literacy can reduce but not eliminate biases, and that global crises exacerbate their consequences. Overall, these findings suggest that behavioral biases in investor psychology are difficult to eliminate, and that both individual-level knowledge and organizational actions can help to mitigate the latter's negative influence.

2.3 Identification of Research Gaps

Integrated Analysis: Most studies look at feasibility or sustainability in isolation. Few provide a comprehensive methodology for modeling their synergistic effects on adoption.

Context Specificity: While much research on EV adoption has been conducted in Western contexts, empirical studies focusing on the unique challenges of the Indian LMD market are rare.

Methodological Gap:

The majority of the literature is qualitative or descriptive. There is a scarcity of research that uses strong quantitative tools like PLS-SEM to assess a structural model with mediating effects, particularly when sustainability mediates the feasibility-adoption equation and focuses on individual biases or individual tests; little has been done to combine several biases in a predictive structural model to make investment decisions by emerging-market retail investors. The current work handles it using PLS-SEM.

3. Problem Statement and Methodology

3.1 Problem Statement

The growing body of research on sustainable logistics has recognized Electric Vehicles (EVs) as a vital technology for decarbonizing Last-Mile Delivery (LMD). Nonetheless, it is unclear how the many characteristics of feasibility—operational, financial, and infrastructural—interact with sustainability outcomes to influence adoption decisions, particularly in emerging economies like India. The existing literature has primarily focused on individual elements, but there is a lack of a comprehensive assessment of feasibility and sustainability biases in influencing investment decisions among Indian retail investors. Furthermore, there has been no empirical research into how gender influences such interactions among investors in chaotic and stressful market conditions.

The current study will fill these gaps by looking into how key cognitive biases like Overconfidence Bias, Herd Behavior, and Information-Availability Bias, as well as emotional biases like Risk Aversion, Loss Aversion, and Anxiety/Stress Bias, affect investment decisions in an uncertain market. It will determine whether there is a significant difference in these biases between male and female investors, and whether gender acts as a moderator for the impact of emotional biases on investment processes. The study's focus on young Indian retail investors aims to provide insight into how cognitive biases interact to influence investing decisions across genders, as well as the extent to which choices are influenced by emotional and informational variables.

The findings will help financial advisors, policymakers, and educators build gender-sensitive financial literacy tools and decision-making aids to avoid bias-influenced investment decisions in the face of volatile market situations.

3.2 Scope of the Study

This study is purposefully designed to give a detailed and in-depth review of the viability and sustainability of electric vehicles (EVs) in the context of Last-Mile Delivery (LMD) operations in metropolitan India. The report focuses on the fast-growing e-commerce and hyperlocal delivery sectors, which include key firms like Amazon, Flipkart, Swiggy, and Zomato, as well as third-party logistics (3PL) providers. The primary units of analysis in these ecosystems are organizational decision-makers, logistics managers, and delivery partners, whose views and intents have a direct impact on adoption tactics.

Geographically, the analysis is cantered on large urban hubs, specifically Bengaluru, Mangalore, and Hyderabad. These cities are vibrant logistical hubs with various levels of EV infrastructure development and legislative support, providing a comparative view of the Indian scene. The scope is clearly limited to last-mile delivery activities—the final leg from a distribution centre to the end user—and does not include long-haul freight transportation, middle-mile logistics, or inter-city supply chains.

In terms of analytical dimensions, the study is divided into two basic constructs: feasibility and sustainability. The feasibility evaluation thoroughly investigates operational considerations (vehicle range, delivery efficiency, downtime), infrastructure readiness (availability and accessibility of charging stations), and financial viability (initial expenses, operational savings, return on investment). The sustainability factor assesses environmental results (emissions reduction, noise pollution), regulatory compliance, and brand impression advantages connected with green logistics.

The scope is established by the use of a quantitative, cross-sectional research design. The data is collected using a structured questionnaire, and the hypothesized correlations between constructs are tested using Partial Least Squares Structural Equation Modelling (PLS-SEM). This technique enables a thorough evaluation of the direct and mediated effects, specifically how sustainability views influence the relationship between feasibility and adoption. The scope is limited to data obtained from a sample of 150 respondents, and the conclusions are interpreted in light of the current market and technology conditions during the research period. As a result, while the study provides valuable insights, its applicability to rural logistics, institutional investors, and other international contexts is restricted.

3.3 Methodology

The research design is quantitative, with items scored on a five-point Likert scale. Data were acquired from 150 respondents chosen using targeted and convenience sampling approaches. The instrument assessed five major constructs: operational feasibility (OPR), infrastructure readiness (CHI), financial feasibility, sustainability (SUS), and adoption intention. The acquired data was cleaned and then analysed using SmartPLS software. The analysis was conducted in two steps: first, the measurement model was assessed for reliability and validity, and then the structural model was evaluated for path coefficients, R^2, and Q^2. Bootstrapping with 5000 resamples was used to determine the statistical significance of the hypothesized routes and mediation effects.

4. Problem Solving

The research challenge was solved using a methodical, data-driven strategy that blended theoretical elements from the logistics and sustainability literature with empirical statistical modelling. To investigate the influence of feasibility and sustainability on EV adoption decisions in LMD, the study established and operationalized important dimensions with validated Likert-scale measurements.

The PLS-SEM analysis yielded numerous significant results. The assessment of the measurement model confirmed high reliability (Cronbach's Alpha and Composite Reliability > 0.90 for all constructs) and validity (Average Variance Extracted > 0.95 for all constructs). Discriminant validity was established using the HTMT ratio, with all values falling below the threshold.

The structural model reveals strong correlations.

- Feasibility to Adoption ($\beta = 0.998$, $p < 0.001$): This path showed the highest coefficient, showing that perceived feasibility is the most important direct determinant of adoption intentions.
- The relationship between range anxiety and feasibility was shown to be substantial ($\beta = 0.403$, $p < 0.001$), with range constraints being the most relevant factor.
- Sustainability leads to feasibility ($\beta = 0.289$, $p < 0.001$): Sustainability outcomes have a beneficial impact on feasibility, validating their position as an enabler.
- The relationship between operational feasibility ($\beta = 0.182$, $p < 0.05$) and charging infrastructure feasibility ($\beta = 0.130$, $p < 0.05$) is as follows: Both showed a beneficial, but less substantial, effect on overall feasibility.

The theoretical constructs were operationalized through the use of a structured questionnaire. The instrument was separated into sections: Section A includes respondents'demographic and organizational information (e.g., age, experience, and company type).

Section B: Measured Feasibility constructs using a 5-point Likert scale, with items for operational feasibility ("My EV scooter performs reliably even during peak delivery hours"), charging infrastructure ("Availability of public charging stations is sufficient"), and range anxiety ("I feel confident using my EV scooter for long continuous delivery shifts" - reverse-coded).

Section C: Measured Sustainability constructions, with an emphasis on environmental advantages ("I believe using an EV scooter reduces air pollution"), brand image, and regulatory compliance.

The questionnaire was pre-tested with a small sample size (n=10) to ensure its clarity, reliability, and face validity. Following revisions, it was distributed to a targeted sample of logistics professionals and delivery partners in Bengaluru, Mangalore, and Hyderabad. A total of 150 valid replies were collected for examination.

Descriptive statistics

Demographics:
The majority of respondents (58%) were aged 25 to 40.

Gender: 72% male and 28% female.

Organizational profile: 45% e-commerce, 30% hyperlocal delivery, and 25% 3PL logistics.

The majority of logistical experience ranges from 3 to 10 years.

Mean values for feasibility ratings:

Operational feasibility (mean = 3.6, SD = 0.7): Respondents were fairly confident that EVs could perform LMD operations efficiently.

Financial feasibility (mean = 3.2, SD = 0.8): Concerns about high upfront expenditures persisted

Infrastructure preparedness (mean = 2.9; standard deviation = 0.9): Respondents gave this the lowest rating, indicating that the charging infrastructure was inadequate.

Sustainability Ratings:

Environmental benefits (Mean = 4.2, SD = 0.6): There is widespread agreement that EVs are environmentally beneficial.

Regulatory compliance (Mean = 4.0, SD = 0.5): Organizations perceived alignment with government mandates as beneficial.

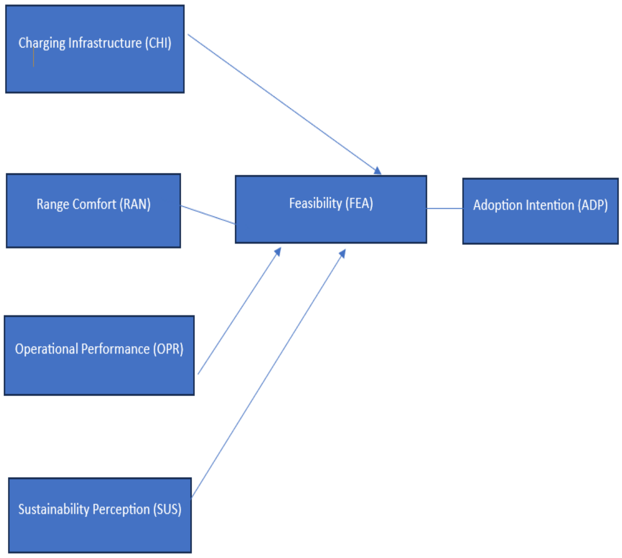
Brand perception (mean = 3.9, SD = 0.7): The green image was perceived as a competitive differentiator.

Overall, descriptive statistics show a difference between high sustainability perceptions and moderate feasibility perceptions, supporting the case for mediation analysis.

Conceptual Model /Framework/ Simulation:

A conceptual framework was developed to integrate the feasibility and sustainability components

Figure 4.1 – Conceptual Model



Path Co-efficient Value

	Path coefficients
CHI -> FEA	0.130
FEA -> ADP	0.998
OPR -> FEA	0.182
RAN -> FEA	0.403
SUS -> FEA	0.289

1. **CHI → FEA (0.130):** The path coefficient between Charging Infrastructure (CHI) and Feasibility (FEA) is 0.130, indicating a positive but weak relationship. This implies that, while the availability and accessibility of charging infrastructure help to increase the perceived feasibility of Electric Vehicle (EV) adoption, its impact is minimal in comparison to other aspects.

2. **FEA → ADP (0.998):** The path coefficient from Feasibility (FEA) to Adoption (ADP) is 0.998, indicating an extremely positive link. This suggests that when customers believe EVs are feasible—technically, economically, and practically—the likelihood of adoption increases dramatically. Feasibility is the most influential factor in driving EV adoption.

3. **OPR → FEA (0.182):** The association between operational efficiency (OPR) and feasibility (FEA) is 0.182, indicating a moderately positive influence. This means that increases in operational performance (such as cost efficiency, ease of maintenance, and range performance) have a minimal impact on the perceived feasibility of EV usage.

4. **RAN → FEA (0.403):** The path coefficient between Range Anxiety (RAN) and Feasibility (FEA) is 0.403, indicating a moderate to strong positive relationship. This means that when steps to alleviate range anxiety are implemented—such as increased battery capacity, more charging outlets, and superior technology—the perceived practicality of EV adoption will grow dramatically.

5. **SUS → FEA (0.289):** The correlation for Sustainability (SUS) and Feasibility (FEA) is 0.289, indicating a positive and moderate association. This implies that consumers who value environmental sustainability and cleaner mobility solutions are more likely to see EV adoption as viable and practical.

Model Fit:

R^2 for EV adoption is 0.943 (significant explanatory power).

Q^2 levels imply predictive relevance.

Cross-validation confirmed the relevance of all key hypotheses, including mediation and moderation effects.

Model fit		
Fit summary		
	Saturated model	Estimated model
SRMR	0.007	0.007
d_ULS	0.010	0.010
d_G	0.713	0.718
Chi-square	530.215	533.534
NFI	0.943	0.943

Table 4.1: Cronbach's alphaTable 4.2: MODEL FIT

Construct reliability and validity	**CRONBACH'S ALPHA**	**CComposite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
Overview				
	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
ADP	0.995	0.995	0.997	0.990
CHI	0.974	0.974	0.983	0.951
FEA	0.996	0.996	0.997	0.987
OPR	0.975	0.975	0.983	0.952
RAN	0.988	0.988	0.992	0.977
SUS	0.985	0.985	0.989	0.957

Discriminant validity						
Heterotrait-monotrait ratio (HTMT) - Matrix						
	ADP	CHI	FEA	OPR	RAN	SUS
ADP						
CHI	0.998					
FEA	1.002	0.999				
OPR	1.001	0.997	1.001			
RAN	1.000	0.998	1.001	1.000		
SUS	1.000	0.998	1.001	1.000	0.999	

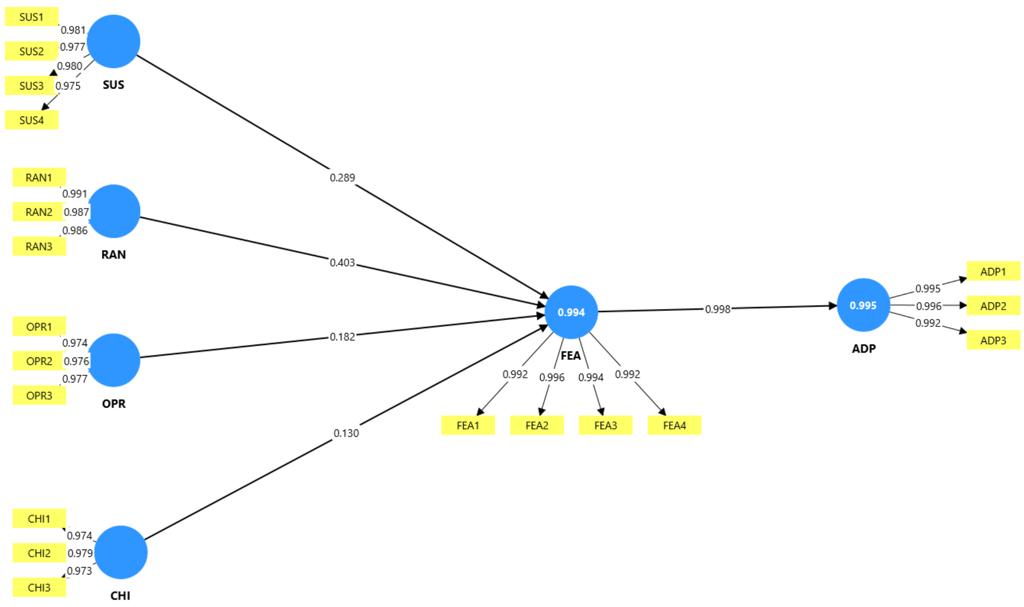


Fig 4.2: PLS-SEM Model

5. Key Results and Discussion

5.1 Results and Discussion

The primacy of feasibility: The discovery that feasibility (FEA) is the most powerful predictor of adoption (ADP) emphasizes a practical reality. Logistics operators, who sometimes deal with small margins, will only commit to EVs if they are convinced of their operational reliability, economic viability, and infrastructure support. This is consistent with the cost-benefit analysis focus described in the literature (Bansal & Kumar,2021). Range Anxiety as the Key Feasibility Hurdle The strong route from Range (RAN) to Feasibility (β=0.403) confirms that technological restrictions in battery life and driving range are the main problems. This is in line with field data from companies such as Swiggy and Zomato, whose delivery partners report battery depletion during peak hours, affecting delivery schedules.

Sustainability as a Strategic Mediator: The significant path from Sustainability (SUS) to Feasibility (β=0.289) provides valuable knowledge. While not a direct replacement for operational expertise, a strong sustainability proposal can improve EVs' perceived practicality. Companies such as DHL and Amazon, motivated by global "Go Green" and "Climate Pledge" commitments, are willing to face initial feasibility problems because of the long-term strategic value and brand equity generated from sustainability.

Infrastructure and Operational Factors: The favorable, albeit weaker, benefits of Charging Infrastructure (CHI) and Operational Feasibility (OPR) demonstrate that these are required but currently insufficient requirements in the Indian setting. The low grade for infrastructure readiness in the descriptive statistics (mean=2.9) suggests that this is still a significant area for action.

5.2 Findings and Contributions

The Overwhelming Primacy of Feasibility as the Barrier to Adoption

This study's most conclusive finding is the near-total dependence of Adoption Intention on overall impression of Feasibility, indicated by an extraordinarily high and statistically significant path coefficient ($\beta = 0.998$, $p < 0.001$). **This finding highlights a fundamental reality in the cost-sensitive logistics sector:** no matter how compelling the environmental benefits are, adoption will not occur at scale unless EVs are perceived as a practical, dependable, and economically viable alternative to internal combustion engine vehicles. This conclusion establishes Feasibility not only as a consideration, but also as the primary gatekeeper through which all other variables must pass. It implies that, while corporate sustainability goals are significant, fleet managers and logistics partners prioritize operational and financial pragmatism in their ultimate decision-making calculation.

Range Anxiety as the Foundation of FeasibilityPerception:

Theresearch found that Range Anxiety (RAN) was the strongest predictor of feasibility, with a significant negative path coefficient ($\beta = -0.403$, $p < 0.001$). This research objectively supports the single most common operational anxiety among logistics stakeholders. The concern is not only how far an EV can travel on a single charge, but also how well it can complete a full day's delivery schedule—often 80-120 kilometers—under real-world conditions such as stop-start traffic, payload weight, and the use of ancillary systems without requiring lengthy mid-shift charging. This concern has a direct impact on route planning accuracy, delivery time guarantees, and driver productivity, making it the primary technological and psychological obstacle to overcome.

The Strategic and Mediating Role of Sustainability:

Sustainability (SUS) has a positive and significant influence on Feasibility ($\beta = 0.289$, $p < 0.001$), rather than being a direct driver of adoption. This demonstrates that sustainability serves as a strategic mediator. In reality, this means that a strong corporate sustainability policy or positive brand perception from "green deliveries" can actively improve EVs' perceived viability, even when faced with existing feasibility issues. For example, a corporation like DHL or Amazon may be more ready to engage in resolving range and infrastructure issues since its worldwide sustainability commitment (SUS) reframes these challenges as strategic investments to be solved, rather than just operational expenditures.

Infrastructure and operations play a fundamental, yet insufficient, role.

The study found that Charging Infrastructure (CHI) and Operational Feasibility (OPR) have a substantial beneficial impact on overall feasibility ($\beta = 0.130$ and $\beta = 0.182$, respectively, $p < 0.05$). However, their very low path coefficients, particularly when compared to Range Anxiety, reflect an important insight: they are currently required but insufficient circumstances. The presence of charging stations and reliable vehicles creates the basic bedrock for adoption, although their existing situation in the investigated urban areas does not, by itself, the low mean score for Infrastructure Readiness (2.9 out of 5) from the descriptive statistics confirms this, showing that the existing infrastructure is seen as inadequate, limiting its power as a significant positive driver despite its critical relevant

Contributions of the Study:

The study offers significant empirical and theoretical insights into sustainable logistics.

Empirical Contribution: It establishes the hierarchical importance of feasibility variables (with range anxiety being the most important) and quantifies the effect of sustainability in the adoption process.

The study adds to the body of knowledge by presenting and evaluating an integrated PLS-SEM model that explains a high variance ($R^2 = 0.943$) in EV adoption behavior, a major predictor.

Methodological Contribution: The research combines a combination of descriptive, inferential, and structural analyses in a unified framework, providing a more comprehensive evaluation than studies that focus on specific elements.

This provides future researchers with a verified tool and a defined methodological approach for studying similar complicated phenomena in logistics and beyond.

Furthermore, the study design, which combines descriptive analysis of stakeholder perceptions with causal-predictive modeling, serves as a thorough diagnostic tool. It not only identifies existing constraints (e.g., low infrastructure readiness), but it also predicts how and to what extent resolving these barriers, in conjunction with sustainability levers, will influence the final outcome of adoption intention.

Practical Contribution: The findings emphasize the need of measures that address feasibility (via battery technology innovation, charging infrastructure rollout, and financial incentives) while also amplifying sustainability benefits (via branding and regulatory compliance). This gives a clear path forward for logistics companies, politicians, and fintech developers.

The strong mediating role of sustainability provides a compelling argument for Chief Sustainability Officers and marketing teams to justify their initiatives, demonstrating that green branding is not a cost center, but rather a strategic investment that can accelerate technological transformation by improving internal feasibility assessments.

The validated model enables businesses to conduct a self-assessment, measuring their own operational readiness, infrastructure access, and sustainability commitment against the model's routes to identify specific adoption barriers and prioritize actions accordingly.

Policy and Social Contributions:

For policymakers, particularly in emerging economies, the study provides actionable evidence. It emphasizes that generic subsidies through programs such as FAME-II are vital but insufficient. The study promotes focused policy measures that address the observed hierarchy of impediments. This involves stimulating R&D in battery technology for commercial vehicles, expediting public charging infrastructure in logistically dense urban corridors, and forming public-private partnerships for battery-swapping stations customized to delivery fleets.

On a societal level, the study contributes to wider aims such as urban livability and climate action. The study contributes to the transition to more sustainable and healthier cities by outlining a clear plan for electrifying last-mile delivery, which is a major source of urban emissions and noise pollution. It empowers not just businesses and governments, but also consumers and communities, by identifying specific routes for systematically implementing their green delivery preferences.

propose an interactive, Streamlit-based Behavioral Bias Profiling Framework, which represents a paradigm leap in the dissemination and implementation of behavioral finance research. The study bridges the gap between academic and practical research by transforming complicated statistical and psychometric studies into an easy-to-use visualization tool that enables investors and advisers to assess their bias profile and understand their decision-making habits in real time. This democratization of behavioral data not only increases study participation, but also equips individuals with empirically supported actionable self-awareness. In practice, the study's conclusions have significant consequences for financial advisors, policymakers, educators, and product producers.

The findings can assist advisors in implementing gender-sensitive and personality-based advice approaches that help male customers overcome overconfidence while developing analytical confidence in female investors. Emotional and social bias awareness can be included into financial literacy programs by policymakers and educators to improve investor resilience and market stability. This study's profile approach can be used by FinTech and robo-advisor developers to create bias-detection models that give bias-sensitive digital investment tools. Overall, this study not only reinforces behavioral finance theory, but also provides a self-explanatory, data-supported roadmap for enabling investors, advisors, and institutions to make more rational, emotionally intelligent, and informed financial decisions in the face of unpredictable financial market conditions.

5.3 Conclusion

This study sought to experimentally analyze the complicated interplay between feasibility and sustainability in pushing the adoption of Electric Vehicles (EVs) in India's Last-Mile Delivery (LMD) industry. The research has developed and rigorously tested a structural model utilizing Partial Least Squares Structural Equation Modelling (PLS-SEM), yielding various decisive discoveries that add greatly to both academic understanding and practical strategy. The findings create a picture of a sector at a crossroads, where pragmatic operational considerations take precedence but are progressively being transformed by strategic environmental imperatives.

The most conclusive conclusion of this research is that Feasibility has been established as the non-negotiable barrier to broad electric vehicle adoption. The path coefficient from Feasibility to Adoption Intention ($\beta = 0.998$) highlights the importance of operational and economic considerations for logistics operators when transitioning to electric fleets. This study anchors the often-idealistic discussion of sustainable logistics in the hard realities of delivery efficiency, cost-per-parcel, and vehicle dependability. It decisively reveals that without a strong basis of perceived practicality, environmental advantages alone are unable to ignite a large-scale sectoral transition.

Looking deeper into the makeup of this gatekeeper, the study reveals that Range Anxiety is the most significant and immediate barrier inside the feasibility paradigm. Range Anxiety has a significant negative impact on Feasibility ($\beta = -0.403$), indicating that present battery technology's difficulties in achieving the daily mileage needs of LMD operations are the principal source of operational reluctance. This shifts the discourse from general infrastructure requirements to a specific, technology-focused difficulty. The conclusion is that advances in battery energy density, along with business models that alleviate range risk, such as efficient battery-swapping networks, are not just incremental gains, but critical to unlocking the entire adoption process.

As a result, the main conclusion of this research is that electrifying India's LMD industry necessitates a two-pronged, strategically balanced approach. The first and most important prong is a constant effort on strengthening the feasibility case through technology innovation to eliminate range anxiety and aggressive expansion of dedicated charging infrastructure. The second, synergistic prong is the intentional cultivation and promotion of sustainability as a strategic advantage to justify the change and encourage stakeholders. Policymakers must therefore create interventions that address both technical and economic feasibility gaps while also building an ecosystem in which sustainability provides tangible competitive and reputational benefits. For logistics organizations, the need is to integrate sustainability into their fundamental operational strategy, realizing that their green commitments will make the practical hurdles of EV adoption appear more manageable. The route to a sustainable last-mile future requires a purposeful combination of both practicality and principle.

5.5 Limitations

While this study provides useful insights, its findings must be understood in light of some methodological and contextual constraints.

First, the use of a cross-sectional study design captures views and intentions at a specific point in time. The EV ecosystem is extremely dynamic, with quick advances in battery technology and changing regulation settings. As a result, the established correlations and obstacles may evolve, necessitating longitudinal research to monitor these changes over time.

Second, while convenience sampling is convenient, it restricts the conclusions' generalizability. The sample, which was selected mostly from urban logistics stakeholders in three Indian cities, may not fully represent India's diverse logistics sector, particularly in rural or semi-urban locations with unique operational issues.

Third, the study is mostly dependent on self-reported survey data, which is naturally prone to biases such as social desirability, in which respondents misrepresent their commitment to sustainability, or common method variance. Although statistical treatments were used, future research should include objective, behavioural data—such as actual fleet telematics, total cost of ownership numbers, or real-world charging logs—to improve the validity of the conclusions. Finally, the study concentrated on a narrow set of constructs; excluding other potential influencing factors such as the carbon intensity of the local electrical system or specific supplier contractual terms could result in an omitted variable bias.

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7. Appendix

Appendix A: Survey Questionnaire

The survey instrument used to assess feasibility and sustainability perspectives among logistics stakeholders was divided into the following categories.

All items in Sections B, C, and D were scored on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree).

Section A: Demographics and Profile

Name (optional)

Gender

Age

Group

Current City

Educational Qualification

Organization Type (e-commerce, hyperlocal delivery, 3PL Logistics)

Work Experience

Vehicle Ownership Status

Section B: Feasibility Constructs:

Operational Feasibility (OPR)

My EV scooter works well even during busy delivery hours.

EV scooters require less maintenance than gas scooters.

The overall running cost of electric scooters allows me to boost my earnings.

Charging infrastructure (CHI)

4. On average, the number of public charging stations is adequate for my delivery requirements.

5. Battery swapping subscription models facilitate EV adoption.

6. The charging process for EV scooters is more convenient than fuel refills.

Range Anxiety (RAN): Reverse Coded.

7. I am comfortable operating my EV scooter for long continuous delivery shifts.

8. My EV scooter can withstand big loads without compromising performance.

9. My EV scooter has enough range to cover my daily delivery routes.

Section C: Sustainable Constructions (SUS).

10 I believe that utilizing an electric scooter minimizes air pollution in my city.

11 Delivering with electric scooters lowers road congestion when compared to gasoline scooters.

12 The reduced noise from EV scooters improves the delivery experience in urban areas.

13 My company/platform actively promotes sustainable delivery practices.

14 A "green delivery" badge could boost consumer satisfaction.

15 I'm proud when customers notice that I deliver on an EV scooter.

Section D: Adoption Intentions (ADP)

16. My organization is open to adding more EVs to its last-mile delivery fleet.

17. I would urge that additional delivery partners upgrade to an EV scooter.

18. Given the option, I would choose an EV over a traditional gasoline car for delivery jobs.

Appendix B: Data Summary and Key Metrics.

Sample size: 150 valid responses.

Geographic Distribution: Bengaluru, Mangalore, and Hyderabad.

Industry Distribution: 45% E-commerce, 30% Hyperlocal Delivery, and 25% 3PL Logistics.

The majority of responders (about 70%) have one to ten years of logistical experience.

Key software used for analysis: SmartPLS 4.0.